SHIFT (SRO) ADVISOR

TRAINING PROGRAM

NOTE: This document transmitted to the NRC (OLB) for their review.

The goal of the Shoreham Nuclear Power Station Shift (SRO) Advisor Training Program is to help maximize the effectiveness of the Shift (SRO) Advisor. This goal will be accomplished by providing Shoreham specific instruction in the areas of Administrative Procedures, Technical Specifications, Plant Systems and Emergency Operating Procedures. The instruction in each of these areas will cover, as a minimum, the objectives listed in Appendix A.

Training in each of these areas will be covered via one or more of the following methods:

- Lecture
- Instructor-led discussion
- Structured self study (i.e. problem sets)

In addition, plant tours will be used to reinforce systems training.

The systems to be covered via a lecture type format will be selected based upon an evaluation of the candidates past experience. Data sheets (Appendix B) may be used to present Shoreham specific data for those systems that are similar to those encountered within the candidates past experience (i.e. Core Spray, Reactor Protection System etc.). Systems that are significantly different from those encountered by the candidate in his past experience will be covered via a lecture format.

Preliminary information concerning possible advisor candidates suggests that the data sheet/lecture groupings will be divided similar to that outlined in Appendix C.

It is anticipated that the Shift (SRO) Advisor training program will be 4 weeks in length. However, the actual schedule will be determined when the final selection of Shift (SRO) Advisor candidates occurs.

Quizzes will be administered during the course of the program to monitor the students grasp of recently covered learning objectives. Results of these quizzes will be used to diagnose the need for remedial training but will not be used as a criteria for program completion. In addition an audit exam will be administered by an independent agency. The audit exam, based on the course learning objectives, will be used to diagnose possible areas that require remedial training prior to administration of the LILCO certification exam.

The LILCO certification exam will consist of both a written and a plant walkthrough exam. Each exam will be similar in format and degree of difficulty to NRC administered exams with the exception that the theory section of the written exam will be waived. Successful completion of the written exam will require an overall grade of greater than or equal to 80% with each section greater than or equal to 70%. The walkthrough exam will be graded on a pass/fail basis.

SHIFT (SRO) ADVISOR TRAINING PROGRAM OBJECTIVES

Administrative Procedures

At the completion of the program the student should be able to:

1. State the station staffing requirements.

2. Given a sample shift roster identify situations in which the on-shift staff is less than that required by SNPS Administrative Procedures.

3. State the responsibilities of all on-shift operations personnel during both normal and abnormal operations.

4. Given a situation that requires the use of any of the below listed documents correctly initiate any that are required.

    1. Station Procedure Change Notice (SPCN)
    2. Temporary Procedure Change (TPC)
    3. Radiation Work Permit (RWP)
    4. Maintenance Work Request (MWR)
    5. Reports of Abnormal Conditions (RAC)
    6. Lifted Lead and Jumper Permit (LLJ)

5. State the conditions that prohibit approval of a TPC.

6. State the conditions that require the cancellation of a RWP.

7. State the conditions during which a lead may be lifted or a jumper installed without a LL & J Permit being required.

8. Given a situation in which the Shift (SRO) Advisor and on-shift Watch Engineer are in a "stalemate" with regard to appropriate operating strategy, state the recourse available to the Shift (SRO) Advisor.

Shoreham Systems

At the completion of the program the student should be able to:

1. State the initiation signals for the following systems.

    a. Core Spray
    b. Low Pressure Coolant Injection
    c. High Pressure Coolant Injection
    d. Automatic Depressurization

e. Reactor Core Isolation Cooling
f. Reactor Protection
g. Emergency Diesel Generators
h. Reactor Building Standby Ventilation
i. Reactor Building Standby Ventilation/Control Room Air Conditioning Chilled Water
j. Control Room Air Conditioning

2. Given a sample control room panel and annunciator status for those systems listed under #1 above:

   a. Determine if a valid initiation signal is present.
   b. Determine if complete system initiation has occurred.
   c. For those situations in which a valid initiation signal is present and a complete initiation has not occurred, state the required operator actions.

3. State the isolation signals for the following systems:

   a. Nuclear Steam Supply Shutoff
   b. High Pressure Coolant Injection
   c. Reactor Core Isolation Cooling
   d. Primary Containment
   e. Reactor Building Closed Loop Cooling Water
   f. Reactor Building Service Water
   g. Reactor Water Cleanup

4. Given a sample control room panel layout drawing and annunciator status for those systems listed under #3.

   a. Determine if a valid isolation signal is present
   b. Determine if complete system isolation has occurred
   c. For those situations in which a valid isolation signal is present and a complete isolation has not occurred, state the required operator action.

Technical Specifications

At the completion of the program the student should be able to:

When given a status of plant conditions via either a written scenario and/or control panel display state the correct actions for any of the following type situations:

a. Single component malfunction that causes a system covered in Technical Specifications to be made inoperable.
b. Multiple malfunctions that cause redundant subsystems of systems covered in Technical Specifications to be made inoperable (i.e. Failure of electrical power supply to a subsystem in conjunction with a single component malfunction in the redundant subsystem).

c. Operations in excess of Technical Specification Limiting Conditions for Operation. (i.e. exceeding thermal limits, failure to meet surveillance criteria).
d. Multiple malfunctions that require the use of Specification 3.0.3.

Procedures (Emergency/Operating)

At the completion of the program the student should be able to:

1. When given a status of plant conditions via either a written scenario and/or control panel display:

   a. Determine if a situation governed by an emergency procedure exists.
   b. For those situations governed by an emergency procedure:

      1. State the automatic actions listed in the emergency procedure.
      2. State the immediate actions listed in the emergency procedure.

HPCI SYSTEM

DATA SHEET

1. INITIATION LOGIC SETPOINTS

Double Low Reactor water level (-38 inches off LT 157 A,B,C and D) or, High Drywell Pressure (1.69 psig).

2. ISOLATION LOGIC & SETPOINTS

a. High Steam Line DP High Flow (290% of rated + 3 sec TD)
b. High Turb Exhaust Diaphragm Pressure (10 psig)
c. Steam Leak (based on High Amb Temps (149°, 187)
d. Manual
e. Low Steam Supply (110 psig)

3. TRIP LOGIC & SETPOINTS

Turbine trips on

a. Any isolation
b. Low Pump Suction Pressure (15" Hg Vac)
c. High Exhaust Pressure (150 psig)
d. High Reactor Water Level (54.5 inches)
e. Manual
f. Mechanical overspeed

4. SIGNIFICANT INTERLOCKS

a. Overspeed at 5000 RPM, auto reset after time delay
b. Manual isolation only closes outboard MOV's
c. Suction auto swaps to suppression pool on a suppression pool high level or CST low level

5. DESIGN DATA

a. 700 to 4000 RPM control range: Avoid operation below 2200 RPM
b. 4250 gpm at 400 RPM and 110 psig

6. MIN FLOW DATA

Opens at $<$800 gpm
Closes at $>$800 gpm

SYSTEMS COVERED VIA DATA SHEETS

- Reactor Protection System
- Core Spray
- Low Pressure Coolant Injection
- Automatic Depressurization
- High Pressure Coolant Injection
- Reactor Core Isolation Cooling
- Nuclear Steam Supply Shutoff
- Neutron Monitoring
- Reactor Water Cleanup

SYSTEMS COVERED VIA LECTURE

- Emergency Electrical Distribution
- Normal Electrical Distribution
- Reactor Protection System Power Supply
- Reactor Vessel Instrumentation
- Containment
- Reactor Building Normal Ventilation
- Reactor Building Standby Ventilation
- Reactor Building Closed Loop Cooling Water
- Reactor Building Service Water
- Reactor Building Standby Ventilation/Control Room Air Conditioning Chilled Water
- Control Room Air Conditioning
- Radiation Monitoring
- Rod Sequence Control

SHIFT (SRO) ADVISOR SYSTEM TRAINING INDEX

118	RBCLCW
121	RHR
122	SERVICE WATER
308	NORMAL ELECTRICAL DISTRIBUTION
309	EMERGENCY ELECTRICAL DISTRIBUTION AND MALFUNCTION SUPPLEMENT
405	RBSVS AND CONTAINMENT VENT SUPPLEMENT
412	CRAC
[illegible]8	RBNVS
421	RBSVS/CRAC SHILLED WATER AND SUPPLEMENT
607	RWM/RSCS
611	RPS AND RPS MG SETS
621	VESSEL INSTRUMENTATION
631	RADIATION MONITORING
654	CONTAINMENT

SHIFT (SRO) ADVISOR TRAINING PROGRAM

WEEK ONE

	MON	TUES	WED	THURS	FRI
8:00	INTRO. TO SNPS BY OPERATIONS SECTION HANDOUT OF PROGRAM DESCRIPTION/OBJECTIVES	CONTAINMENT LECTURE	CONTAINMENT/RPS QUIZ TP	NORMAL ELECTRICAL DIST. QUIZ MP	EMERG. DIST./ADS QUIZ CS
9:00			QUIZ REVIEW	QUIZ REVIEW	QUIZ REVIEW
	GET (TO BEGIN AT END OF INTRO)		NORMAL ELECTRICAL DISTRIBUTION	NORMAL ELECTRICAL DISTRIBUTION	VESSEL INSTRUMENTATION
10:00					
11:00		TP			
12:00	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
12:30	SNPS REFERENCE SYSTEM PPSL/LILCO SYSTEM INDEX	RPS DATA SHEET/ RPS MALFUNCTION REVIEW		CS	CS
1:00	SNPS TOUR	TS	MP	ADS DATA SHEET/ ADS MALFUNCTION REVIEW TP	TOUR
2:00	TOUR TO START AT COMPLETION OF SNPS REFERENCE DISCUSSION	TOUR (REACTOR BUILDING)	TOUR (TURBINE BUILDING)	TOUR (CONTROL BUILDING)	(REACTOR BUILDING)
3:00					
4:00					

SHIFT (SRO) ADVISOR TRAINING PROGRAM

WEEK TWO

	MON	TUES	WED	THURS	FRI
8:00	WEEK 1 QUESTION/ ANSWER SESSION	RBNVS/RBSVS QUIZ MP	CRAC/HPCI/RICI QUIZ CS	RBSVS/CRAC CHILLED WATER/LPCI/RWCU QUIZ TP	RSCS/NS^4/NM QUIZ TS
9:00	WEEK 1 EXAM	QUIZ REVIEW MP	QUIZ REVIEW CS	QUIZ REVIEW TP	QUIZ REVIEW TS
		CRAC CS	RBCLCW LECTURE	RSCS	CORE SPRAY DATA SHEET/MALFUNCTION REVIEW
10:00					RBSVS/CRAC CHILLED WATER LECTURE
11:00	RBNSVS BC	HPCI DATA SHEET HPCI MALFUNCTION REVIEW CS	CS	TS NEUTRON MONITORING DATA SHEET/MALFUNCTION REVIEW	
12:00					
12:30	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
1:00	RBSVS CS	TOUR	LPCI DATA SHEET LPCI MALFUNCTION REVIEW CS		TP TOUR/STUDY
2:00			TOUR	TOUR	
3:00	TOUR	RCIC DATA SHEET RCIC MALFUNCTION REVIEW CS	RWCU DATA SHEET/ MALFUNCTION REVIEW	NS^4 DATA SHEET/ MALFUNCTION REVIEW BC	
4:00					

SHIFT (SRO) ADVISOR TRAINING PROGRAM

WEEK THREE

	5/28 MON	5/29 TUES	5/30 WED	5/31 THURS	6/1 FRI
8:00	M E M O	WEEK 2 QUESTION/ ANSWER SESSION	RBSW/RM QUIZ MP	EMERGENCY PROCEDURE QUIZ MP	TECH SPEC PROBLEM SOLVING
9:00		WEEK 2 EXAM	QUIZ REVIEW MP	QUIZ REVIEW MP	
			RAD MONITORING	EMERGENCY PROCEDURE	
10:00	R I A		HANDS ON TRAINING WITH JOB AID DL	SCENARIOS	
11:00		RX BLDG SERVICE WATER LECTURE			TP
12:00					
12:30	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
1:00	L D	MP	READ STANDARD EMERGENCY PROCEDURES & MEMORIZE AUTOMATIC & IMMEDIATE ACTIONS	MP	CONTINUE WALTHROUGH OF EMERGENCY PROCEDURE IMMEDIATE & SUBSQUENT ACTIONS MP
2:00	A Y	RADIATION MONITORING LECTURE DL		WALKTHROUGH EMERGENCY PROCEDURE IMMEDIATE & SUBSEQUENT ACTIONS IN CONTROL ROOM AND PLANT MP	
3:00					
4:00					

SHIFT(SRO)ADVISOR TRAINING PROGRAM

WEEK FOUR

	6/4 MON	6/5 TUES	6/6 WED	6/7 THURS	6/8 FRI
8:00	WEEK 3 QUESTION/ ANSWER SESSION MP	TEC SPEC PROBLEM SOLVING (CONTINUED)	ADMIN PROCEDURE QUIZ MG	ADMIN PROCEDURE QUIZ MG	S T U D Y
9:00	WEEK 3 EXAM ↓	↓	QUIZ REVIEW MG	QUIZ REVIEW MG	
			TECH SPEC PROBLEM SOLVING ↓	TECH SPEC PROBLEM SOLVING ↓	
10:00–12:00		TP	TP	TP	
12:30	LUNCH				
1:00	CONTINUE WALKTHROUGH OF EMERGENCY PROCEDURE IMMEDIATE & SUBSQUENT ACTIONS. ↓	SNPS ADMINISTRATIVE PROCEDURES ↓	SNPS ADMINISTRATIVE PROCEDURES ↓	SNPS ADMINISTRATIVE PROCEDURES	S T U D Y
2:00–4:00	MP	MG	MG	MG	WEEK 4 EXAM

SHIFT SRO ADVISOR TRAINING PROGRAM

WEEK FIVE

	MON 6/11	TUES 6/12	WED 6/13	THURS	FRI
8:00					
9:00	S	AUDIT WALKTHROUGHS	AUDIT WRITTEN		
10:00	T				
11:00	U D				
12:00	Y				
12:30	LUNCH				
1:00	S T				
2:00	U D				
3:00	Y				
4:00					

SHIFT SRO ADVISOR TRAINING PROGRAM

WEEK SIX

	6/18 MON	6/19 TUES	6/20 WED	6/21 THURS	6/22 FRI
8:00					
9:00				LILCO Written Cert. Exam	LILCO Walkthrough Cert. Exam
10:00					
11:00					
12:00					
12:30	LUNCH				
1:00					
2:00					
3:00					
4:00					

REACTOR BUILDING CLOSED LOOP
COOLING WATER
(R.B.C.L.C.W)

STUDENT HANDOUT FOR SHIFT (SRO)
ADVISOR TRAINING PROGRAM

Prepared by: Christopher J. Schum 4/10/84
Trg. Instructor / Date

Rev. 0 Date: 5/10/84

Approved by: Marc W. P. Pechin 4/19/84
Training Specialist / Date

1.0 LESSON PLAN: Reactor Building Closed Loop Cooling Water (RBCLCW)

2.0 LECTURE DURATION: 2.ø hrs. ___ min.

3.0 MATERIALS REQUIRED FOR STUDENT:

3.1 RBCLCW Lesson Plan

4.0 MATERIALS REQUIRED FOR INSTRUCTOR:

4.1 Associated Graphics

5.0 REFERENCE MATERIAL:

5.1 RBCLCW System Description and reference therein

5.2 FSAR 7.6.1.5, 9.2.2

5.3 FB-23B Drywell Air Coolers

5.4 FM-15A/B

5.5 RBCLCW System Operating Procedure SP 23.118.ø1

6.0 SCOPE OF THE LECTURE:

To inform the student of:

6.1 RBCLCW layout in the plant

6.2 Major loads serviced by RBCLCW

6.3 Major Components

6.4 Normal and emergency operation

6.5 Alarms and Instrumentation

7.0 RBCLCW STUDENT OBJECTIVES:

At the end of this lecture the student should know:

7.1 State the purpose of the RBCLCW system as given in the student handout.

7.2 Given a diagram of the RBCLCW system trace out the flowpath for:

a) Normal operation (Rx at power operation)

b) Accident conditions (system split signal present) with the C RBCLCW pump lined up to the same RBCLCW loop as the other running RBCLCW pump.

c) Accident conditions (system split signal present) with the C RBCLCW pump lined up to the redundant loop of the running RBCLCW pump.

7.3 Given a RBCLCW control panel display & without the use of procedures:

   a) Verify automatic actions associated with a system split signal have occurred.

   b) Identify a failure of the system to split.

   c) Differentiate between a RBCLCW malfunction (i.e. pump trip etc.) and a total loss of RBCLCW.

7.4 Given a total loss of RBCLCW state the immediate operator actions and any auto actions that are listed in SP 29.017.01.

7.5 List the station loads that can be cooled by RBCLCW loop A.

7.6 List the station loads that can be cooled by RBCLCW loop B.

7.7 List the station loads that are isolated from cooling water due to an RBCLCW system split.

7.8 Given a diagram of the RBCLCW system and a RBCLCW control panel display identify the following system malfunctions:

   a) RBCLCW TCV failure (open/closed)

   b) RBCLCW PCV failure (open/closed)

   c) RBCLCW LCV failure (open/closed)

   d) Flow disturbance that causes low section pressure trip of RBCLCW pumps (running & standby)

8.0 <u>LESSON OUTLINE</u>:

8.1 <u>Theory</u>

8.1.1 Purpose of the system

.1 Provide cooling to Reactor auxiliary equipment and other equipment inside the Reactor Building.

.2 Transfer heat from equipment to service water through heat exchanger.

.3 <u>Provide nuclear safety related systems with redundant means of cooling during an accident condition to accomplish and maintain a safe shutdown.</u>

8.1.2 Design Basis of the System

The RBCLCW system is designed to:

.1 Provide two independent cooling water paths to safety related systems that require cooling during an accident condition.

.2 Auto. isolate non-safety related systems during an accident condition.

.3 Isolations are accomplished via 2 series MOV's that are powered from separate emergency electrical divisions.

.4 Seismic, Cat. I.

.5 Have RBCLCW pressure higher than Rx Bldg. service water pressure and higher than pressure of most of its loads. To prevent inleakage of salt water and uncontrolled R/A material releases.

8.2 Physical Description

8.2.1 General System Description

.1 Redundant, closed loop system providing nuclear safety and non-nuclear safety related components with reliable source of cooling water.

a. Three 50% capacity circulating water pumps *PØØ5A (B) (C)

b. Two 100% capacity M.G. set oil cooler circulating water pumps

c. Two 100% capacity heat exchangers *E-Ø11A/B

d. Two RBCLCW head tanks *TKØ26A/B

e. Piping, valves, instruments and controls

.2 Nuclear safety related loops and loads

a. Two redundant nuclear safety related loops

1) During an accident the system is automatically separated into two independent loops, each with one pump, heat exchanger and head tank and each supplying one safety related loop.

2) Safety related loops are redundant to ensure at least one half of the nuclear safety related components serviced by RBCLCW are supplied in the event of a single RBCLCW component failure.

3) Loop isolation is assured by having series MOV's that are powered from separate electrical divisions. Therefore, if an EDG fails to start, the redundant MOV will isolate the loop.

b. Nuclear safety related loads are:

1) RHR pump seals coolers

2) Spent fuel pool cooling water Hx.

3) Reactor Recirc. Pump

a) Seal cooler

b) Motor winding

c) Bearing coolers

NOTE: RBCLCW may be isolated, during an accident, from the Rx recirc pumps, at the operators discretion by MOV's on the inlet and outlet of recirc pump section of RBCLCW piping.

.3 Non-Nuclear safety related loops and loads Fig. 2

a. During an accident the non-nuclear safety related loads are isolated by MOV's.

b. The loads are not always redundant.

c. The loads are:

1) Reactor recirc. pump MG set oil cooler

2) RWCU Non-Regen Hx

3) RWCU pump coolers

4) Drywell equipment drain cooler

5) CRD Pump

a) bearing cooler

b) gear oil cooler

6) Drywell coolers

.4 Pumps Fig. 3

a. Three 16ØØ gpm RBCLCW circulating water pumps *PØØ5A-B-C

1) Common discharge header, and suction header

2) Two pumps normally operated third in stand-by

b. Two 16ØØ gpm reactor recirculating pump motor generator set fluid coupling cooler cooling water circulating pump.

1) Takes suction from Hx discharge

2) Through pump to common discharge to M.G. room

3) Return line to suction of B loop, RBCLCW Hx.

4) Isolated on accident conditions

.5 RBCLCW Heat Exchangers *EØ11 A/B

a. Two 100% capacity heat exchangers.

b. Crosstied on inlet and outlet by series MOV's.

c. Upon an accident signal the Heat Exchanger Isolation valve *MOV42 A/B and service water valve 1P41 *MOV37 A/B are given an open signal to ensure both heat exchangers are in service when split into two independent loops.

d. Temperature is controlled by mixing flow through Hx and bypass flow to maintain constant 91°F.

e. RBCLCW pressure higher than service water to prevent in-leakage of salt water.

.6 Head tanks *TK-Ø26A/B

a. Make-up is automatically controlled by level control valve (LCV-11A & B) supplying demin. water.

b. Integrator on makeup line can be used to detect system out-leakage.

.7 Radiation monitor

a. On discharge of pumps

b. Samples water and returns to pump suction.

c. The monitor detects a failed system component leaking radioactive contaminants to the RBCLCW system.

.8 Alarms

a. Alarms for the RBCLCW system are on the BOP panel.

.9 Pressure control valve

a. Recircs from discharge to suction of pump to maintain constant differential pressure across system loads.

b. By maintaining a constant differential pressure loads can be valved in and out of service without effecting other running equipment.

.10 System conductivity is monitored on Turbine Building sample panel.

a. High conductivity on RBCLCW system will bring up "Turbine Bldg. Sample Panel" alarm.

8.2.2 Major Equipment Description

.1 RBCLCW circulation pump *PØØ5 A-B-C

a. Single stage centrifugal pump

b. Pumps located on elev. 151

c. Power supply - *PØØ5 Fig. 4

A-48ØV DIV I MCC

B-48ØV DIV II MCC

C-48ØV DIV III MCC

d. All pumps controlled from main control board (BOP). In addition, *PØØ5B can be controlled from the remote Shutdown Panel.

e. Interlocks Pump A, B & C Fig. 5

1) AUTO START on:

a) low system pressure
or
b) accident signal (not C pump)

2) AUTO TRIP due to:

a) low suction pressure (time delayed)

f. Interlocks Pump B

1) Same as A & C above when RSP transfer switch is normal.

2) RSP control switch only functions if the associated RSP transfer switch is in emergency position.

.2 MG set cooler cooling water circulating pump

a. Single stage centrifugal pump

b. Pumps are located on elev. 40 of Rx Bldg.

c. Power supply P002A Normal 480V MCC (11 side)

P002B Normal 480V MCC (12 side)

d. Control from Control Room (PNL-602)

1) AUTO START due to:
running pump trip

2) AUTO TRIP due to:

low suction pressure (this interlock prevents pump damage due to accident isolation).

.3 RBCLCW heat exchanger *E011A & B

a. Each Hx is 100% capacity

b. Single pass counter flow shell and tube type heat exchanger with RBCLCW on the shell side and RB service water on the tube side.

c. Elev. 8' of Rx Bldg.

.4 Booster Heat Exchanger

a. Cools RBCLCW prior to entering Drywell coolers

b. Cooled by Rx Bldg. service water system.

c. Further reduces RBCLCW supply temperature to increase DW cooling capacity.

d. Booster Hx's isolates on an accident condition.

.5 RBCLCW Head Tank *TKØ26 A/B

a. Location Elv. 151 ft. near pumps

b. Normal operation is @ atmospheric pressure

c. Provide NPSH for pumps

d. LCV operates to maintain proper level in head tank.

e. Each makeup demin line is outfitted with a totalizer to its associated head tank that allows system outleakage to be detected.

8.3 Principles of Operation Fig. 5

8.3.1 System Operational Modes

.1 Normal operation

a. Two pumps running, third in stand-by

b. One M.G. set cooler circ. water pump running one pump in stand-by.

c. One heat exchanger with cross ties open.

d. If *PØØ5C is running it must be manually valved to the same loop as the one it is replacing. Valve line-up can be confirmed on the MXP Panel.

e. Valve line-up - All valves open except one Hx. and service water valve to that Hx.

.2 Abnormal Operation

a. Loss of Station Air

1) The following RBCLCW components fail OPEN upon loss of station air.

o HX Outlet Temp. Control Valve (*TCV-001W,Y)

o Makeup Control Valves (LCV-011A, B)

2) The following RBCLCW components fail CLOSED upon loss of station air.

   o Bypass Temperature Control Valves (*TCV-001X,Z)

   o RBCLCW Circ. Pumps d/p Control Valve (PCV-071)

3) Field operator must be dispatched to isolate Makeup Control Valves to prevent overflowing head tank.

4) RBCLCW HX outlet temperature can be controlled manually by use of manual handwheels on Temp Cont. Valves

b. RBCLCW Detective or Leaking Equipment or Coolers

LOADS	RBCLCW	LOADS
o RBCLCW HX Ser. Wtr		o RHR Pump Seal Cooler
o F.P. Cool H.X.		o Rx Recirc Pump Seal Cooler
o Drywell Air Coolers		o Rx Recirc Pump MG Set Fluid Coupling Oil Cooler
o Drywell Eqpt. Drain Clr		
o CRD Pump Mtr. Brg & Gearcase Oil		o RWCU NRHX
o Rx Recirc Pump Motor Cooler		o RWCU Recirc Pump Seal Cooler
o Rx Recirc Pump Motor Brg. Cooler		

1) Redundant loads will be systematically secured starting with the RBCLCW HX's. Determine if leakage exists by monitoring pressure increase or decrease on loadside. If pressure change cannot be seen, vent load side for indication of leak.

c. Drywell Air Coolers Cooling Coils Leak

1) Leakage may be determined by:

o Drywell Floor Drain Tank Integrator

o Drywell humidity increase with RBCLCW Head Tank decrease

2) Isolate leaking coil by closing its Inlet Valve

d. Rx Recirc Pump Motor Windings Air Cooler Leak

1) Leakage may be determined by:

o 1298(1299) RECIRC PUMP A(B) MTR COOLER LEAKAGE HI

o 1300(1301) RECIRC PUMP A(B) MTR CLG WTR FLOW LO

2) Recirc pump must be shutdown prior to isolating RBCLCW flow.

e. Rx Recirc Pump Motor Bearing Oil Cooler Leak

1) Leakage may be determined by:

o Visual inspection of the bearing oil of the lower bearing.

o 1284 (1285) RECIRC PUMP A(B) MTR BRG OIL LEVEL HI/LO

2) Recirc pump must be shutdown prior to isolating RBCLCW flow.

f. Rx Recirc Pump Mechanical Seal Coolers

1) Leakage may be determined by:

o Increase in seal temperature (TR-100)

o Increasing level RBCLCW surge tanks and/or increasing rad levels RBCLCW rad. monitor.

2) Max allowable seal cavity temperature is 250°F. If this temperature is reached, it will be necessary to secure the affected pump.

g. Recirc Pump MG - Set Oil Cooler Leak

1) Leakage may be determined by:

- o Decreasing oil level in the fluid coupling oil reservoir and oil in the RBCLCW system.

2) An oil cooler leak will necessitate shutdown of the associated MG set.

h. <u>RWCU NRHX Tube Leak</u>

1) Leakage may be determined by:

- o RBCLCW Surge Tank level increase with a corresponding increase in RBCLCW rad. level (Large leak may cause NRHX temp increase).

2) An NRHX tube leak will necessitate shutdown of the RWCU system.

i. <u>Drywell Eqpt. Drain Cooler Leak</u>

1) Leakage may be determined by:

- o RBCLCW Surge Tank makeup increase
- o Drywell Eqpt. Drain Tank Flow increase

2) Isolate leaking cooler by shutting Inlet Valve

j. <u>CRD Pump Bearing and Gear Oil Cooler Leak</u>

1) Leakage can be detected by visual inspection

2) A CRD Oil Cooler Leak will necessitate the affected CRD pump to be shutdown and RBCLCW to be isolated to it.

k. <u>RHR Pump Seal Coolers Leak</u>

1) Leakage may be detected by:

a. RBCLCW Head Tank level increase with an increase in rad levels with an RHR pump running.

2) Shutdown affected RHR pump and isolate RBCLCW flow to that pump.

l. <u>RWCU Recirc Pump Seal Cooler Leak</u>

1) Leakage may be detected by:

- o Increase in cooling water rad. levels and an increase in RBCLCW Head Tank level.

2) Refer to RWCU procedure to shutdown the affected pump.

m. RBCLCW Pipe Break

1) Leakage may be detected by:

o Decrease in RBCLCW Head Tank Level

o Increase in component temp. of RBCLCW Loads

2) Determine cause of leak by observing:

o Flows and temp. for RBCLCW component loads

o Sump pump running frequency and level alarms

3) Isolate leakage by rotating affected equipment and isolating the pipe break

NOTE: Removal of cooling water to supplied components will render those components inoperable. Check Tech Specs prior to their removal.

.3 Emergency Operations

a. Loss of off-site power

1) MOV's remain in their original position

2) All pumps stop

3) Pumps *PØØ5 A&B will auto start (DG dependent)

4) M.G. set circ pump will not restart until normal power is restored.

5) Pump *PØØ5C can be started manually after a 10 min. time delay. The operator must place the pump control switch in the-PTL-position after 10 min., then AUTO after START.

b. Accident without loss of power Fig. 6

1) The accident condition actuation signals are:

a) Low/Low level in head tank (5'9") or

b) High Drywell Pressure 1.69 psig or

c) Reactor low level -132.5

If any of the above conditions should arise the following will occur:

2) The system will isolate into two separate loops each with one pump, one Hx, and one surge tank.

3) RBCLCW pumps continue to run.

4) Non-safety related loops are automatically isolated

5) Heat exchanger that is out of service is put into service. Both Service Water and RBCLCW inlet valve auto OPEN.

6) M.G. set cooler circulating water pumps ar isolated and trip on low suction pressure (greater than 10" Hg VAC).

7) PCV is isolated.

8) AOV check valves will close

9) RBCLCW Heat Exchangers go to maximum cooling.

d. Accident with loss of off-site power

Same as above except:

1) Isolation and splitting is delayed until the diesel comes on (approximately 10 sec).

2) M.G. set circ. pump will stop on loss of power rather than low suction.

3) A & B pump will restart.

4) "C" Pump is prevented from starting for 10 minutes after the loss of power. After 10 minutes the C pump can be manually started by placing its control switch in -PTL-& then placing the control switch in the start position.

e. Loss of RBCLCW (SP 29.017.01)

1) A loss of RBCLCW may be determined by any of the following annunciators:

o RBCLCW HX A(B) OUT TEMP HI/LO

o RBCLCW SYS A(B) HDR PRESS LO

o RBCLCW HD TK A(B) LEV LO-LO

o FLUID CPLG COOLING WTR PP A/B TRIP OR DISCH LO.

o RBCLCW SYS A(B) INOP

o RBCLCW SYS A(B) DEGRADED

2) Other indication:

o RBCLCW header pressures low or fluctuating

o Abnormal temp. on various eqpt. cooled by RBCLCW

3) RBCLCW system splits and isolates non critical loads on Lo-Lo Head Tank Level, +1.69 psig drywell press, or -132.5" RPV level.

4) Upon verification that a sustained Loss of RBCLCW has occurred:

o Reduce Rx Recirc pumps to min, trip Recirc MG Set, and initiate Emergency Shutdown (SP 29.010.01)

o Trip the RWCU pump and isolate system

o When all control rods verified to be inserted and recirc pumps are tripped, secure the CRD pumps.

8.3.2 Precautions

.1 RBCLCW should not be isolated simultaneously to both sets of redundant safety related equipment.

<u>Recognition</u>

o Field check of valve alignment

.2 RBCLCW Pump *P-ØØ5C should not be lined up to both RBCLCW loops at the same time.

<u>Recognition</u>

o Indicating lights on the MXP panel.

.3 Cooling water to the RWCU NRHX's should not be lined up to both RBCLCW loops at the same time.

<u>Recognition</u>

o Field check of valve alignment

.4 The Standby RBCLCW pump will auto start due to low discharge pressure on either of the operating pumps.

Recognition

o Low pressure ALARM, indication of RBCLCW pump trip.

.5 The Standby MG Set Fluid Coupling Cooler Recirc Pump will auto start if the other pump trips or is shutdown.

Recognition

o FLUID CPLG CLG WTR PP A/B TRIP

o FLUID CPLG CLG WTR PP A/B DISCH PRESS LO

8.3.3 Instrumentation and Control

.1 Main Control Board, BOP Section

a. RBCLCW Pumps *P-Ø05A, B and C

SPRING RETURN 4 POSITION SWITCHES

b. RBCLCW System A and B Inoperative Alarm Switches Individual switches with NORMAL-TEST positions. (admin. purposes)

c. RBCLCW Heat Exchanger Service Water Discharge Valves 1P41*MOVØ37A and B are equipped with the following controls:

1) Open-Close pushbutton control switch

2) Override pushbutton & indicating light

3) Normal/throttle keylock switch

4) Intermediate pushbutton

Operation of these controls is as follows:

1. Open/Close pushbutton switch

during normal operation functions as a seal-in. Valve will full stroke once either open or close pushbutton is depressed.

2. Normal/Throttle keylock switch
placing the keylock switch to the THROTTLE position allows the open/close pushbutton switch to serve as a momentary contact switch.

3. Intermediate pushbutton

with keylock switch in NORMAL pressing the intermediate pushbutton will cause the valve to travel to a 50% position.
if the intermediate pushbutton is pressed with the NORMAL/THROTTLE keylock switch in THROTTLE no valve motion will occur at that time. However, when the keylock switch is returned to NORMAL the valve will travel to a 50% position.

4. OVERRIDE pushbutton

a) pressing the override pushbutton allows the valve to be closed with an accident signal present.

b) the override pushbutton must also be pressed in order to reclose the valves after a sustained undervoltage has occurred on the associated 4KV emergency bus i.e., Bus 1Ø1 for 37A. (Same signal that initiates slow transfer).

.3 Miscellaneous Control Panel (MXP)

a. Motor Operated Valve Control Switches

Individual pushbutton switches, momentary contact, seal-in type, with integral Red-Open and Green-Closed indicating lights. A small blue light (out for loss of control power and motor overload) is mounted above each switch.

b. 1. blue light out & either green or red light on indicates motor overload.

2. blue light out & no green or red lights indicative of control power failure.

c. if motor overload occurs valve can still be repositioned by holding pushbutton down.

.4 Control Room Indication

a. System A&B discharge pressure (Ø-15Ø PSIG) (MCB-Ø1)

b. Radiation monitor recorder

c. RBCLCW discharge temp. recorder (MXP PNL)

d. Hand valve position indication ("C" Pump Discharge Valves) (MXP PNL)

.5 The Rx Bldg Closed Loop Cooling Water system contains the following annunciators

ANN		CONTROL ROOM VERIFICATION
0040 (41) (56) RBCLCW PUMP B(A)(C) AUTO TRIP	o	Pump 'green' light ill. with CS in Auto-After-Start
0340 (41) RBCLCW HX A(B) TEMP HI/LO	o	Temp recorder on MXP panel
	o	Computer Point
0342 (3) RBCLCW HEAD TANK A(B) LEVEL LO-LO	o	Computer Point
0347 (8) RBCLCW HEAD TANK A(B) LEVEL HI-LO	o	Computer Point
0352 (3) RBCLCW SYS A(B) HEADER PRESS LO	o	RBCLCW PI on MCB-01
0360 (2) RBCLCW SYS LOOP A(B) INOP	o	MAN-INOP switch sys A to INOP
	o	Loss of control power to critical valves
	o	Loss of control power, motor overload, or CS in P-T-L for RBCLCW pumps 'A' (B) and either RBCLCW pump 'B' motor ovld CS in P-T-L loss of control power, or HV-051A(B) Not full open
0361 (3) RBCLCW SYSTEM LOOP A(B) DEGRADED	o	Loss of control power to various RBCLCW MOV's
	o	RBCLCW pumps A(B) or C motor ovld, P-T-L, or loss of control power and HV-051 A(B) closed
0407 RBCLCW VV INTERLOCK LCTL	o	Field verification by E.O.
1380 FLUID CPLG CLG WTR PP A/B TRIP	o	CS in AUTO-AFTER-START and 'green' light lit
1381 FLUID CPLG CLG WTR PP A/B DISCH PRESS LO	o	Local Press indication.

.6 Remote Shutdown Panel (RSP) Controls (Rx Bldg: El 63')

a. Maintained contact type transfer switch with NORMAL-EMERGENCY positions for pump *P-ØØ5B and valve "B" Hx inlet valve (MOV 42B)

b. Control switch with START-STOP positions and indicating lights for pump *P-ØØ5B.

c. Control switch with OPEN-CLOSE positions indicating lights for valve *MOVØ42B.

d. Maintained contact type transfer switch with NORMAL-EMERGENCY positions for RBCLCW heat exchanger *E-Ø11B service water outlet valve 1P41*MOVØ37B

e. Maintained contact switch with OPEN-CLOSE positions and indicating lights for 1P41*MOVØ37B.

.7 Interlocks

NOTE: Valve motor overload protection will be cut out during accident signal to ensure that valves are able to travel to their accident configuration.

8.3.4 System Interrelations

.1 Start-up

a. Rx Bldg. Service Water

b. Emergency buses

c. Normal operation (normal electrical buses)

.2 Shutdown

a. RHR system

1) Loss of RBCLCW - S/D of Pump effected, time of operation dependent on temperature of primary water.

b. Spent Fuel Pool Cooling

1) Loss of RBCLCW - Time factor dependent on amount of spent fuel.

c. Rx Recirc System

1) Cooling to pump should not be isolated until pumps have cooled to below limiting temperature.

2) Pumps may run for 10 min. however the seals will be damaged in short order and pumps should be stopped immediately upon loss of cooling.

3) Loss of MG set fluid coupling cooling will result in a trip of MG due to high oil temperature.

4) With no Rx Recirc. pumps operating the Rx Mode Switch must be placed in SHUTDOWN.

d. Reactor Water Cleanup

Due to loss of non-regen. Heat exchangers high temperature will cause isolation of system. Pumps should be shutdown to prevent damage.

e. CRD

Loss of cooling water will require the stopping of the affected CRD pump.

f. Drywell Air Cooler

Upon loss of RBCLCW, temperature increases dependent upon heat loads, causing possible shutdown due to excessive operational temperature for equipment.

8.4 Summary

8.4.1 The purpose of the system is to cool reactor auxiliary equipment and other systems in the reactor building.

8.4.2 The main flow is through the two loops of each subsystem to cool the safety and non-safety related equipment, returning to the heat exchangers and then goes to the suction of the pumps.

8.4.3 Actuation Signals

Signals that will split the system include:

Low/Low Level in Head Tank

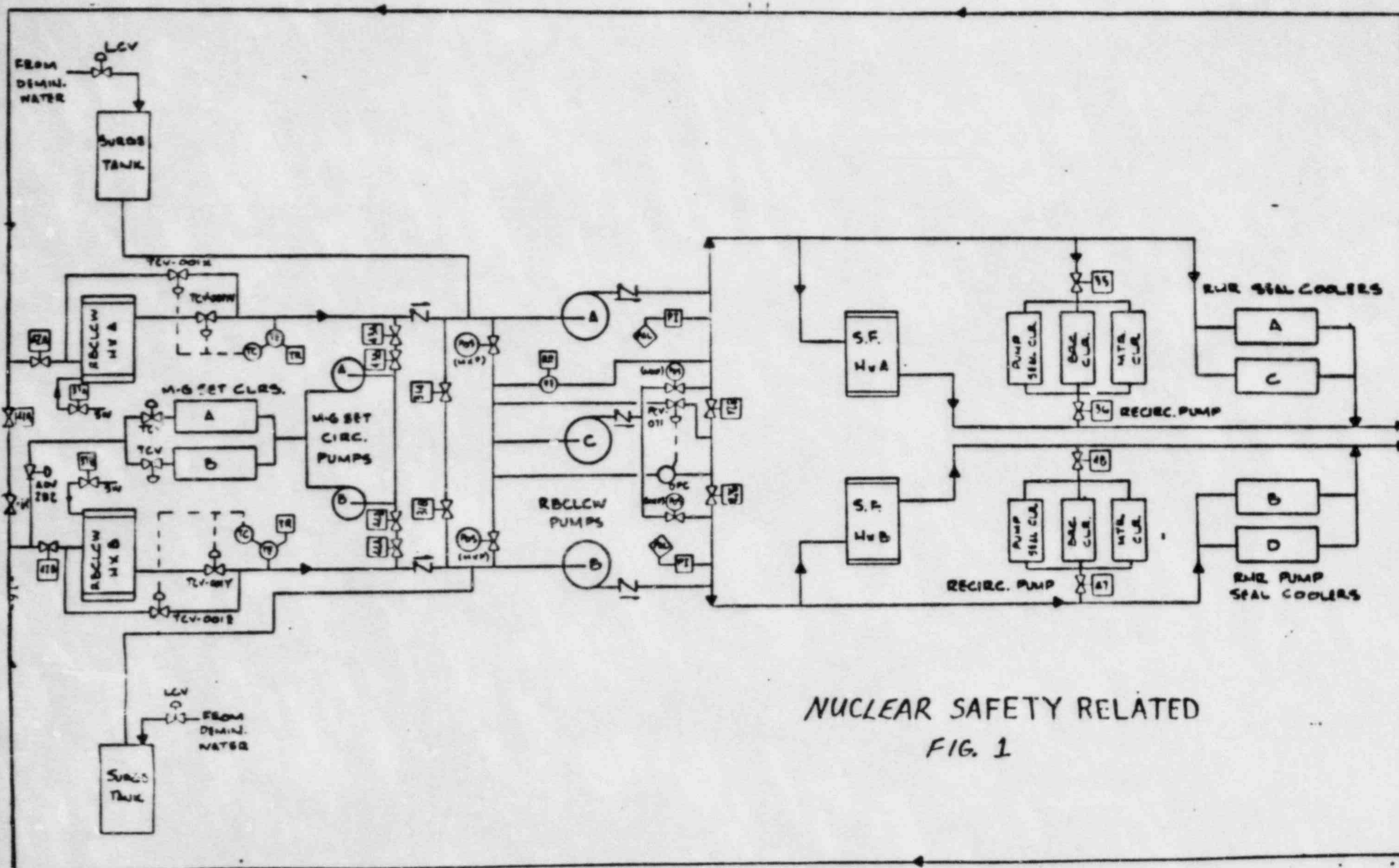
High Drywell Pressure 1.69 psig

Reactor Low Level -132.5

8.4.4 Normal operation of the RBCLCW system removes heat from the equipment in service. The loss of the cooling to any of the equipment will necessitate operator action to correct the condition. In some cases a shutdown of the reactor may be needed. Loss of service water to the heat exchanger will cause the same end result as above.

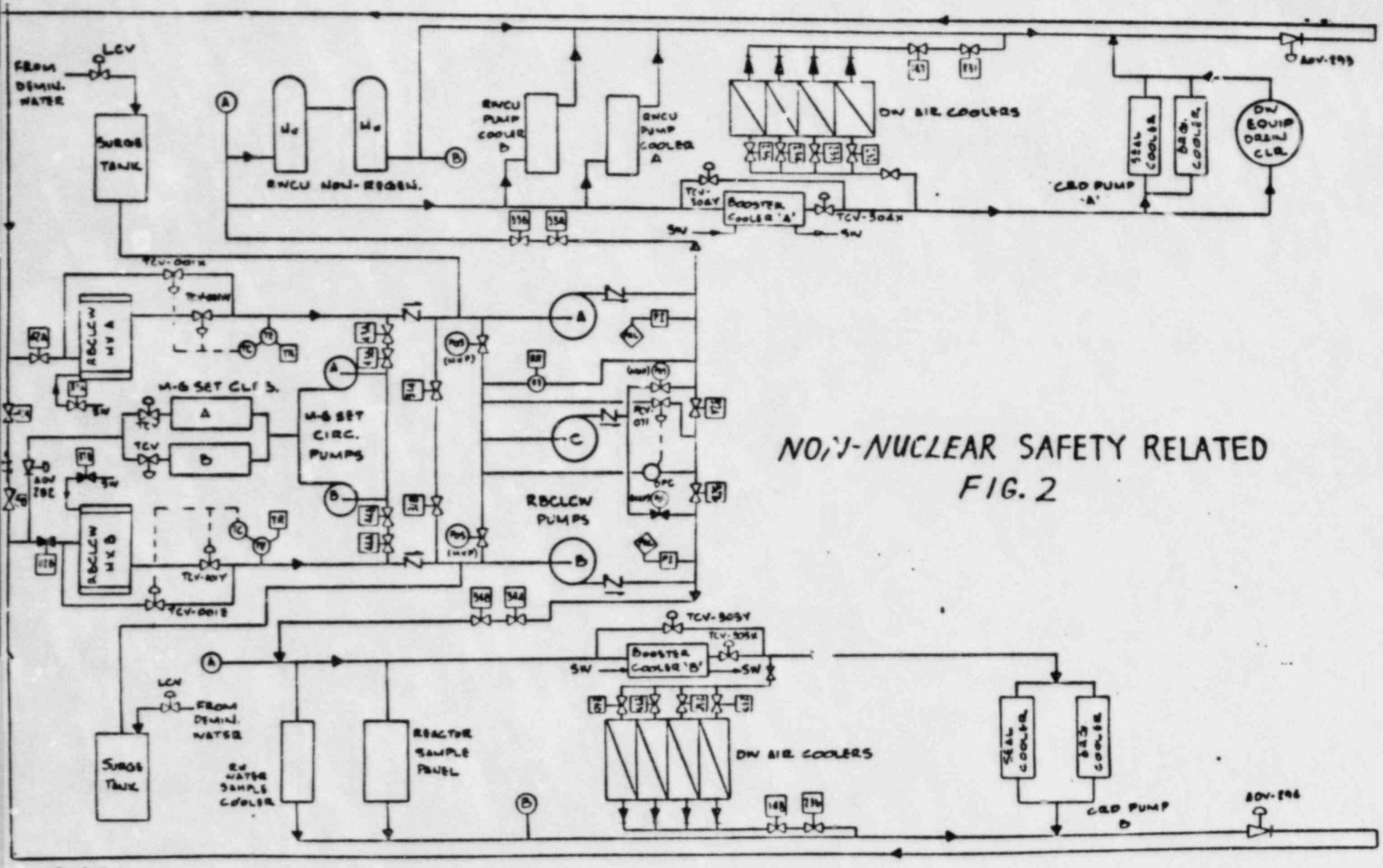
9.0 TRANSPARENCIES CONTAINED IN THIS LESSON:

Fig. No.	Description
1	RBCLCW (Nuclear Safety Related)
2	RBCLCW (Non-Nuclear Safety Related)
3	RBCLCW (Composite)
4	RBCLCW Electric Dist. (Safety Related)
5	RBCLCW Normal Operation
6	RBCLCW Accident Operation
7a,b	RBCLCW Control Room Mimic

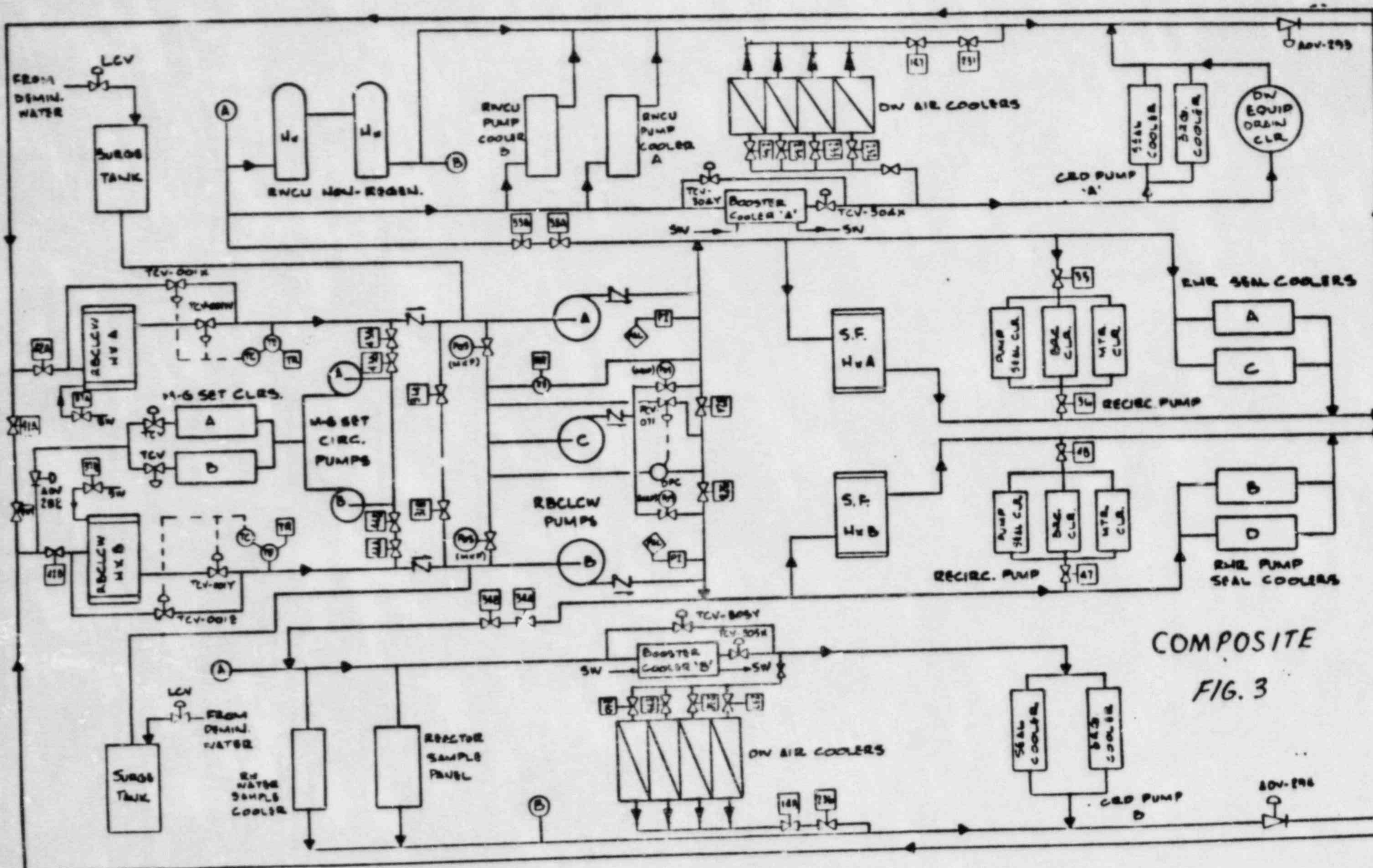


NUCLEAR SAFETY RELATED

FIG. 1



NON-NUCLEAR SAFETY RELATED
FIG. 2



COMPOSITE

FIG. 3

RBCLCW
ELEC. DIST.
NUCLEAR SAFETY RELATED

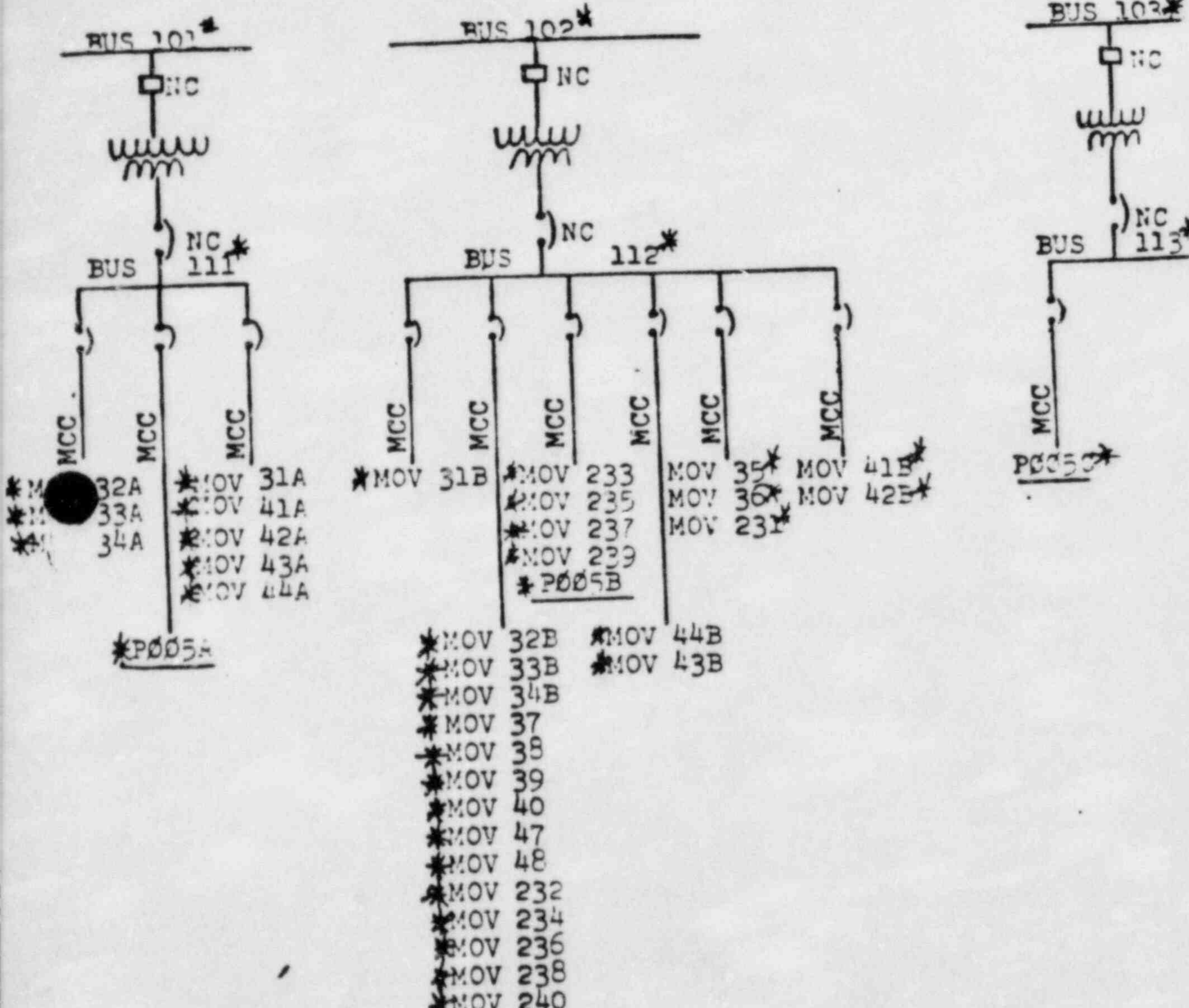
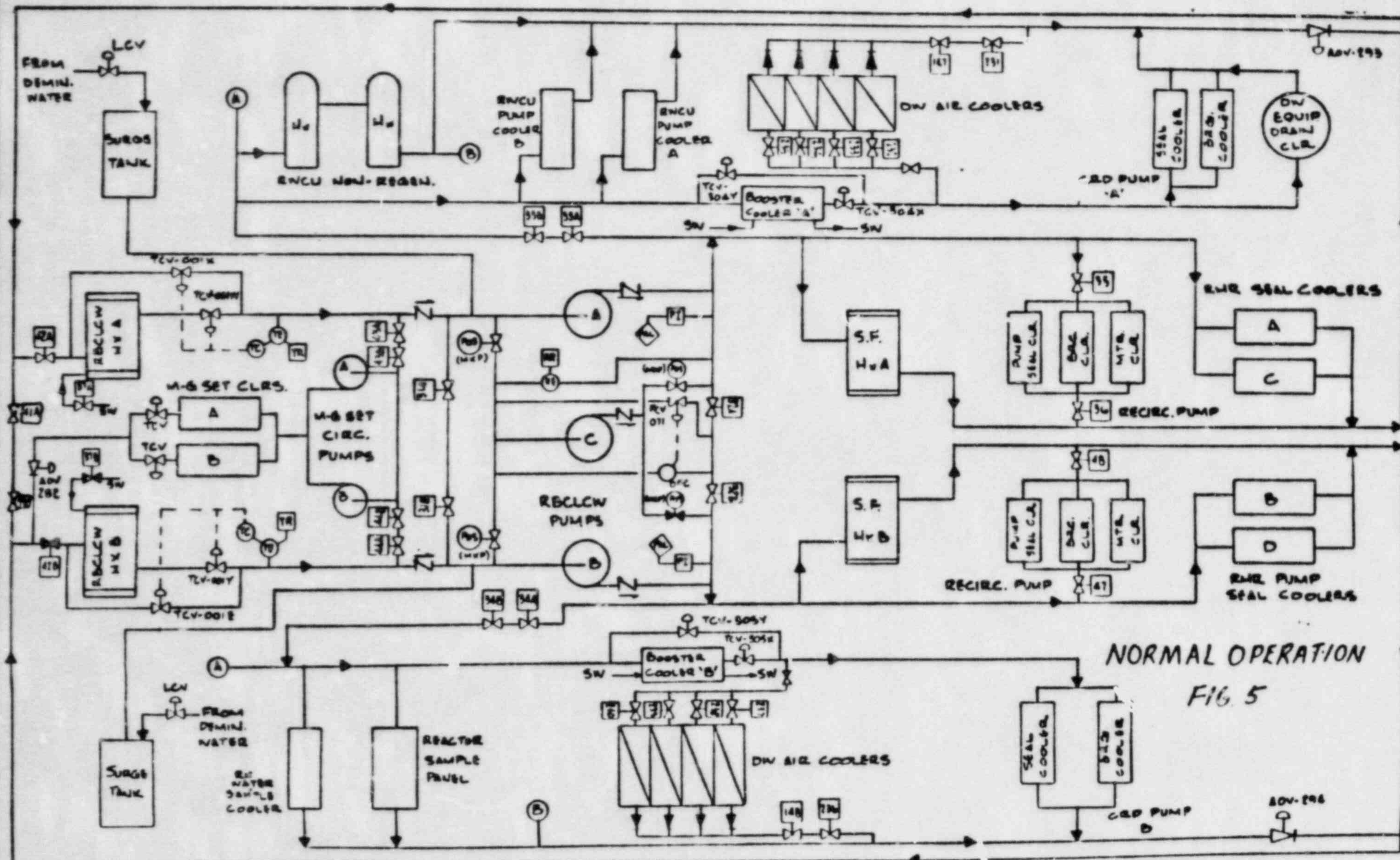
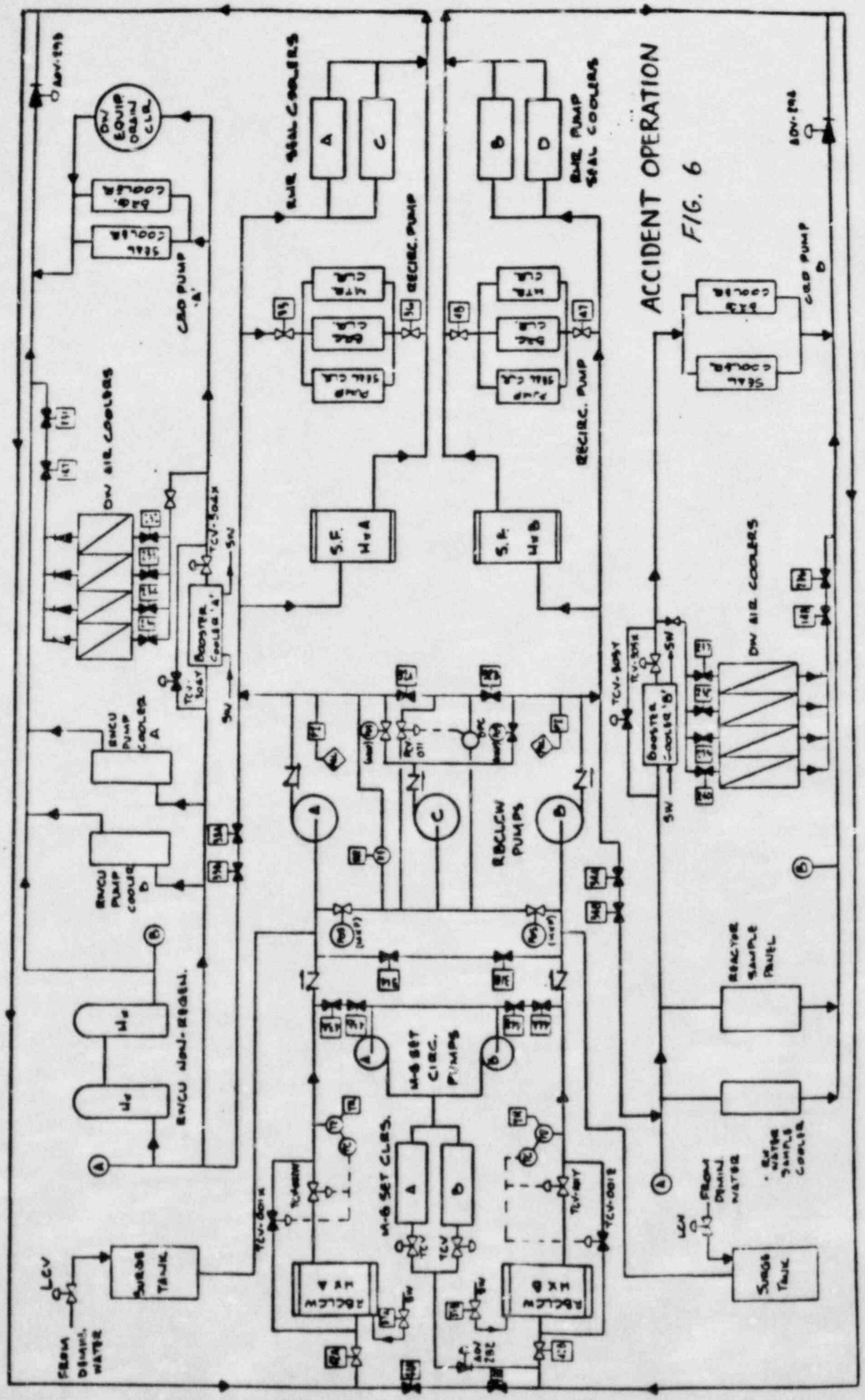


Fig. 4



NORMAL OPERATION

FIG. 5



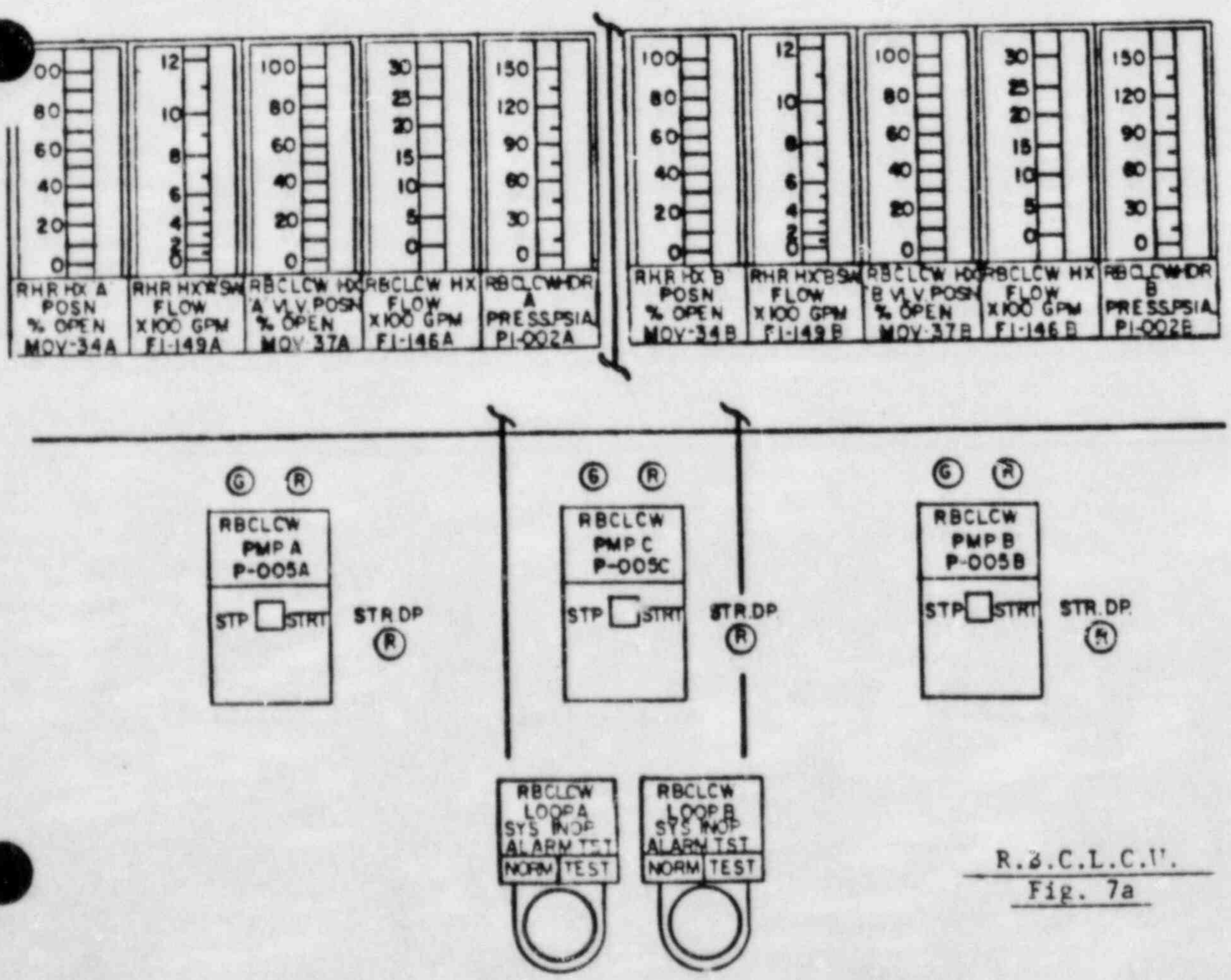
ACCIDENT OPERATION

FIG. 6

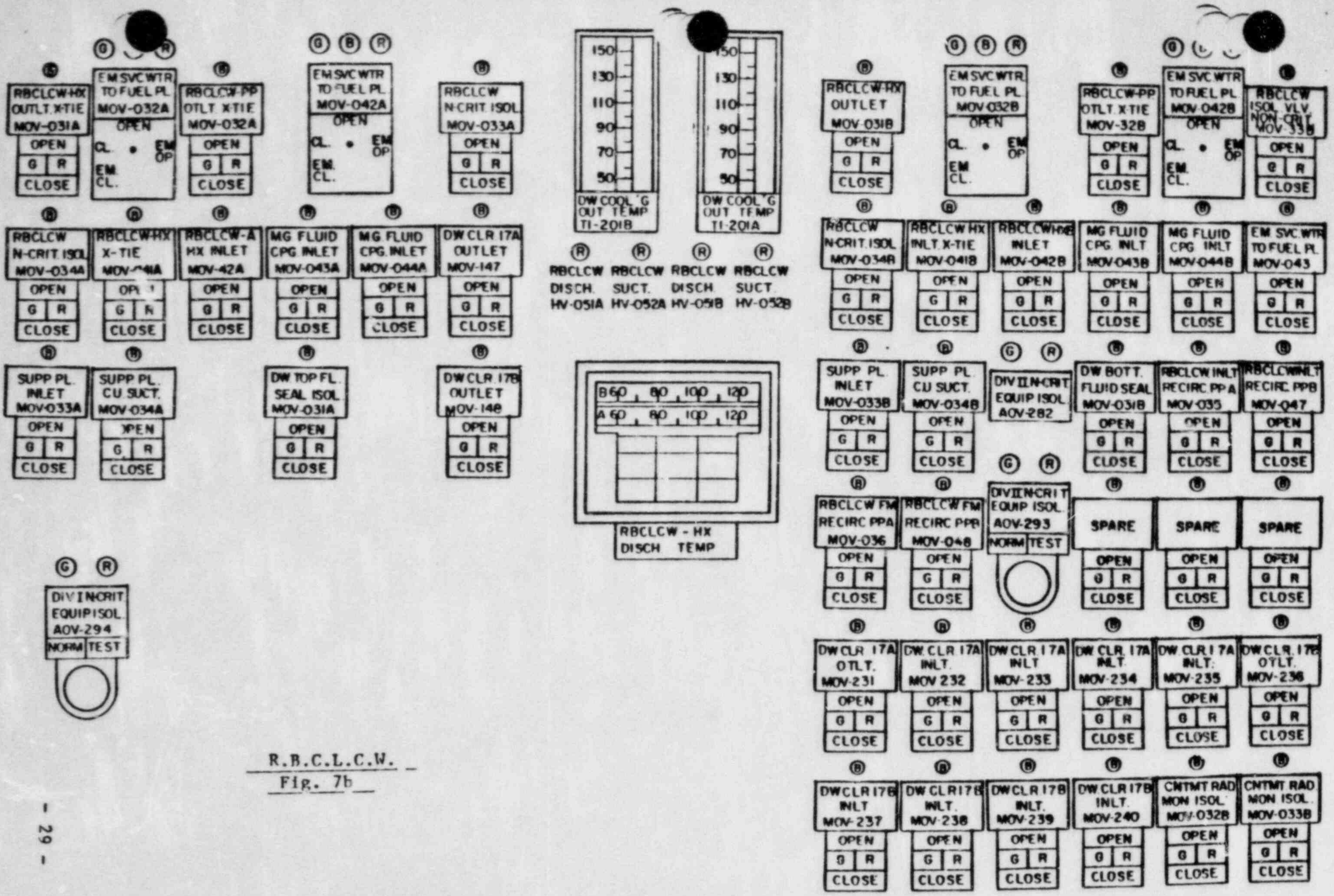
209E

1	2	3	4	5	6	7	8	9	10
CPRSR ROUBLE	0190 AIR CPRSR B TROUBLE	0192 AIR CPRSR C TROUBLE	0195 INSTM AIR HDR PRESS LO	0041 RBCLCW PUMP A AUTO TRIP	0056 RBCLCW PUMP C AUTO TRIP	0040 RBCLCW PUMP B AUTO TRIP	0355 SPENT FUEL STOR PL TEMP HI	0440 CNTMT HEPA FLT IN FLOW HI	0158 RB-TB SERVICE WTR ISOL VV OPEN
DRYER BLE	0180 AIR CPRSR OC TRIP	0188 AIR CPRSR MTR OVLD	0187 STANDBY AIR CPRSR RUNNING	0347 RBCLCW HEAD TK A LEVEL HI/LO	0340 RBCLCW HX A TEMP HI/LO	0348 RBCLCW HEAD TK B LEVEL HI/LO	0365 SPENT FUEL STOR PL LEVEL HI/LO	0447 WASTE VV TO CANAL OPEN	0444 RB SUMPS LEVEL HI
SERVICE PUMP A) TRIP	0205 RB SERVICE WTR PUMP C AUTO TRIP	0076 RB SERVICE WTR PUMP D AUTO TRIP	0075 RB SERVICE WTR PUMP B AUTO TRIP	0342 RBCLCW HEAD TK A LEVEL LO-LO	0341 RBCLCW HX B TEMP HI/LO	0343 RBCLCW HEAD TK B LEVEL LO-LO	0354 SPENT FUEL CLG PUMP A TROUBLE	0445 STM TO AIR EJECTOR PRESS LO	0446 YARD PPG SUMP LEVEL HI
SERVICE PUMP A OVLD	0208 RB SERVICE WTR PUMP C MTR OVLD	0209 RB SERVICE WTR PUMP D MTR OVLD	0207 RB SERVICE WTR PUMP B MTR OVLD	0352 RBCLCW SYS A HDR PRESS LO	0407 RBCLCW VV INTERLOCK LCTL	0353 RBCLCW SYS B HDR PRESS LO	0356 SPENT FUEL CLG PUMP B TROUBLE	0438 DW FLOOR UP SEAL PRESS HI/LO	0439 DW FLOOR LWR SEAL PRESS HI/LO
SERVICE SYS A RADED	0424 RB SERVICE WTR SYS A INOP	0427 RB SERVICE WTR SYS B DEGRADED	0425 RB SERVICE WTR SYS B INOP	0361 RBCLCW SYS A DEGRADED	0360 RBCLCW SYS A INOP	0363 RBCLCW SYS B DEGRADED	0362 RBCLCW SYS B INOP	0032 RB SERVICE WTR STR DIFF P HI	0437 TBCLCW HX BYP VV FULL OPEN/CLSD

MCB



R.B.C.L.C.W.
Fig. 7a



R.B.C.L.C.W.

Fig. 7b

R.B.C.L.C.W. MALFUNCTIONS

FIG #

1a-b. Normal Operations
- Both loops are cross connected with one HX.

2a-b. Accident Condition
- (+1.69psig drywell both loops split, non crit. loads isolated).

3a-b. Loss of RBCLCW pump 'B'
- Loss Hdr pressure, 'C' RBCLCW auto start.

4a-b. Loss of Station Air
- TCV's go to max cooling, head tank will overflow.

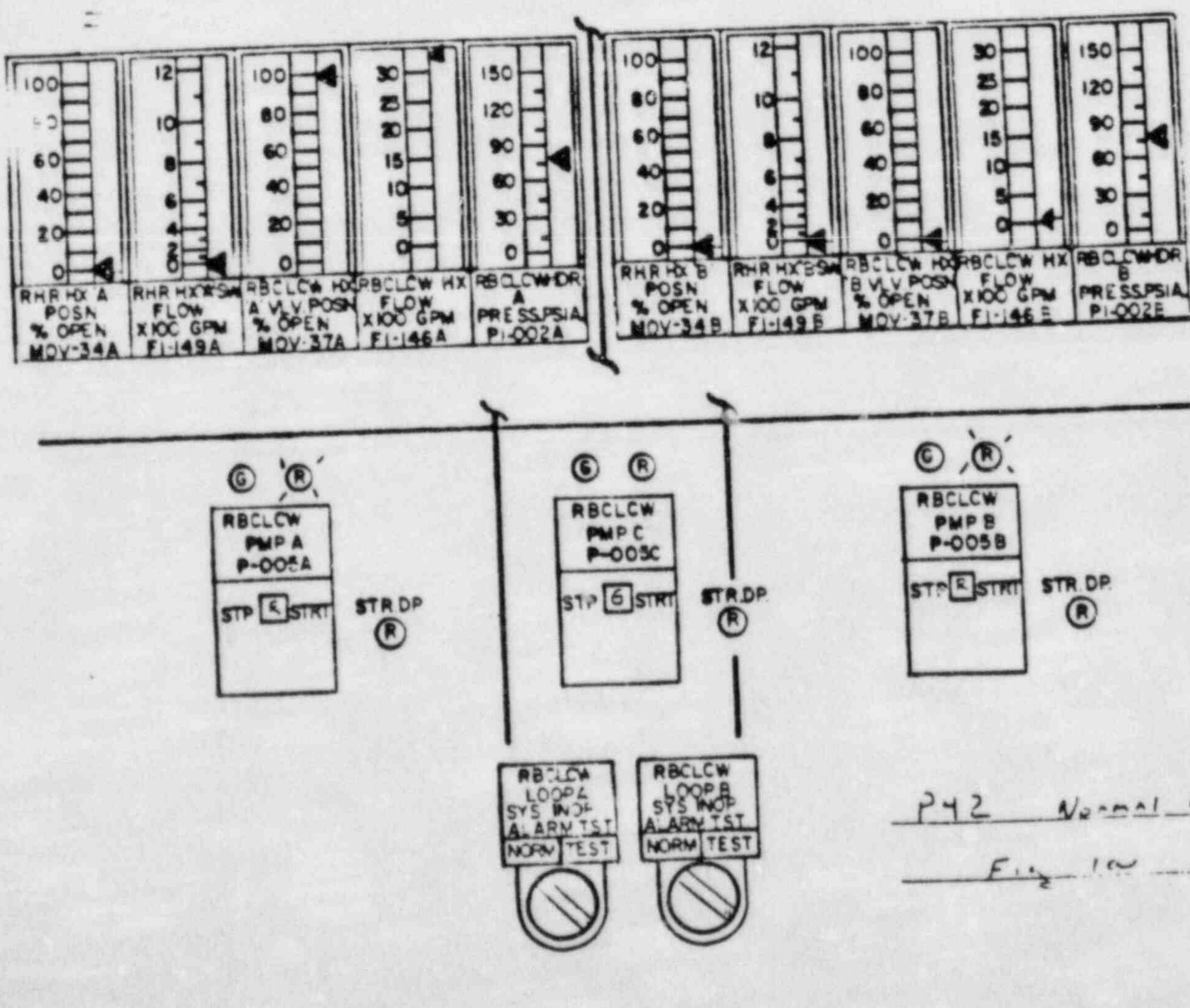
5a-b. Total Loss of RBCLCW
- Head tank lo. lo levels, RBCLCW pumps trip on low suction pressure.

6a-b. Failure RBCLCW to split
- Rx water level -140", some non-critical isolations did not close, system INOP and DEGRADED.

709E

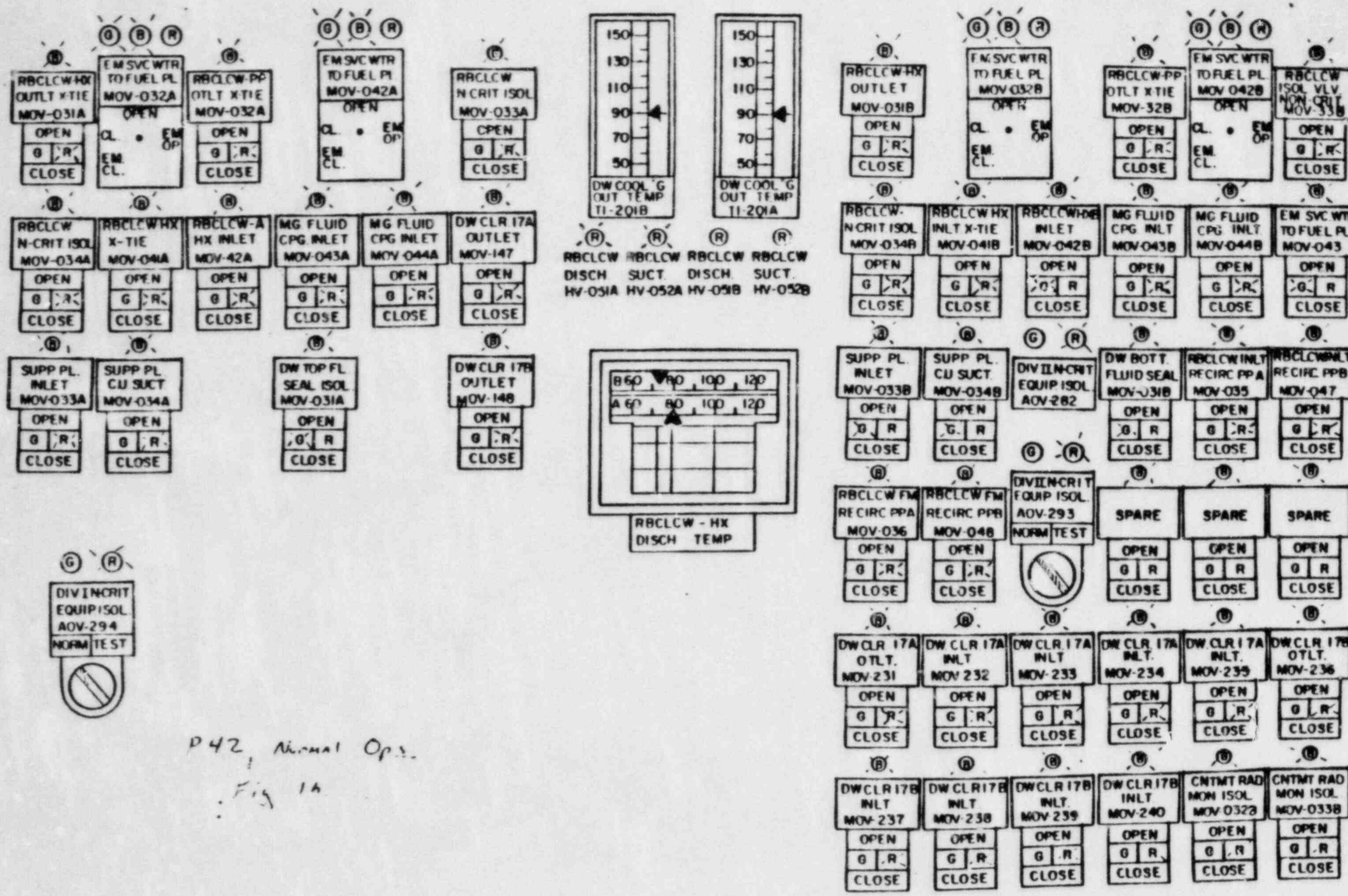
0189 AI R A TROUBLE	0197 AIR CPRSR B TROUBLE	0191 AIR CPRSR C TROUBLE	0195 INSTM AIR HDR PRESS LO	0041 RBCLCW PUMP A AUTO TRIP	0056 RBCLCW PUMP C AUTO TRIP	0040 RBCLCW PUMP B AUTO TRIP	0355 SPENT FUEL STOR PL TEMP HI	0440 CNTMT HEPA FLT IN FLOW HI	0158 RB-TB SERVICE WTR ISOL VV OPEN
0192 AIR DRYER TROUBLE	0182 AIR CPRSR OC TRIP	0188 AIR CPRSR MTR OVLD	0187 STANDBY AIR CPRSR RUNNING	0347 RBCLCW HEAD TK A LEVEL HI/LO	0340 RBCLCW HX A TEMP HI/LO	0348 RBCLCW HEAD TK B LEVEL HI/LO	0365 SPENT FUEL STOR PL LEVEL HI/LO	0443 WASTE VV TO CANAL OPEN	0444 RB SUMPS LEVEL HI
0074 RB SERVICE WTR PUMP A AUTO TRIP	0205 RB SERVICE WTR PUMP C AUTO TRIP	0076 RB SERVICE WTR PUMP D AUTO TRIP	0075 RB SERVICE WTR PUMP B AUTO TRIP	0342 RBCLCW HEAD TK A LEVEL LO-LO	0341 RBCLCW HX B TEMP HI/LO	0343 RBCLCW HEAD TK B LEVEL LO-LO	0354 SPENT FUEL CLG PUMP A TROUBLE	0445 STM TO AIR EJECTOR PRESS LO	0446 YARD PPG SUMP LEVEL HI
0206 RB SERVICE WTR PUMP A MTR OVLD	0208 RB SERVICE WTR PUMP C MTR OVLD	0209 RB SERVICE WTR PUMP D MTR OVLD	0207 RB SERVICE WTR PUMP B MTR OVLD	0352 RBCLCW SYS A HDR PRESS LO	0407 RBCLCW VV INTERLOCK LCTL	0353 RBCLCW SYS B HDR PRESS LO	0356 SPENT FUEL CLG PUMP B TROUBLE	0438 DW FLOOR UP SEAL PRESS HI/LO	0439 DW FLOOR LWR SEAL PRESS HI/LO
0426 RB SERVICE WTR SYS A DEGRADED	0424 RB SERVICE WTR SYS A INOP	0427 RB SERVICE WTR SYS B DEGRADED	0425 RB SERVICE WTR SYS B INOP	0361 RBCLCW SYS A DEGRADED	0360 RBCLCW SYS A INOP	0363 RBCLCW SYS B DEGRADED	0362 RBCLCW SYS B INOP	0032 RB SERVICE WTR STR DIFF P HI	0437 TBCLCW HX BYP VV FULL OPEN/CLSD
1	2	3	4	5	6	7	8	9	10

MCB



P42 Normal Ops

Fig 10



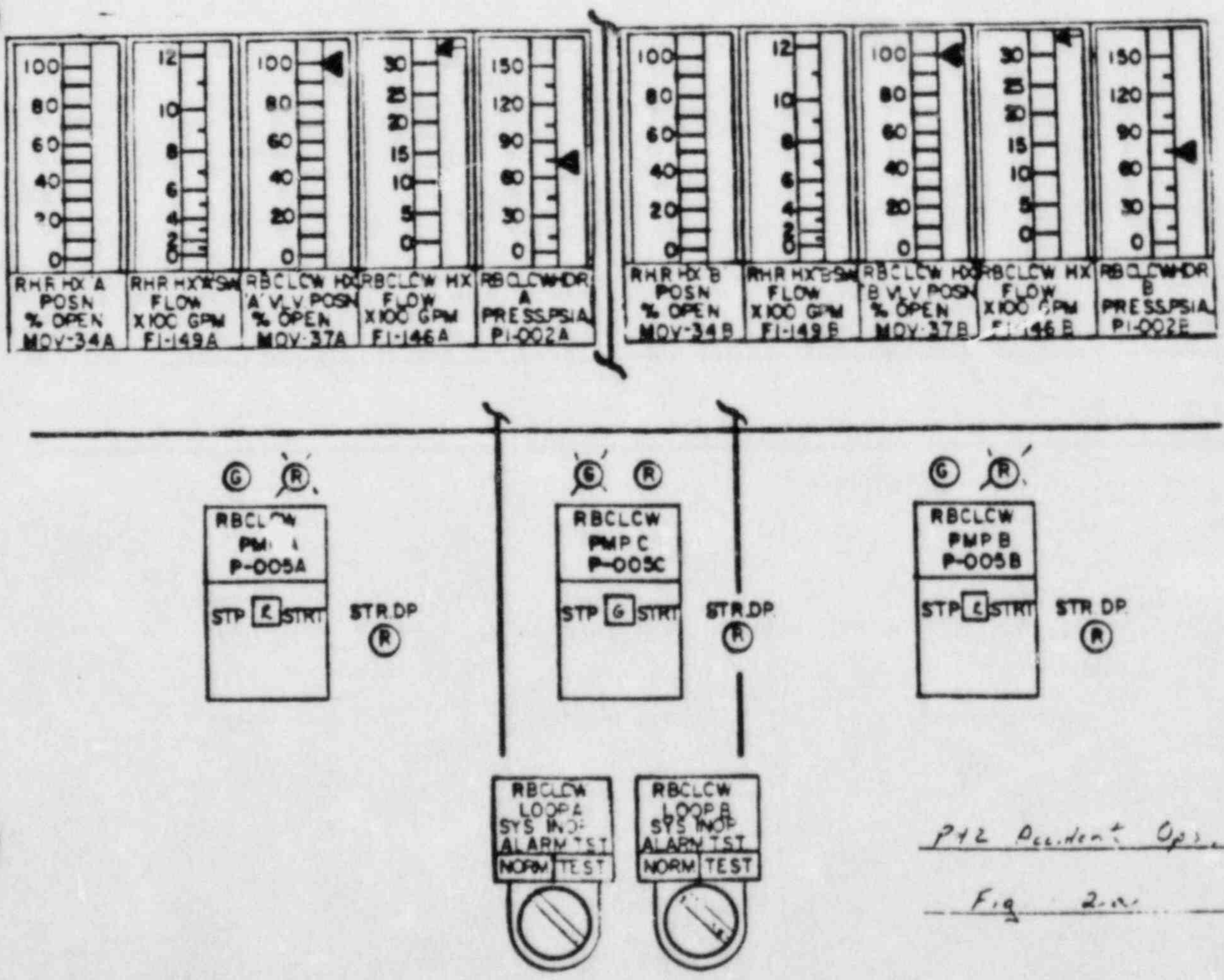
P42, Normal Ops.

Fig 1A

209E

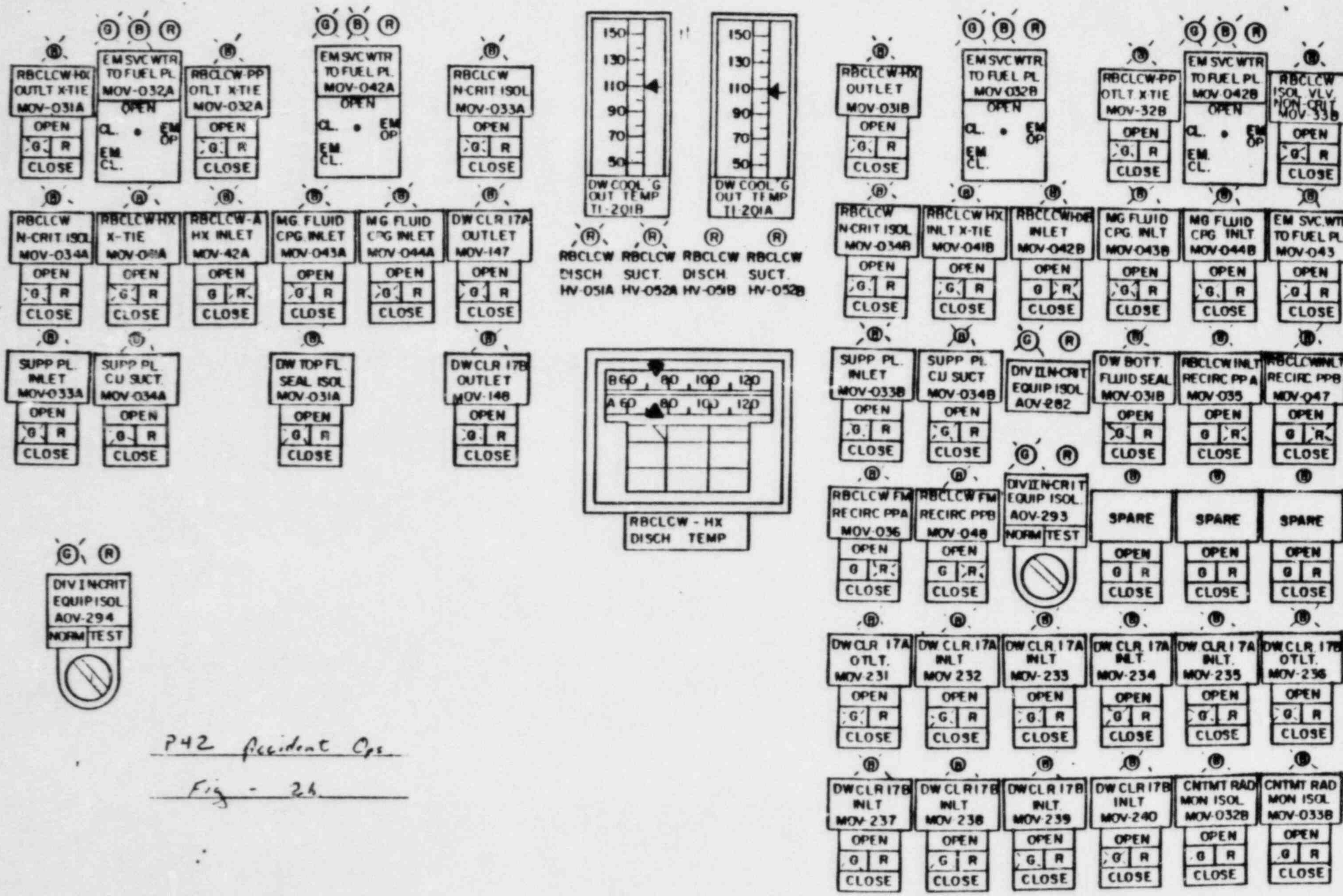
0189 AIR A TROU	0190 AIR CPRSR B TROUBLE	0191 AIR CPRSR C TROUBLE	0195 INSTM AIR HDR PRESS LO	0041 RBCLCW PUMP A AUTO TRIP	0056 RBCLCW PUMP C AUTO TRIP	0040 RBCLCW PUMP B AUTO TRIP	0355 SPENT FUEL STOR PL TEMP HI	0440 CNTMT HEPA FLT IN FLOW HI	0158 RB-TB SERVICE WTR ISOL VV OPEN
0192 AIR DRYER TROUBLE	0180 AIR CPRSR OC TRIP	0188 AIR CPRSR MTR OVLD	0187 STANDBY AIR CPRSR RUNNING	0.4 RBCLCW HEAD TK A LEVEL HI/LO	0340 RBCLCW HX A TEMP HI/LO	0348 RBCLCW HEAD TK B LEVEL HI/LO	0365 SPENT FUEL STOR PL LEVEL HI/LO	0447 WASTE VV TO CANAL OPEN	0444 RB SUMPS LEVEL HI
0074 RB SERVICE WTR PUMP A AUTO TRIP	0205 RB SERVICE WTR PUMP C AUTO TRIP	0076 RB SERVICE WTR PUMP D AUTO TRIP	0075 RB SERVICE WTR PUMP B AUTO TRIP	0342 RBCLCW HEAD TK A LEVEL LO-LO	0341 RBCLCW HX B TEMP HI/LO	0343 RBCLCW HEAD TK B LEVEL LO-LO	0354 SPENT FUEL CLG PUMP A TROUBLE	0445 STM TO AIR EJECTOR PRESS LO	0446 YARD FPG SUMP LEVEL HI
0206 RB SERVICE WTR PUMP A MTR OVLD	0208 RB SERVICE WTR PUMP C MTR OVLD	0209 RB SERVICE WTR PUMP D MTR OVLD	0207 RB SERVICE WTR PUMP B MTR OVLD	0352 RBCLCW SYS A HDR PRESS LO	0407 RBCLCW VV INTERLOCK LCTL	0353 RBCLCW SYS B HDR PRESS LO	0356 SPENT FUEL CLG PUMP B TROUBLE	0438 DW FLOOR UP SEAL PRESS HI/LO	0439 DW FLOOR LWR SEAL PRESS HI/LO
0426 RB SERVICE WTR SYS A DEGRADED	0424 RB SERVICE WTR SYS A INOP	0427 RB SERVICE WTR SYS B DEGRADED	0425 RB SERVICE WTR SYS B INOP	0361 RBCLCW SYS A DEGRADED	0360 RBCLCW SYS A INOP	0363 RBCLCW SYS B DEGRADED	0362 RBCLCW SYS B INOP	0032 RB SERVICE WTR STR DIFF P HI	0437 TBCLCW HX BYP VV FULL OPEN/CLSD
1	2	3	4	5	6	7	8	9	10

MCR



P+Z Accident Ops.

Fig 2.n



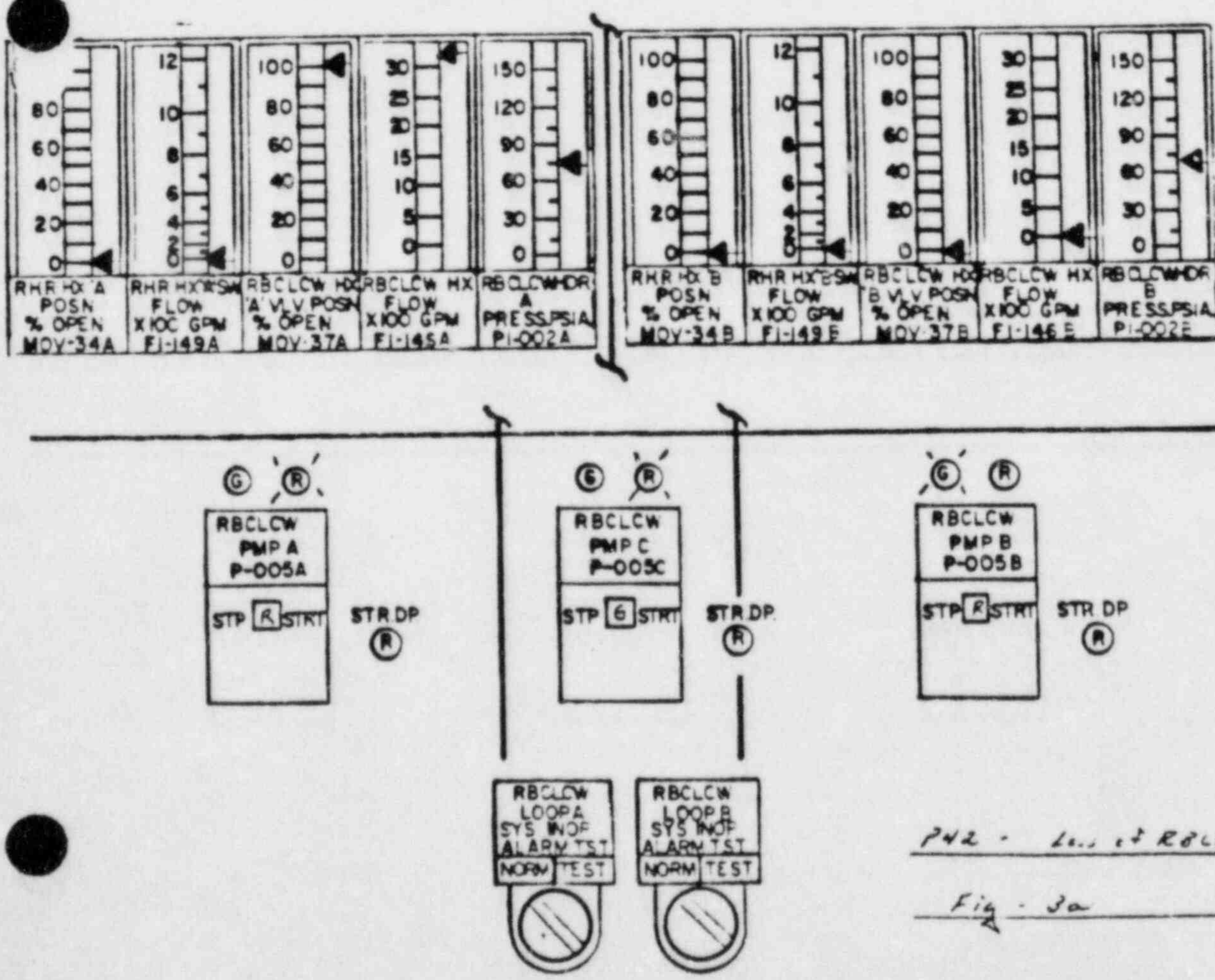
P42 Accident Ops

Fig - 2b

209E

SR LE	R CPRSR TROUBLE	0191 AIR CPRSR C TROUBLE	0195 INSTM AIR HDR PRESS LO	0041 RBCLCW PUMP A AUTO TRIP	0056 RBCLCW PUMP C AUTO TRIP	0040 RBCLCW PUMP B AUTO TRIP	0355 SPENT FUEL STOR PL TEMP HI	0440 CNTMT HEPA FLT IN FLOW HI	0158 RB-TB SERVICE WTR ISOL VV OPEN
ER	0180 AIR CPRSR OC TRIP	0188 AIR CPRSR MTR OVLD	0187 STANDBY AIR CPRSR RUNNING	0347 RBCLCW HEAD TK A LEVEL HI/LO	0340 RBCLCW HX A TEMP HI/LO	0348 RBCLCW HEAD TK B LEVEL HI/LO	0365 SPENT FUEL STOR PL LEVEL HI/LO	0443 WASTE VV TO CANAL OPEN	044[illegible] RB SUMPS LEVEL HI
ICE P A IP	0205 RB SERVICE WTR PUMP C AUTO TRIP	0076 RB SERVICE WTR PUMP D AUTO TRIP	0075 RB SERVICE WTR PUMP B AUTO TRIP	0342 RBCLCW HEAD TK A LEVEL LO-LO	0341 RBCLCW HX B TEMP HI/LO	0343 RBCLCW HEAD TK B LEVEL LO-LO	0354 SPENT FUEL CLG PUMP A TROUBLE	0445 STM TO AIR EJECTOR PRESS LO	0446 YARD PPC SUMP LEVEL HI
ICE P A D	0208 RB SERVICE WTR PUMP C MTR OVLD	0209 RB SERVICE WTR PUMP D MTR OVLD	0207 RB SERVICE WTR PUMP B MTR OVLD	0352 RBCLCW SYS A HDR PRESS LO	0407 RBCLCW VV INTERLOCK LCTL	0353 RBCLCW SYS B HDR PRESS LO	0356 SPENT FUEL CLG PUMP B TROUBLE	0438 DW FLOOR UP SEAL PRESS HI/LO	0439 DW FLOOR LWR SEAL PRESS HI/LO
ICE A D	0424 RB SERVICE WTR SYS A INOP	0427 RB SERVICE WTR SYS B DEGRADED	0425 RB SERVICE WTR SYS B INOP	0361 RBCLCW SYS A DEGRADED	0360 RBCLCW SYS A INOP	0363 RBCLCW SYS B DEGRADED	0362 RBCLCW SYS B INOP	0032 RB SERVICE WTR STR DIFF P HI	0437 TBCLCW HX BYP VV FULL OPEN/CLSD
	2	3	4	5	6	7	8	9	10

MCB



P42 - Loss of RBCLCW P?

Fig - 3a

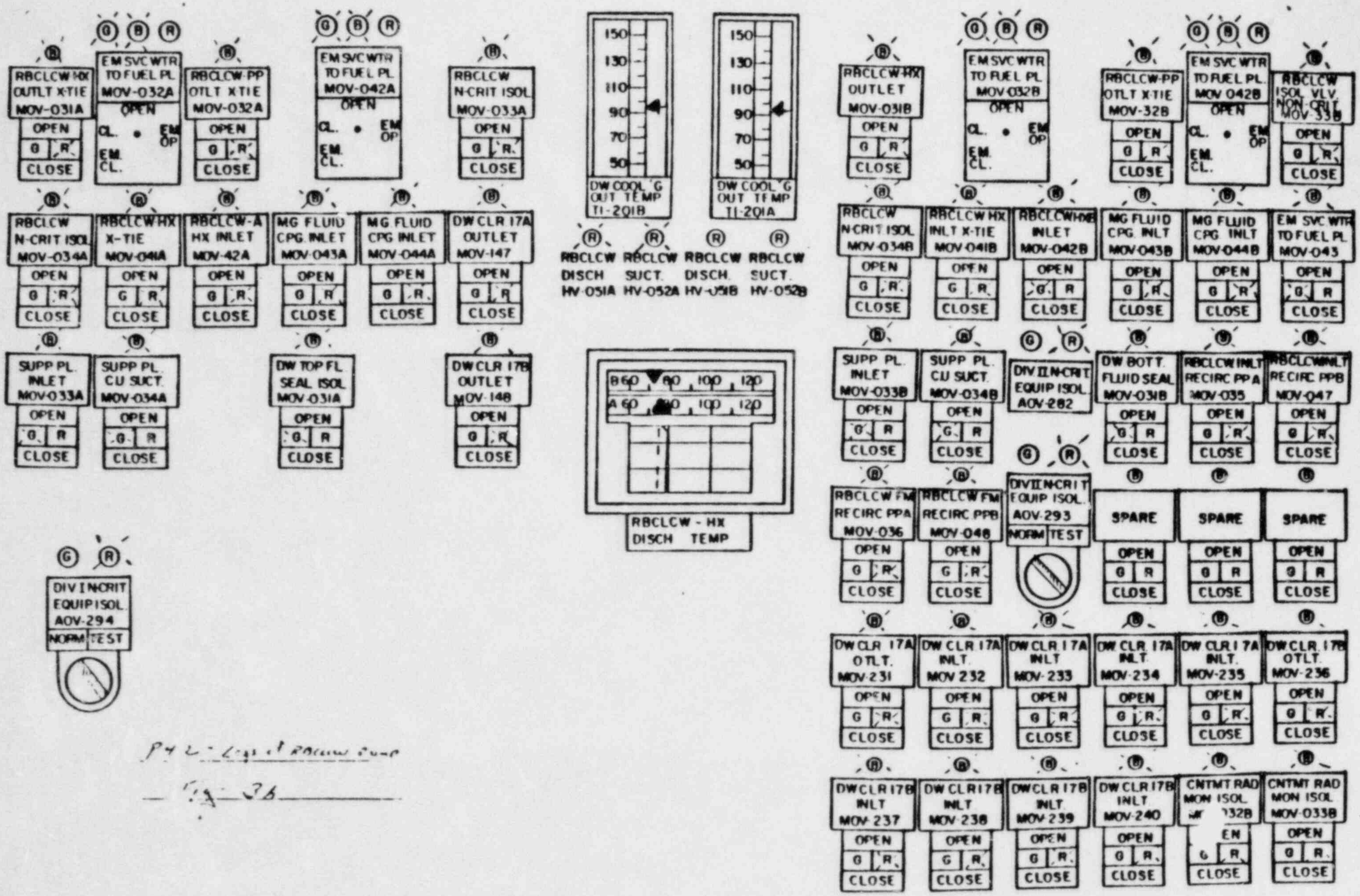
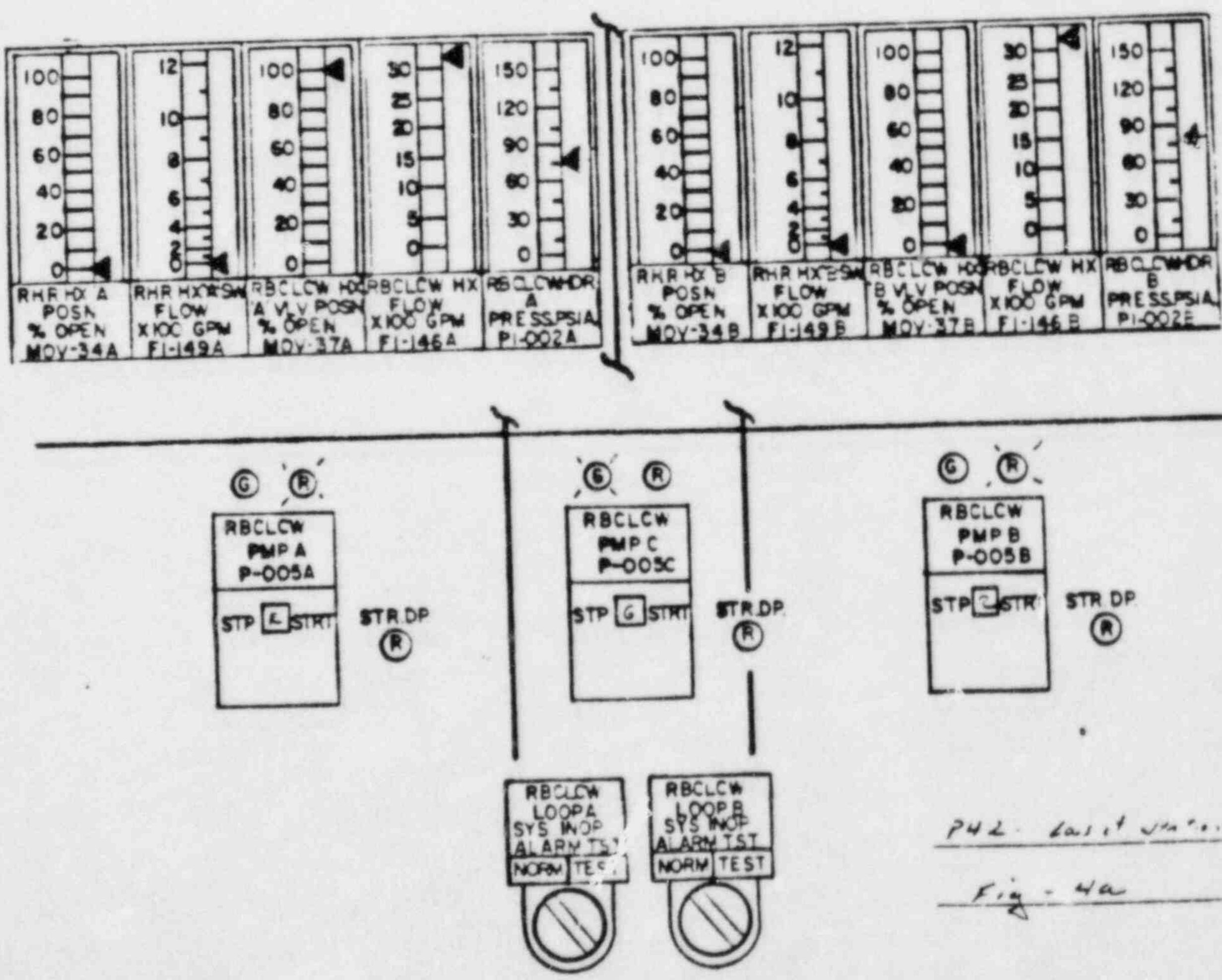

EM SVC WTR TO FUEL PL MOV-032A
RBCLCW-HX OUTLT X-TIE MOV-031A
RBCLCW-PP OTLT X-TIE MOV-032A
EM SVC WTR TO FUEL PL MOV-042A
RBCLCW N-CRIT ISOL MOV-033A
OPEN
CL.
EM OP
EM CL.
CLOSE
RBCLCW N-CRIT ISOL MOV-034A
RBCLCW-HX X-TIE MOV-041A
RBCLCW-A HX INLET MOV-42A
MG FLUID CPG INLET MOV-043A
MG FLUID CPG INLET MOV-044A
DW CLR 17A OUTLET MOV-147
SUPP PL. INLET MOV-033A
SUPP PL. CU SUCT. MOV-034A
DW TOP FL. SEAL ISOL MOV-031A
DW CLR 17B OUTLET MOV-148
DIV I N-CRIT EQUIP ISOL. AOV-294
NORM TEST
150
130
110
90
70
50
DW COOL'G OUT TEMP TI-201B
DW COOL'G OUT TEMP TI-201A
RBCLCW DISCH HV-051A
RBCLCW SUCT. HV-052A
RBCLCW DISCH. HV-051B
RBCLCW SUCT. HV-052B
B 60 80 100 120
A 60 80 100 120
RBCLCW - HX DISCH TEMP
RBCLCW-HX OUTLET MOV-031B
EM SVC WTR TO FUEL PL MOV-032B
RBCLCW-PP OTLT X-TIE MOV-32B
EM SVC WTR TO FUEL PL. MOV 042B
RBCLCW ISOL. VLV. NON-CRIT MOV-33B
RBCLCW N-CRIT ISOL MOV-034B
RBCLCW HX INLT X-TIE MOV-041B
RBCLCW HXB INLET MOV-042B
MG FLUID CPG. INLT MOV-043B
MG FLUID CPG. INLT MOV-044B
EM SVC WTR TO FUEL PL MOV-043
SUPP PL. INLET MOV-033B
SUPP PL. CU SUCT. MOV-034B
DIV II N-CRIT EQUIP ISOL AOV-282
DW BOTT. FLUID SEAL MOV-031B
RBCLCW INLT RECIRC PP A MOV-035
RBCLCW INLT RECIRC PP B MOV-047
RBCLCW FM RECIRC PP A MOV-036
RBCLCW FM RECIRC PP B MOV-048
DIV II N-CRIT EQUIP ISOL. AOV-293
SPARE
DW CLR 17A OTLT. MOV-231
DW CLR 17A INLT. MOV 232
DW CLR 17A INLT MOV-233
DW CLR 17A INLT. MOV-234
DW CLR 17A INLT. MOV-235
DW CLR 17B OTLT. MOV-236
DW CLR 17B INLT MOV-237
DW CLR 17B INLT MOV-238
DW CLR 17B INLT. MOV-239
DW CLR 17B INLT MOV-240
CNTMT RAD MON ISOL MOV-032B
CNTMT RAD MON ISOL MOV-033B

Fig. 3b

2091

01[illegible] AI[illegible] A [illegible]LE	0190 AIR CPRSR B TROUBLE	0191 AIR CPRSR C TROUBLE	0195 INSTM AIR HDR PRESS LO	0041 RBCLCW PUMP A AUTO TRIP	0056 RBCLCW PUMP C AUTO TRIP	0040 RBCLCW PUMP B AUTO TRIP	0355 SPENT FUEL STOR PL TEMP HI	0440 CNTMT HEPA FLT IN FLOW HI	0158 RB-TB SERVICE WTR ISOL VV OPEN
0192 AIR DRYER TROUBLE	0180 AIR CPRSR OC TRIP	0188 AIR CPRSR MTR OVLD	0187 STANDBY AIR CPRSR RUNNING	0347 RBCLCW HEAD TK A LEVEL HI/LO	0340 RBCLCW HX A TEMP HI/LO	0348 RBCLCW HEAD TK B LEVEL HI/LO	0365 SPENT FUEL STOR PL LEVEL HI/LO	0443 WASTE VV TO CANAL OPEN	0444 RB SUMPS LEVEL HI
0074 RB SERVICE WTR PUMP A AUTO TRIP	0205 RB SERVICE WTR PUMP C AUTO TRIP	0076 RB SERVICE WTR PUMP D AUTO TRIP	0075 RB SERVICE WTR PUMP B AUTO TRIP	0342 RBCLCW HEAD TK A LEVEL LO-LO	0341 RBCLCW HX B TEMP HI/LO	0343 RBCLCW HEAD TK B LEVEL LO-LO	0354 SPENT FUEL CLC PUMP A TROUBLE	0445 STM TO AIR EJECTOR PRESS LO	0444 YARD PPG SUMP LEVEL HI
0206 RB SERVICE WTR PUMP A MTR OVLD	0208 RB SERVICE WTR PUMP C MTR OVLD	0209 RB SERVICE WTR PUMP D MTR OVLD	0207 RB SERVICE WTR PUMP B MTR OVLD	0352 RBCLCW SYS A HDR PRESS LO	0407 RBCLCW VV INTERLOCK LCTL	0353 RBCLCW SYS B HDR PRESS LO	0356 SPENT FUEL CLC PUMP B TROUBLE	0435 DW FLOOR UP SEAL PRESS HI/LO	0439 DW FLOOR LWR SEAL PRESS HI/LO
0426 RB SERVICE WTR SYS A DEGRADED	0424 RB SERVICE WTR SYS A INOP	0427 RB SERVICE WTR SYS B DEGRADED	0425 RB SERVICE WTR SYS B INOP	0361 RBCLCW SYS A DEGRADED	0360 RBCLCW SYS A INOP	0363 RBCLCW SYS B DEGRADED	0362 RBCLCW SYS B INOP	0032 RB SERVICE WTR STR DIFF P HI	0437 TBCLCW HX BYP VV FULL OPEN/CLSD
1	2	3	4	5	6	7	8	9	10

MCB



PH2 - [illegible]

Fig - 4a

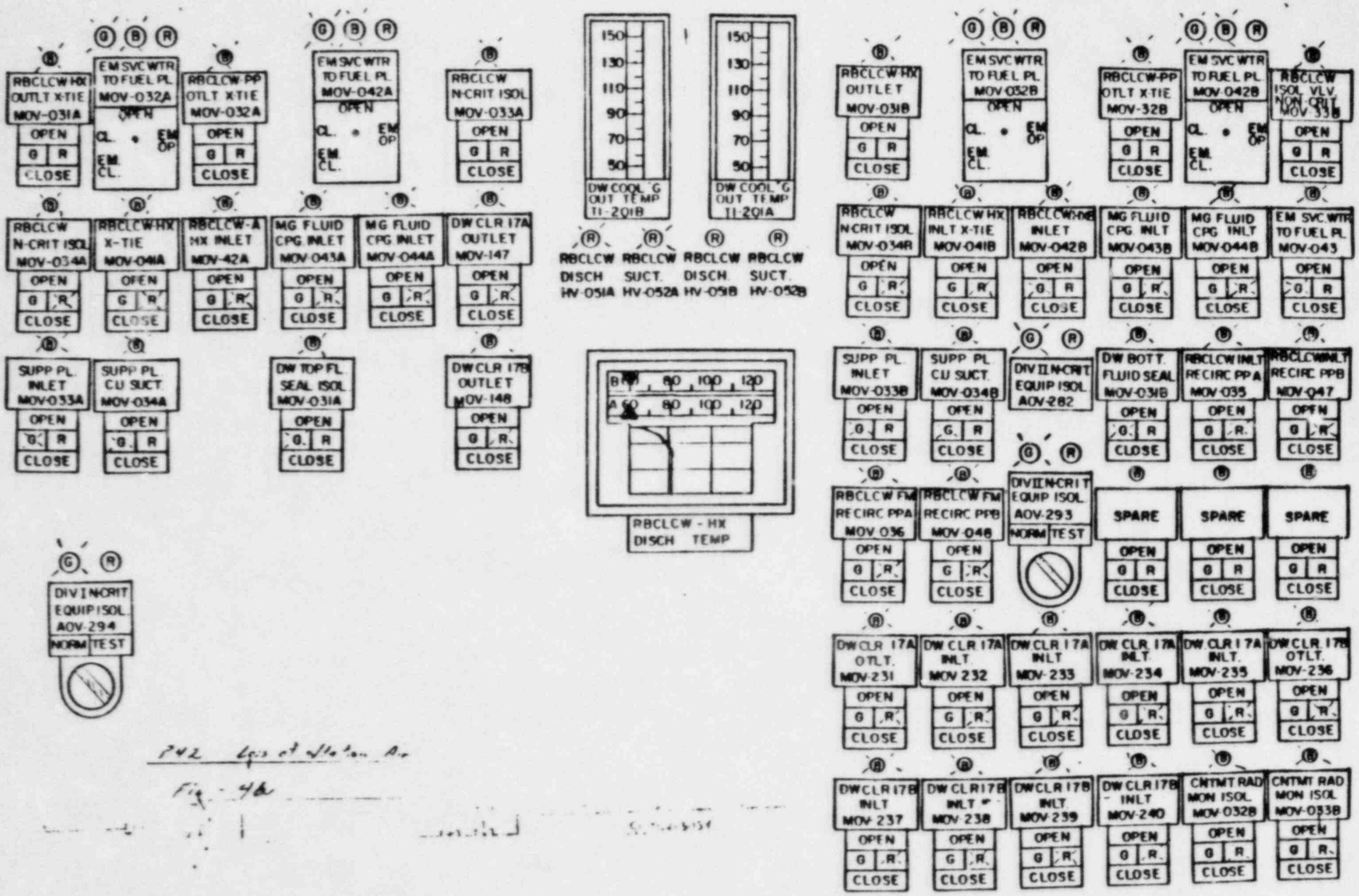
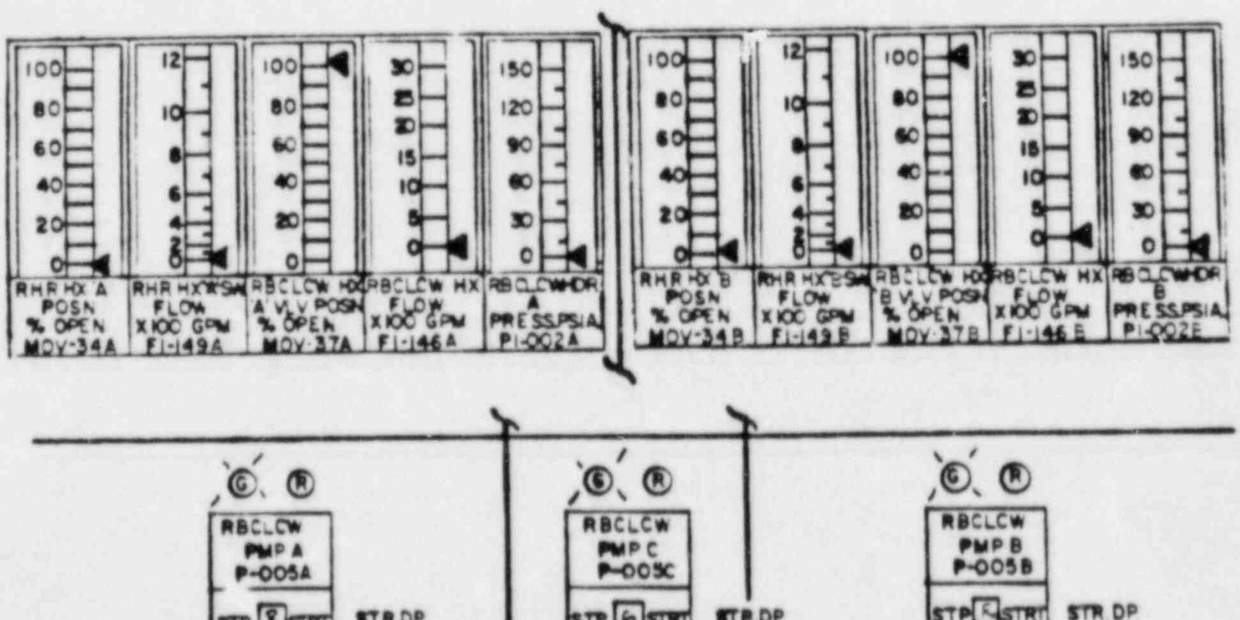

RBCLCW-HX OUTLT X-TIE MOV-031A
EM SVC WTR TO FUEL PL MOV-032A
RBCLCW-PP OTLT X-TIE MOV-032A
EM SVC WTR TO FUEL PL MOV-042A
RBCLCW N-CRIT ISOL MOV-033A
RBCLCW N-CRIT ISOL MOV-034A
RBCLCW-HX X-TIE MOV-041A
RBCLCW-A HX INLET MOV-42A
MG FLUID CPG INLET MOV-043A
MG FLUID CPG INLET MOV-044A
DW CLR 17A OUTLET MOV-147
SUPP PL INLET MOV-033A
SUPP PL CU SUCT MOV-034A
DW TOP FL SEAL ISOL MOV-031A
DW CLR 17B OUTLET MOV-148
DIV I N-CRIT EQUIP ISOL AOV-294
NORM
TEST
OPEN
CLOSE
CL.
EM CL.
EM OP
DW COOL'G OUT TEMP TI-201B
DW COOL'G OUT TEMP TI-201A
RBCLCW DISCH HV-051A
RBCLCW SUCT HV-052A
RBCLCW DISCH HV-051B
RBCLCW SUCT HV-052B
RBCLCW - HX DISCH TEMP
RBCLCW-HX OUTLET MOV-031B
EM SVC WTR TO FUEL PL MOV-032B
RBCLCW-PP OTLT X-TIE MOV-32B
EM SVC WTR TO FUEL PL MOV-042B
RBCLCW ISOL VLV NON-CRIT MOV-33B
RBCLCW N-CRIT ISOL MOV-034B
RBCLCW HX INLT X-TIE MOV-041B
RBCLCW-HXB INLET MOV-042B
MG FLUID CPG INLT MOV-043B
MG FLUID CPG INLT MOV-044B
EM SVC WTR TO FUEL PL MOV-043
SUPP PL INLET MOV-033B
SUPP PL CU SUCT MOV-034B
DIV II N-CRIT EQUIP ISOL AOV-282
DW BOTT FLUID SEAL MOV-031B
RBCLCW INLT RECIRC PP A MOV-035
RBCLCW INLT RECIRC PPB MOV-047
RBCLCW FM RECIRC PPA MOV-036
RBCLCW FM RECIRC PPB MOV-046
DIV II N-CRIT EQUIP ISOL AOV-293
SPARE
SPARE
SPARE
DW CLR 17A OTLT MOV-231
DW CLR 17A INLT MOV 232
DW CLR 17A INLT MOV-233
DW CLR 17A INLT MOV-234
DW CLR 17A INLT MOV-235
DW CLR 17B OTLT MOV-236
DW CLR 17B INLT MOV-237
DW CLR 17B INLT MOV-238
DW CLR 17B INLT MOV-239
DW CLR 17B INLT MOV-240
CNTMT RAD MON ISOL MOV-032B
CNTMT RAD MON ISOL MOV-033B

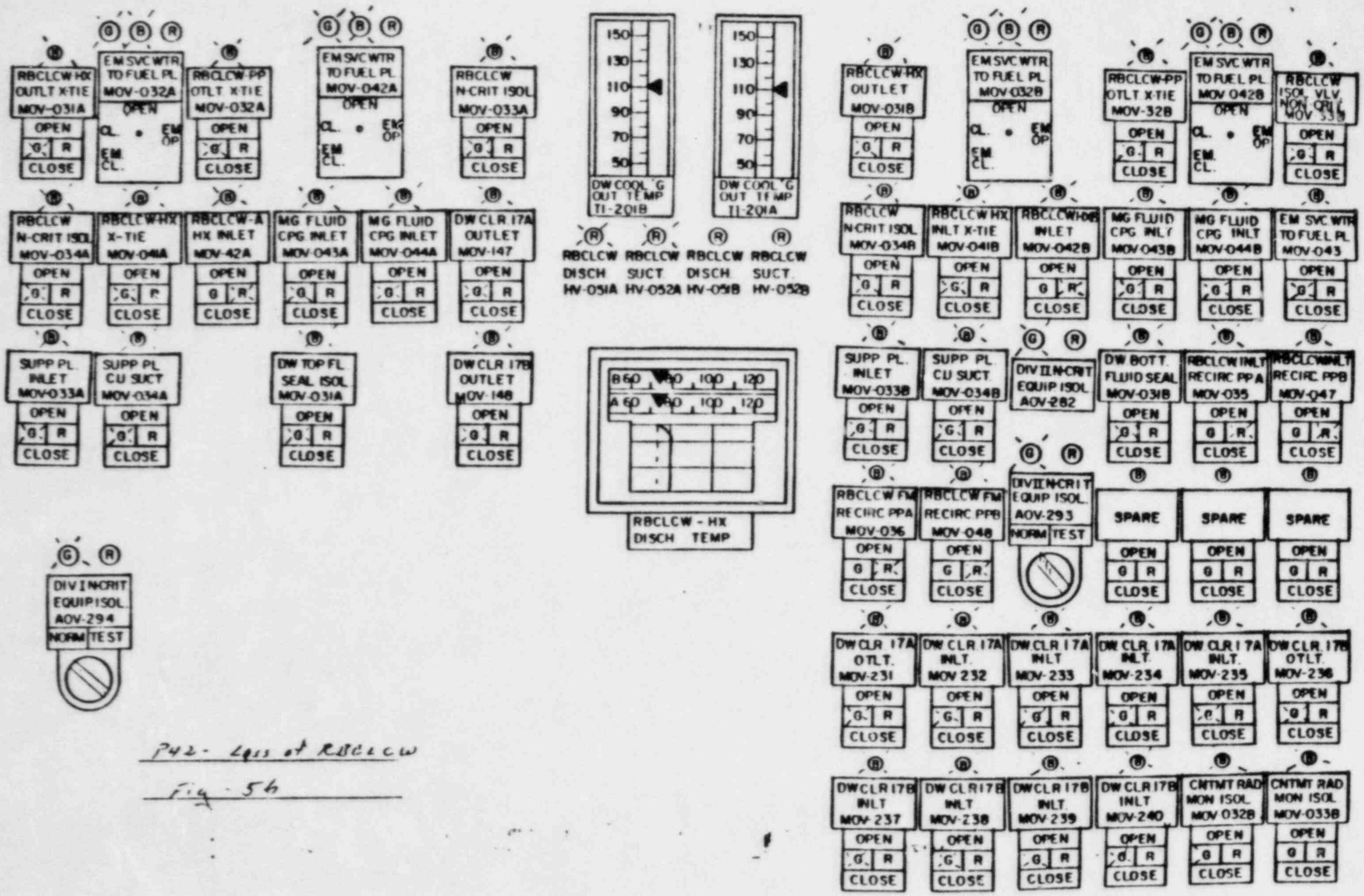
Fig. 4b

209E

	1	2	3	4	5	6	7	8	9	10
A	RSR BLE	0197 AIR CPRSR B TROUBLE	0191 AIR CPRSR C TROUBLE	0195 INSTM AIR HDR PRESS LO	0041 RBCLCW PUMP A AUTO TRIP	0056 RBCLCW PUMP C AUTO TRIP	0040 RBCLCW PUMP B AUTO TRIP	0355 SPENT FUEL STOR PL TEMP HI	0440 CNTMT HEPA FLT IN FLOW HI	0158 RB-TB SERVICE WTR ISOL VV OPEN
B	0192 AIR DRYER TROUBLE	0180 AIR CPRSR OC TRIP	0188 AIR CPRSR MTR OVLD	0187 STANDBY AIR CPRSR RUNNING	0347 RBCLCW HEAD TK A LEVEL HI/LO	0340 RBCLCW HX A TEMP HI/LO	0348 RBCLCW HEAD TK B LEVEL HI/LO	0365 SPENT FUEL STOR PL LEVEL HI/LO	0447 WASTE VV TO CANAL OPEN	0444 RB SUMPS LEVEL HI
C	0074 RB SERVICE WTR PUMP A AUTO TRIP	0205 RB SERVICE WTR PUMP C AUTO TRIP	0076 RB SERVICE WTR PUMP D AUTO TRIP	0075 RB SERVICE WTR PUMP B AUTO TRIP	0342 RBCLCW HEAD TK A LEVEL LO-LO	0341 RBCLCW HX B TEMP HI/LO	0343 RBCLCW HEAD TK B LEVEL LO-LO	0354 SPENT FUEL CLG PUMP A TROUBLE	0445 STM TO AIR EJECTOR PRESS LO	0446 YARD PPG SUMP LEVEL HI
D	0206 RB SERVICE WTR PUMP A MTR OVLD	0208 RB SERVICE WTR PUMP C MTR OVLD	0209 RB SERVICE WTR PUMP D MTR OVLD	0207 RB SERVICE WTR PUMP B MTR OVLD	0352 RBCLCW SYS A HDR PRESS LO	0407 RBCLCW VV INTERLOCK LCTL	0353 RBCLCW SYS B HDR PRESS LO	0356 SPENT FUEL CLG PUMP B TROUBLE	0438 DW FLOOR UP SEAL PRESS HI/LO	0439 DW FLOOR LWR SEAL PRESS HI/LO
E	0426 RB SERVICE WTR SYS A DEGRADED	0424 RB SERVICE WTR SYS A INOP	0427 RB SERVICE WTR SYS B DEGRADED	0425 RB SERVICE WTR SYS B INOP	0361 RBCLCW SYS A DEGRADED	0360 RBCLCW SYS A INOP	0363 RBCLCW SYS B DEGRADED	0362 RBCLCW SYS B INOP	0032 RB SERVICE WTR STR DIFF P HI	0437 TBCLCW HX BYP VV FULL OPEN/CLSD

MCB





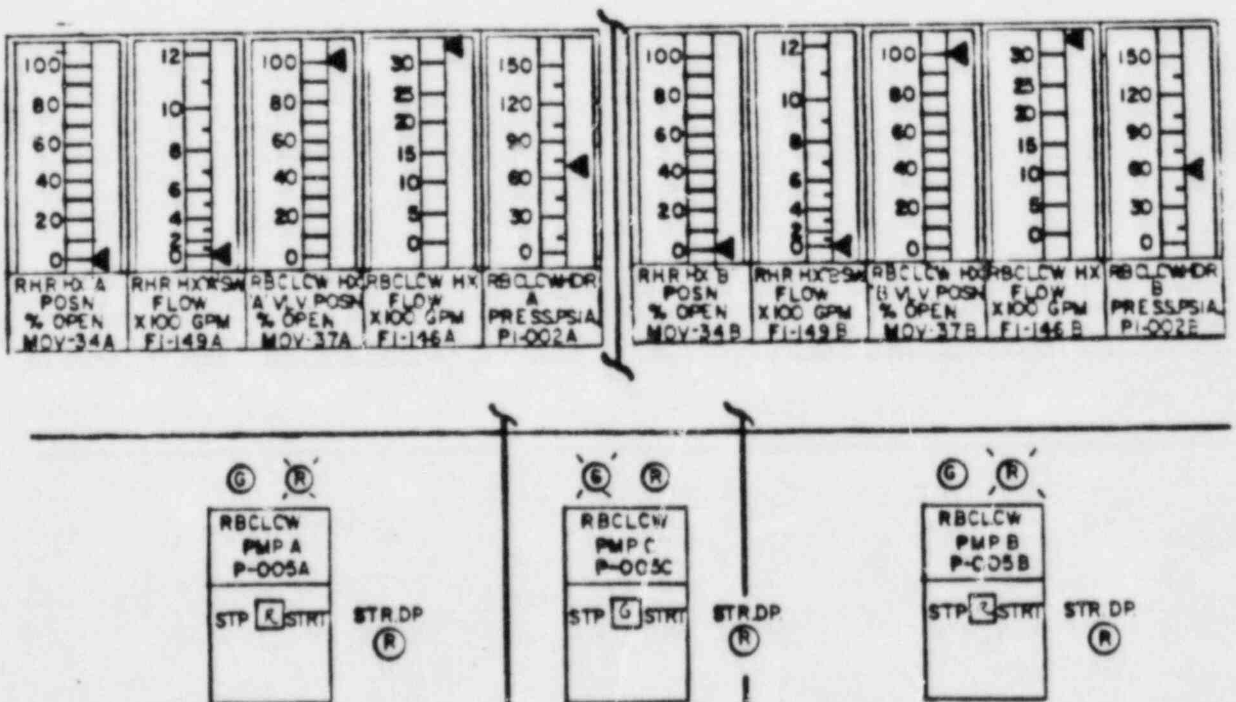
P42 - Loss of RBCLCW

Fig. 5b

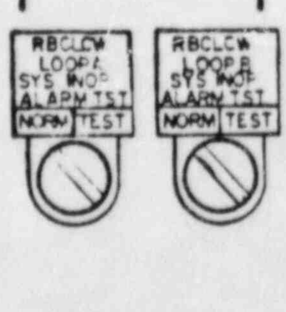
2091

RSR FLE	0192 AIR CPRSR B TROUBLE	0191 AIR CPRSR C TROUBLE	0195 INSTM AIR HDR PRESS LO	0041 RBCLCW PUMP A AUTO TRIP	0056 RBCLCW PUMP C AUTO TRIP	0040 RBCLCW PUMP B AUTO TRIP	0355 SPENT FUEL STOR PL TEMP HI	0440 CNTMT HEPA FLT IN FLOW HI	0158 RB-TB SERVICE WTR ISOL VV OPEN
0192 AIR DRYER TROUBLE	0180 AIR CPRSR OC TRIP	0188 AIR CPRSR MTR OVLD	0187 STANDBY AIR CPRSR RUNNING	0347 RBCLCW HEAD TK A LEVEL HI/LO	0340 RBCLCW HX A TEMP HI/LO	0348 RBCLCW HEAD TK B LEVEL HI/LO	0365 SPENT FUEL STOR PL LEVEL HI/LO	0447 WASTE VV TO CANAL OPEN	0444 RB SUMPS LEVEL HI
0074 RB SERVICE WTR PUMP A AUTO TRIP	0205 RB SERVICE WTR PUMP C AUTO TRIP	0076 RB SERVICE WTR PUMP D AUTO TRIP	0075 RB SERVICE WTR PUMP B AUTO TRIP	0342 RBCLCW HEAD TK A LEVEL LO-LO	0341 RBCLCW HX B TEMP HI/LO	0343 RBCLCW HEAD TK B LEVEL LO-LO	0354 SPENT FUEL CLG PUMP A TROUBLE	0445 STM TO AIR EJECTOR PRESS LO	0446 YARD PPG SUMP LEVEL HI
0206 RB SERVICE WTR PUMP A MTR OVLD	0208 RB SERVICE WTR PUMP C MTR OVLD	0209 RB SERVICE WTR PUMP D MTR OVLD	0207 RB SERVICE WTR PUMP B MTR OVLD	0352 RBCLCW SYS A HDR PRESS LO	0407 RBCLCW VV INTERLOCK LCTL	0353 RBCLCW SYS B HDR PRESS LO	0356 SPENT FUEL CLG PUMP B TROUBLE	0438 DW FLOOR UP SEAL PRESS HI/LO	0439 DW FLOOR LWR SEAL PRESS HI/LO
0426 RB SERVICE WTR SYS A DEGRADED	0424 RB SERVICE WTR SYS A INOP	0427 RB SERVICE WTR SYS B DEGRADED	0425 RB SERVICE WTR SYS B INOP	0361 RBCLCW SYS A DEGRADED	0360 RBCLCW SYS A INOP	0363 RBCLCW SYS B DEGRADED	0362 RBCLCW SYS B INOP	0032 RB SERVICE WTR STR DIFF P HI	0437 TBCLCW HX BYP VV FULL OPEN/CLSD
1	2	3	4	5	6	7	8	9	10

MCB

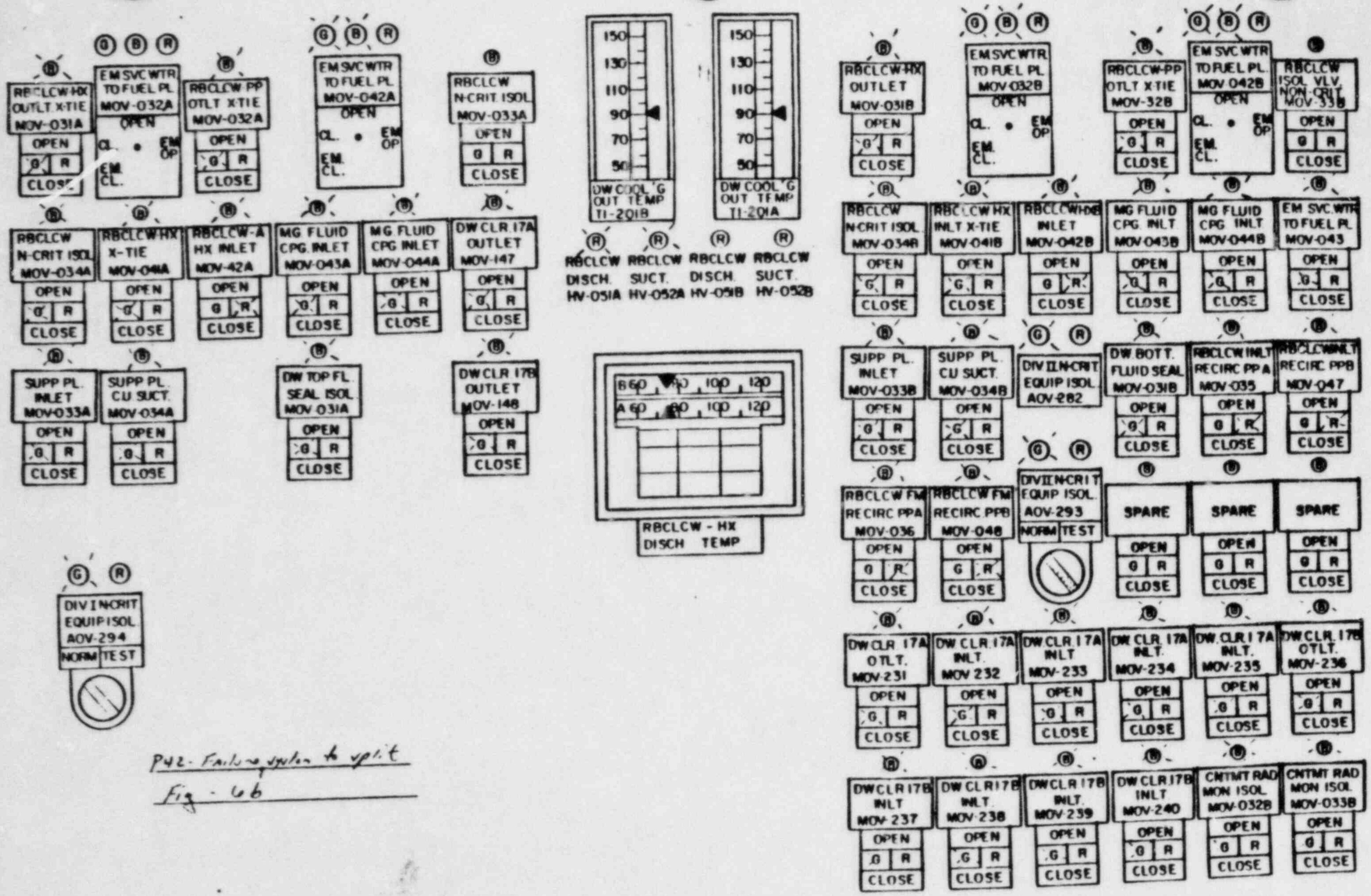


Rx Water Level -140"



PH2 · Failure system to ...

Fig - 6a



P42- Failure system to split

Fig - 6b

INFORMATION COPY

RESIDUAL HEAT REMOVAL
STUDENT HANDOUT

Date: 2/28/84

Handout #: HL121

Revision #: 0

Prepared by: Christopher [illegible] 2/28/84
~~Training~~ Instructor / Date

Reviewed by: W. J. Chittenden 2/28/84
Operations Training Specialist / Date

Approved by: Marcelin R. Pechin Jr. 3/7/84
Training Supervisor / Date

I OBJECTIVES:

The student shall be able to:

A. State the purpose of the RHR system.

B. State the purpose of each mode of the RHR system.

C. Given a diagram of the RHR system, be able to trace out the flow path for:

1. Standby
2. Suppression Pool Cooling
3. Containment Spray
4. Steam Condensing
5. Shutdown Cooling
6. Fuel Pool Cooling Assist
7. Test

D. Given any of the precautions, cautions, or limitations contained in SP23.121.01:

1. State the purpose
2. State how the operator can identify from control indications that the limit is being approached and/or exceeded.

E. Given control room indications and/or annunciators associated with the RHR system, identify and initiate corrective actions for condition which require use of the following Abnormal and Emergency procedures.

1. SP23.121.01 Steam Supply Isolation
2. SP23.121.01 Heat Exchanger Trouble
3. SP23.121.01 Leak Detection and Isolation
4. SP23.121.01 Ops of "A" RHR Sys From RSP with Single Failure of Bus 102.

F. Given SP23.121.01, be able to correctly operate the RHR system in the following modes:

1. Suppression Pool Cooling
2. Containment Spray
3. Steam Condensing
4. Shutdown Cooling

5. Fuel Pool Cooling Assist

6. Test

G. Given the mode of operation of the RHR system, state any operat~~ion~~or actions for RHR required upon receipt of an LOCA signal (1.69 psig drywell and/or -132.5" RPV level).

H. Given various plant conditions and/or indicators, determine which mode of RHR is required.

I. Given appropriate RHR system parameters, be able to identify a leaking RHR heat exchanger and/or valves.

J. Given an annunciator(s), be able to verify its validity from available control room indications.

K. Using associated RHR Alarm Response Procedures, and selected plant parameter, diagnose cause for alarm and initiate corrective action.

L. Given control room indications, immediately after a RHR pump start, identify a no flow condition.

M. State how *MOV-036A(B) can be verified to be approximately 10% open.

II PURPOSE:

The purpose of the Residual Heat Removal System is to remove post power operational energy from the reactor under both operational and accident conditions.

III SYSTEM DESIGN:

A. GENERAL DESCRIPTION

1. Process Flow Path (Figure 121-1)

The Residual Heat Removal (RHR) system consists of two redundant loops, either of which contains the necessary equipment to enable each loop to provide most of the functions required of the RHR system. Each loop contains two suction strainers, two pumps, a heat exchanger, and a drywell spray header. The two loops are interconnected by a normally closed and de-energized Cross Header Shutoff valve which joins the loop's discharge piping. The RHR system can be operated in seven (7) basic modes:

a. Low Pressure Coolant Injection - (LPCI) (Figure 121-2)

(see LPCI (204) Lesson Plan).

b. Containment Spray (Figure 121-3)

(see LPCI (204) Lesson Plan).

c. Suppression Pool Cooling (Figure 121-4)

The Suppression Pool Cooling mode is used to cool the Suppression Pool following RCIC, HPCI, or S/RV operation to ensure the suppression pool's primary role as a quenching agent during a LOCA condition is not limited.

Suppression pool cooling mode limits the suppression pool water temperature by using the RHR pumps and heat exchangers in a closed loop with the suppression pool. One or both loops can be utilized in this mode.

d. Steam Condensing (Figure 121-5)

During conditions with the Rx shutdown and isolated from the main condenser, the steam condensing mode maintain the reactor vessel at or close to operating pressure and temperature.

HPCI steam supply line supplies steam to the RHR heat exchangers through Pressure Control Valve. The steam is condensed in the heat exchanger via Service Water and is then directed to the RCIC pump which returns water to the reactor pressure vessel. One heat exchanger operating as a steam condenser has sufficiant heat transfer capacity to handle the reactor decay heat after $\approx$1½ hours of operation.

e. Shutdown Cooling (Figure 121-6)

Utilized to remove the residual, sensible and decay heat from the reactor when vessel pressure decreases to less than 125 psig. This mode can reduce the reactor vessel pressure to 125°F within 20 hours after reactor shutdown and maintains or reduces reactor temperature as desired.

The RHR pumps take a suction from the recirculation loop and pump reactor coolant through the heat exchangers. The cooled reactor water is returned to the vessel via the reactor recirculation system piping. Some flow may be diverted to the reactor head for condensing the system in the upper portion of the vessel. This ensures that the water level in the reactor vessel can rise without temperature stratification in the vessel.

f. Fuel Pool Cooling (Figure 121-7)

If large quantities of fuel are to be removed from the fuel pool the decay heat generated would be greater than the heat removal capacity of the fuel pool cooling system.

The RHR system may be aligned to supplement the fuel pool cooling system by closing the "A" loop suppression pool suction valve, manually valving in suction from fuel pool to RHR pump and heat exchanger, and return to fuel pool via a manual isolation valve.

g. Test Mode (Figure 121-4)

The Test mode of RHR is utilized to test the LPCI mode of operation. Each loop is equipped with a test line capable of rated LPCI flow.

The test mode taken suction from the suppression pool to its respective RHR pumps and heat exchanger bypass valve, and returns to the suppression pool via a 100% capacity test return line.

B. COMPONENT DESCRIPTION

1. The RHR Pumps, located in the Rx Bldg at elevation 8', are supplied power from 4160V DIV I- "A" RHR, 4160V DIV II- "B" RHR, 4160V DIV III- "C"+"D" RHR pumps. The motors are supplied with standard 4KV motor protection relaying. The RHR pumps are rated at 10,000 gpm each against Ø psig reactor pressure. Each pair of pumps must deliver 15.400 gpm against 20 psi reactor pressure. Pump sealing is provided by a mechanical seal which uses injection water from the RHR pump discharge. The injection water must first pass through a cyclone seperator to remove impurities and then is cooled in a seal cooler which uses RBCLCW as its cooling medium and finally to the mechanical seal of the pumps. High temperature for extended periods of time can cause accelerated degredation of the mechanical seals.

2. The Core Sprav/RHR Loop Level Pumps, one per division, maintains ≈40 psig on the RHR pump discharge piping to assure prompt injection time and to help prevent water hammer from occurring. Electrical power is supplied to each pump by its respective Division Motor Control Center (MCC).

3. The RHR Heat Exchangers, located in the Rx Bldg at elevation 40', are vertical, inverted U-tube heat exchangers. The tube side of the heat exchanger, constructed of CuNi, uses service water to make a double pass through the heat exchanger. The shell side is for reactor water and is only single pass.

4. There are two Drywell Spargers located in the primary containment drywell. Each sparger is a 12" circular stainless steel pipe with "A" sparger supplied by A loop and "B" sparger supplied by B loop. Each sparger, located in the Rx Bldg at elevation 109'-A and 106'-B, contains nozzles pointed inward towards the reactor to give a uniform spray pattern and thereby ensure containment atmosphere mixing during containment spray mode.

5. There is one Suppression Pool Sparger, located inside the suppression chamber area at elevation 51', which can be supplied by either RHR loop. The sparger is a 5" circular stainless steel pipe, with stainless steel nozzles pointed outward from on top of the pipe spraying away from reactor. There are holes on the bottom of the sparger to permit drainage.

6. The Head Spray Nozzle, supplied [illegible] the "B" loop only, is bolted to the reactor vessel head, and is [illegible]d to condense steam bubble during a flood up of the Rx vessel. The head sprey nozzle points inward towards the center of the reactor vessel to avoid spraying the Rx vessel wall and causing thermal stress.

IV CONTROLS AND INSTRUMENTS

A. CONTROLS

The following RHR system controls are located in the control room.

1. Key Lock Switches:

   Supp. Pool Suct (*MOV-031 A-D), Hx shell inlet (*MOV-033 A,B), Hx shell outlet (*MOV-035 A,B), Cross tie hdr (*MOV-050), Cont spray outboard (*MOV-038 A,B), Test & Supp pool spray isolation (*MOV-040 A,B), H^2 recombiner supply (*MOV-057 A,B).

2. The Manual Isolation Valves (HV-071 A (B)), located in the drywell, have position indication available in the control room.

3. The Testable Check Valve and Motor Operated Bypass Valve AOV-081 A (B) has a five position switch; Test - EM. close - close - open - EM. open. In the Test position, the motor operated bypass valve opens and the AOV actuator solenoid energizes to admit air to operate the actuator. The air actuator position is indicated in the Control Room (red - open, green - closed). Actuator movement during test proves freedom of movement of check valve operating shaft. The EM. close - close - open - and EM. open positions only affect motor operated bypass valve, not AOV air actuator. If a low RPV level (+12.5") is sensed when the motor operated bypass valve will be given a close signal and the air actuator will reposition to the close position.

4. RHR Switches

   a. Manual initiation A&B Cutler - Hammer armed pushbuttons (Loop A&B) which has a pushbutton collar which must be rotated to arm the switch, and once the pushbutton is armed, depressing the switch will result in loop initiation.

   b. Initiation reset A&B pushbuttons (loop A&B) allows operator to return system to standby status.

   c. RHR System I (II) Inop which causes a RHR System I (II) inoperative alarm when placed in INOP. INOP switch used to give alarm indication of RHR logic status during logic testing.

   d. Steam condensing mode selector switches (A&B) which allows energizing of solenoid to supply air to PVC 003 A (B) and PVC 007 A (B).

B. The Following RHR system parameters are monitored in the control room on Panel 601:

1. Flow

   a. Loop A(B) Flow Indicators and Recorders

   b. Head Spray Flow Indicator (B Loop)

   c. Heat Exchanger A(B) Service Water Flow Indicator.

2. Pressure

   a. RHR Loop A(B) Heat Exchanger Shell Pressure.

   b. RHR Hx Pressure Controller.

3. Level

   a. Suppression Pool Level

   b. RHR Hx Shell Level

   c. RHR Hx Shell Level Controller.

4. AMPS

   a. A, B, C, D RHR pumps

5. RHR Hx Vent Valve Position (1E11 *MOV-055A(B), 056A(B))

6. Indicating lights:

   a. Service Water pumps

   b. Ultimate cooling valves (1P41 *MOV-033 C,D)

   c. Initiation signal seal in

   d. Automatic isolation for *MOV-037

   e. Containment Spray Permissive

   f. RHR pump automatic override.

C. INTERLOCKS

1. Auto Initiation

a. Auto initiation of the RHR system will occur due to the following signals:

Signal	Identification
Coincident Hi DW pressure	+1.69 psig Drywell o Drywell sys A(B) Press Hi: ARP 1128 (9)
OR	
Coincident Lo-Lo-Lo Level. (or MANUAL pushbutton)	-132.5" RPV Water Level o RHR sys A(B) Rx Lo Level Init: ARP 1130 (1)

b. System Response

The RHR system will align itself to the LPCI injection mode from standby or other operating modes except during Fuel Pool Cooling Assist (requires manual valve alignment) and Shutdown Cooling (SHUTDOWN COOLING RESET pushbuttons must be depressed). The trip is sealed in and the following occurs:

1) Close signal to containment spray valves.

2) Open signal to injection valves *MOV-036A(B) and *MOV-037 A(B) (*MOV-037A(B) will not open until Rx pressure $<$465 psig. *MOV-036A(B) norm. open).

3) Start signal to respective EDG101 (2) and 103 and its associated Emergency Bus Loading Program.

4) RHR pumps A, B, C start 2 sec T.D.

5) RHR pump D start 7 sec T.D. (Loss of offsite power, wait for diesel to pick up bus)

6) Hx bypass valve (*MOV-034A(B)) int. open for 3 min.

7) Steam condensing mode valves interlocked closed.

8) Min. Flow VV open with RHR bkr. closed +10 sec T.D. $<$2200 gpm. Min. flow shuts $>$ 2200 gpm.

9) When RPV pressure $<$465 psig, *MOV-037A(B) opens, (MOV-036 A(B) int. open for 5 min.).

2. Auto Isolation

a. Auto isolation of the RHR system will occur due to the following signal:

Signal	Identification
o Lo level trip (12.5") 125 psig Rx Recirc suction pressure and either MOV-047 or MOV048 is open.	o Shutdown Cooling VV "white" ind. light with system in Shutdown Cooling mode.

b. System Response

The Inboard Injection Valve *MOV-037, Shutdown Cooling Suction Valves *MOV-047,048, and Head Spray Valves *MOV-053,054 will close.

3. Component Interlocks

a. Pumps A,B,C, and D

1)	Auto Start	Identification
	Initiation signal	Drywell Sys A(B) Press Hi: ARP 1128(9) RHR SYS A(B) RX LO LEVEL INIT: ARP 1130(1)
2)	Auto Trips	o PUMP MTR OVLD ANN.
	a) 4KV motor protection	o Double brilliant 'white' light
	b) Suction valve *MOV-031 not fully open and any of the following valves not fully open: Shutdown Cooling Inlet Valve (*MOV-047(8)), Shutdown Cooling Pump Suction valve *MOV-032.	o Valve position on PNL601 o RHR PUMP TRIPPED ANN.
3)	Initiation override - placing control switch to stop with initiation signal present.	o Pump Stop Signal SEAL - IN ('white' light)

b.	Shutdown Cooling Suction Valves (*MOV-032 A-D): will not open unless Suppression Pool Suction and Test Line Isolation vlv (*MOV-040A(B)) to that loop are closed. (Prevents draining the Rx vessel to the Suppression Pool).	o Valve position on *PNL-601

c.	RHR Heat Exchanger Bypass Valve (*MOV-034A(B))	o DRYWELL SYS A(B) PRESS HI: ARP 1128(9)
	1) Auto Open: on LPCI initiation signal and is interlocked open for three (3) minutes after signal received	o RHR SYS A(B) RX LO LEVEL INIT: ARP 1130(1) o Valve position on *PNL601
d.	Outboard Injection Valve (*MOV-036 A(B))	
	1) Auto Open: on LPCI initiation signal and Rx pressure $<$ 465 psig	o LPCI LOW PRESS PERMISSIVE SYS A(B): ARP 1433(4)
	2) Can be opened manually if *MOV-037 A(B) fully closed <u>or</u> Rx pressure $\leq$ 465 psig	o Valve position
	3) Close: manually with no LPCI initiation <u>or</u> after 5 min. T.D with LPCI initiation signal	o Initiation signal reset
e.	Inboard Injection Valve (*MOV-037A(B))	o LPCI LOW PRESS PERM SYS A(B): ARP 1433(4)
	1) Auto Open: Rx pressure $\leq$465 psig <u>and</u> LPCI initiation signal present, <u>and</u> Shutdown Cooling Isolation not present (Rx level low ($<$12.5") with Rx Recirc Suction pressure ($\leq$125 psig) and both shutdown cooling valves (*MOV-047 and *MOV-048 not fully closed) and sealed in.	o Initiation signal light illuminated o Shutdown Cooling isolation light not illuminated
	2) Can be opened manually if *MOV-036A(B) fully closed or Rx pressure $\leq$ 465 psig	o Valve position

3) Auto Close: No auto open signal present and shutdown cooling isolation signal present — o Rx VESSEL LO LEVEL A(B) TRIP ARP 1191 (1207)

a) Low Rx water level ($\leq$12.5") <u>and</u> — o Rx Press ind.

b) Low Rx Recirc Suct. Press. ($\leq$125 psig), <u>and</u> — o Valve indication

c) Shutdown Cooling valves (*MOV-047 and *MOV-048) not fully closed.

NOTE: This isolation is sealed in and must be reset after any one isolation signal has cleared by depressing Shutdown Cooling *MOV-037A(B) RESET pushbutton in order for the injection valve to be able to auto open on a subsequent LPCI initiation signal.

4) Valve will manually close if no auto open signal present.

I. Minimum Flow Valves (*MOV-045 A(B)) — o Valve position

1) Auto Open: with loop flow $\leq$2200 gpm, pump A or C (B or D) breaker closed after a 10 sec. T.D. — o Loop flow indication on *PNL-601

NOTE: The purpose of the 10 second time delay is to inhibit the minimum flow valve from opening during RHR pump starting in the shutdown cooling mode or fuel pool cooling assist mode. This prevents introduction of reactor water or fuel pool water into the suppression pool via the minimum flow line. During RHR pump starting in the shutdown cooling mode or fuel pool cooling assist mode, sufficient flow should be generated to send a close signal to the minimum flow valve (>2200 gpm) within 10 seconds of the pump starting. The RHR pumps are designed to operate for at least 10 seconds with no discharge flow path with no pump or motor damage resulting.

2) *MOV-045 A(B) will close with either the switch in close or the switch in auto and 2200 gpm

g. Discharge to Radwaste vlvs (*MOV-051, 052) and Heat Exchanger Shell Sample Vlvs (*AOV-061 A(B), 062 A(B))

1) Auto close: NSSSS isolation signal (+12.5")

o REAC VESSEL LO LEVEL TRIP A(B)

2) Open manually if no NSSSS isolation signal

h. The following valves will automatically close upon receipt of an LPCI initiation signal:

RCIC SUCT *MOV-043 A(B) HEAT X DRN TO SUPP POOL *MOV-044 A(B) HPCI STM SUPP. *MOV-049 HPCI STM TO RHR HX A(B) *PCV-003A(B) RCIC SUC FROM RHR HX A(B) *PCV-007A(B)

o DRYWELL SYS A(B) PRESS HI: ARP 1128(a)

o RHR SYS A(B) RX LO LEVEL INIT: ARP 1130(1)

o Valve position *PNL-601

i. The following valves will automatically close if <u>either</u> Rx Recirc Loop Suction >125 psig or Rx Level < 12.5": SUCT FROM RECIRC *MOV-047(8) HEAD SPRAY *MOV-053(4)

o RX VESSEL LO LEVEL A(B) TRIP: ARP 1119(1207)

o Rx Pressure Ind.

o Valve position

D. ANNUNCIATORS

The following parameters are annunciated in the Main Control Room:

Annunciator	ARP#	Control Room Verification
1. RHR HX A/B DISCH COOL WTR TEMP HI	1120	1.a) 1E41-TR-100 on *PNL -614 b) P41*MOV-034 A(B) valve position.
2. RHR SYS A(B) DISCH HDR/SDC SUCT PRESS HI	1122(3)	2.a) A(B) HX SHELL PRES-sure b) *MOV-047(408) valve position

D. ANNUNCIATORS (con't)

Annunciator		ARP#	Control Room Verification
3.	RX SYS A(B) PRESS LO	1126(7)	3.a) Rx Press on PAMS *PNL-601
4.	DRYWELL SYS A(B) PRESS HI	1128(9)	4.a) PRI CNTMT HI PRESS TRIP A(B) b) Drywell Press. ind. or *PNL-602 c) Drywell Press. recorder on *PNL-PCM.
5.	RHR SYS A(B) RX LO LEVEL INIT	1130(1)	5.a) Wide Range level A(B) on PAMS recorders on *PNL-601 b) Wide Range Level ind. on *PNL-602
6.	RHR SYS A(B) MAN INIT SW ARMED	1132(3)	6.a) Arming collar rotated
7.	RHR PUMP A(B,C,D) TRIPPED	1134(5,6,7)	7.a) Green stop light illuminated b) White light 'dim' c) 'Red' Flag on control switch for pump
8.	RHR PUMP A(B,C,D) MOTOR OVLD	1138(39,40,41)	8.a) White light 'bright' b) Green indicating light. c) Red flag on control switch for pump.
9.	RHR SYS A(B) LOGIC POWER FAIL	1142(3)	9.a) Fuses F1A and F2A on *PNL-617 b) Other 125VDL ann. c) RBSVS initiation signal
10.	RX SYS A(B) LEVEL LO	1144(5)	10.a) Wide Range level A(B) on PAMS on *PNL-601 b) RCIC, HPCI Auto Start

D. ANNUNCIATORS (con't)

Annunciator	ARP#	Control Room Verification
11. RHR SYS A(B) DEGRADED	1146(54)	11.a) Blue light for thermal overload extinguished b) Position indicating lights extinguished
12. RHR SYS A(B) INOP	1147(55)	12.a) Blue light for thermal overload extinguished b) Position indicating lights extinguished c) Discharge XCONN (*MOV-050) not closed d) INJ. VLV. MAN. ISOL. (*HV-71A(B)) not full open
13. RHR SYS HX A(B) OUTLET CNDCT HI	1148(49)	13.a) Local indication
14. RHR SYS B(A) CNTMT SP VV MAN OVERLOAD	1150(1)	14.a) Override switch position on *PNL-601
15. RHR SYS A(B) IN TEST	1152(3)	15.a) Field check
16. RHR SYS COMMON VALVE TROUBLE	1370	16.a) Blue thermal overload light extinguished b) Indicating lights extinguished c) Normal alarm Cond 1, 2, or 3 (*MOV-050 elec. disabled)
17. RHR SYS CROSSTIE VV SW IN OPEN POSN.	1379	17.a) *MOV-050 Key lock switch in open pos.
18. LPCI LOW PRESS PERM. SYS A(B)	1433(4)	18.a) Rx Press A(B) on PAMS on *PNL-601 b) *MOV-037A(B) opens if LOCA signal present & no SDC isolation.

V SYSTEM PROCEDURES

A. SYSTEM PRECAUTIONS, CAUTIONS, AND/OR LIMITATIONS

1. As a part of the ECCS (LPCI Mode), conformance with Technical Specifications is required under all conditions (including Standby). Technical Specifications shall be consulted prior to rendering any part of RHR inoperable.

   a. Purpose

      Ensure minimum number of systems available for plant operating condition to cope with a design basis accident.

   b. Recognition

      Consult Tech Specs as part of SECP's

2. The Core Spray and RHR loop level system pumps should be kept in service at all times during standby status to maintain RHR discharge piping full.

   a. Purpose

      Shorten response time for injection and prevent water hammer from occurring.

   b. Recognition

      The following annunciators may be illuminated:

      1) RHR HX shell pressure

      2) LINE FILL PUMP A/B DISCH PRESS LOW (ARP 1116)

      3) LINE FILL PUMP A/B FLOW HIGH (ARP 1117)

3. In Shutdown Cooling and Fuel Pool Cooling mode, RHR flow shall be maintained greater than 2400 gpm to prevent the minimum flow valve(s) opening. Failure to do so will result in pumping reactor or fuel pool water to the suppression pool.

   a. Recognition

      1) Shutdown Cooling Suction Valves (*MOV-047,048) open, Minimum Flow Valve (*MOV-045A(B)) open, and Rx water level decreasing.

      2) Fuel Pool Supply manual valve (*HV-073) open with Minimum Flow Valve (*MOV-045A(B)) open.

4. When Shutdown Cooling, Fuel Pool Cooling or Steam Condensing modes, the CS and RHR loop level pumps shall be isolated from RHR. Failure to do so will result in and/or B loop level pumps pumping

suppression pool water into the reactor if RHR pressure becomes less than loop level pump pressure.

a. Recognition

Increasing Rx water level without any makeup water to the RPV.

5. Before initiating Steam Condensing, Fuel Pool or Shutdown Cooling modes, the RHR shall be flushed to the suppression pool and/or to Radwaste until water is of sufficient purity for RPV use.

a. Purpose

To avoid introducing impure water into the RPV and exceeding chemistry Tech Spec requirements.

b. Recognition

RHR HX A(B) OUTLET CNDCT HI annunciator clear and/or local conductivity indication within limits.

6. Heat all steam lines and the RHR heat exchanger slowly with steam traps open when entering the Steam Condensing mode.

a. Purpose

Prevent causing thermal stress to RHR component.

b. Recognition

Loud noises in RHR components if water not adequately drained when warming up steam lines.

7. Exercise care not to inadvertently spray the drywell, particularly during testing modes. Even with the RHR pumps shut down, system pressure would cause spray activation with incorrect valve alignments.

a. Purpose

To prevent damage to components in the drywell

b. Recognition

Valve position on *PNL-601.

8. When venting, filling, flushing or draining, limit and control spillage since this water is potentially radioactive.

a. Purpose

Prevent personnel and equipment contamination

b. Recognition

When operating RHR system, operator should know system is potentially radioactive.

9. Maintain suppression pool temperature in compliance with Technical Specifications in all operating modes.

a. Purpose

Ensure adequate heat sink available for the reactor coolant system energy release following a postulated rupture of the system.

b. Recognition

1) SUPP POOL TEMP HI (ARP 0467)

2) SUPP POOL TEMP HI HI (ARP 0468)

3) Temp Ind. on PNL-601

10. Manual valves to the fuel pool cooling system shall not be opened while containment integrity is required.

a. Purpose

To prevent compromising primary containment due to no automatic isolation.

b. Recognition

Field check by E.O. to ensure valves are locked closed.

11. When opening reactor Shutdown Cooling valves *MOV-047 and *MOV-048, open them one at a time and maintain close surveillance of reactor water level.

a. Purpose

Ensure Rx water level does not decrease to Rx trip setpoint (+12.5").

b. Recognition

1) REACTOR WTR LEV HI/LO (ARP 1246)

2) Rx Level Narrow Range indicator on *PNL-603.

12. If a RHR pump suppression pool suction valve is opened while that loop is in Shutdown Cooling Mode, a rapid Rx water level decrease will occur - until the NSSSS interlock shuts *MOV-047 and 048, at+12.5 inches reactor water level.

a. Purpose

Prevent draining Rx vessel to the Suppression pool.

b. Recognition

1) REAC VESSEL LO LEVEL TRIP B(A) (ARP 1191, 1207)

2) Rx Water Level Narrow Range ind on *PNL-603

13. Do not allow steam and water to be simultaneously admitted to the shell side of the RHR heat exchanger.

a. Purpose

Prevent water hammer from occurring which could damage components.

b. Recognition

1) RHR Heat Exchanger Inlet and/or Outlet valve open with PCV-003 controlling steam pressure to Hx as indicated on *PNL-601.

2) SP 23.121.01 procedure

3) Valve lineup

14. If the Steam Condensing mode is inadvertantly isolated, be prepared to immediately and intermittently actuate a relief valve to maintain reactor pressure nearly constant.

a. Purpose

To prevent a pressure transient on Rx plant.

b. Recognition

1) Valve position on *PNL-601

2) Rx pressure increases as indicated on PAMS recorders 'A', 'B' on *PNL-601.

15. Maintain constant surveillance of reactor water level, heat exchanger water level, and RCIC inlet pressure in the Steam Condensing mode.

a. Purpose

To maintain parameters within their normal operating ranges.

b. Recognition

1) REACTOR WTR LEVEL HI/LO (ARP 1246)

2) Rx Wtr Level Wide Range recorder 'A', 'B' on PAMS on *PNL-601

3) Heat Exchanger Level ind on *PNL-601

4) RCIC pump Suction Pressure ind. on *PNL-602

B. NORMAL OPERATION

1. The Residual Heat Removal system is in Standby during operating conditions 1, 2, and 3 with two pumps and one heat exchanger per loop and a flow path as previously described. In this standby mode of operation the RHR system is lined up in anticipation of Low Pressure Coolant Injection actuation.

2. Suppression Pool Cooling mode (Figure 7) of RHR is used during RCIC, HPIC, or safety/relief valve operation, following a LOCA, or during steam condensing mode (heat build-up from RCIC exhaust). The 'A' RHR loop is the preferred loop for this function since it can more readily be "lined up" to reject water to Radwaste. Established Service Water flow thru the selected RHR loop Heat Exchanger, close the loop's injection valve and heat exchanger by pass, and open Supp. Pool Cooling and Spray Shutoff valve. Start a RHR pump in the selected loop and open Supp. Pool Inlet throttle valve. Cooldown rate is established by throttling the heat exchanger bypass valve. If LPCI initiation occurs, the system will automatically line up for LPCI and inject.

3. Shutdown Cooling mode (Figure 9) of RHR is used to remove decay heat from the reactor in the shutdown condition with reactor pressure $<$ 109 psig. Shutdown Cooling can be put into service when Rx recirc suction pressure decreases $<$ 125 psig and no LPIC initiation signal present. The 'B' RHR loop shall normally be used since the 'A' loop can then be simultaneously used to cool and/or reject water from the Suppression Pool. A Rx Recirculation pump in the opposite loop should be left running for even mixing. Lineup a suction flow path from the 'B' recirc loop while carefully monitoring RPV level. Throttle Injection Valve 10% open and start a RHR pump in the selection loop. Note: The Operator must establish $>$ 2400 gpm flow to the RPV within 10 seconds to prevent the Minimum Flow Valve from opening and discharging water form the RPV to the Suppression Pool. Throttle the LPCI injection valve to the desired flow rate. Slowly close the Heat Exchanger Bypass Valve to establish the required cooldown rate. Use Hood Spray valve to decrease Rx pressure and maintain an even RPV cooldown rate. Do not exceed 100°F/hr nor 140°F flange-to-shell Δ T.

4. The Steam Condensing Mode (Figure 3) may be used when the reactor is isolated from the main condenser (MSIV's closed). The objective is to maintain the reactor at or close to operating pressure and temperature so if the existing problem or condition is corrected within 8 hours, the reactor can be placed on line with a minimum loss of time required to bring reactor to normal operation temperature.

a. For the first 30 minutes of operation, condensate from heat exchangers is rejected to the suppression pool to warm up the RHR system, establish heat exchanger water level, and flush the heat exchanger shell side.

b. When the conductivity is within limits, condensate is sent to the RCIC Pump suction. There are two limits on the condensate to RCIC; 140°F limit to prevent flashing in the suction of the pump, 45 psi to protect low pressure piping.

c. PCV 003 A(B) keeps steam pressure to Heat Exchanger at 200 psig.

d. PCV 007 A(B) controls heat - X level and RCIC Pump suction pressure (less than 45 psig). Varying HX level will vary the exposed heat transfer surface and thereby vary Rx pressure (9 ft. above tube sheet = 68,000 lbu/hr).

<u>Caution</u>: Heat exchangers shell side shall not exceed 400°F nor 450 psig at any time during this operational mode.

e. After 1 1/2 hours of operation, one HX can handle the load and the other HX should be used to cool the suppression pool (heat buildup from RCIC Turbine exhaust).

If a LPCI initiation signal occurs, the RHR systems will revert to the LPCI mode of operation. RCIC auto initiation will occur at $\leq$ 38" Rx water level (LPCI-132.5"). The operator shall increase RCIC flow controller to 425 gpm in AUTO. Before opening Heat Exchanger Inlet and Outlet valves, secure the Steam Condensing mode of RHR. When securing from the Steam Condensing mode, ensure RCIC Supply valve (MOV-043A(B)) closed prior to securing steam due to possibility of drawing a vacuum in the heat exchanger. Indicated by no pressure on heat exchanger pressure indicator.

5. The Fuel Pool Cooling Assist mode of RHR is used when the Rx is shutdown, and the fuel pool cooling system cannot handle the heat load (caused by full core load of fuel in the fuel pool). Indication in the control room to direct the operator to use fuel pool cooling assist are: SPENT FUEL POOL HI TEMP ann. (ARP-0355), and Spent Fuel Pool temperature indicator on MCB*01.

   a. This mode requires manual valve lineup (HV-072 and 073). This lineup renders LPCI loop A inop.

   b. 'A' loop should be used since return line taps off of loop 'A'. Crosstie header, valve MOV-050 closed.

   c. Suction from Fuel Pool Cooling Assist valve (*HV-073) to the RHR Pump and HX to RHR PP Disch to Fuel Pool Cooling valve (*HV-072).

   d. When the RHR pump is started, operator must have *HV-073 opened to pass $>$ 2400 gpm within 10 seconds to prevent draining the fuel pool to the suppression pool.

6. The Test mode (Figure 12) of RHR provides a functional test of the LPCI mode.

   a. The test consists of taking a suction from the suppression pool, through the RHR Pumps, and returning to the suppression pool through one of the two 100% capacity lines.

   b. The test can be performed during plant operation and conducted from the control room.

   c. During the test, MOV-042A or B is throttled to a position where 15,400 gpm is attained at a total pump discharge head equivalent to 20 psig reactor backpressure.

   d. If an auto initiation signal is received during the test, the system will reposition valves as necessary to auto revert to the LPCI Mode.

7. Reactor Pressure Vessel Draining mode should only be used if RWCU reject is unavailable or inadequate (pump down after refuel).

   CAUTION: Fission Product gases may be present and could be released to the Radwaste Bldg. Ventilation System.

   a. The 'A' loop should be placed in the Shutdown Cooling mode.

CAUTION: Either there must be a positive pressure in the RPV, the head removed, or adequate venting established to prevent a negative pressure in the RPV which could damage or decalibrate instrumentation.

b. Open Radwaste Drain Isolation (*MOV-051) and throttle flow with Radwaste Drain (*MOV-052) to obtain desired RPV level.

8. Suppression Pool Draining can be accomplished by first placing the 'A' loop in Suppression Pool Cooling.

   a. Drain to Radwaste via the Radwaste Drain Isolation (*MOV-051) and throttle with Radwaste Drain (*MOV-052).

   b. A very large drop in Suppression Pool Level may result in a negative pressure in the Suppression Pool. To prevent this, the Suppression Pool should be vented to the RBNVS.

C. ABNORMAL OPERATIONS

1. Heat Exchanger Trouble

The two RHR heat exchangers are supplied with Service Water form separate headers. In the event of loss of one Service Water header, the RHR loop in which the heat exchanger is affected loses its function in Shutdown Cooling, Fuel Pool Cooling Assist, Steam Condensing and Suppression Pool Cooling.

A heat exchanger tube leak of such severity as to result in off-site releases of radioactivity in excess of limits necessitates shutdown and isolation of that heat exchanger. This does not preclude operation of the LPCI or Drywell Spray modes, since flow can be bypassed through *MOV-034A(B). Radiation monitors monitor service water flow through the respective heat exchangers whenever service water is passing through their discharge lines.

   a. If a high radiation alarm occurs on the service water outlet, the operator must immediately close the HX Discharge valve (*MOV-033A(B)). This results in a Loss of Service Water.

   b. If Service Water is lost in a cooling mode of RHR, but down the loop in accordance with the station procedure.

2. Leak Detection and Isolation

   a. System leakage can be indicated by any of the following listed parameters. The leak should be located by systematically observing parameters, noting any abnormalities.

1) Heat exchangers service water side temperature in consistencies.

2) Abnormal RHR system flow for mode of operation.

3) Abnormal RHR system pressures for mode of operation.

4) Reactor water level inconsistencies for mode of operation.

5) Sump high level alarm.

6) Reactor building flooding alarm.

b. Isolate the leakage by shutting down the affected loop.

c. Systematically shut valves to isolate areas of the system found above to be possible sources of leakage.

3. Operation of the 'A' RHR System when there has been a single failure at the Remote Shutdown Panel of Bus 112

a. This procedure addresses a condition whereby the Control Room has become uninhabitable and a single failure of Bus 102 at the Remote Shutdown panel has occured.

b. The RPV will be placed in alternate shutdown cooling by taking a suction from the suppression pool with the 'A' RHR pump, discharging through the RHR Heat Exchanger, LPCI Injection Valve and returning the water to the Suppression pool via the safety relief valves.

4. Steam Supply Isolation (Steam Condensing)

a. Maintain Rx water level with RCIC.

b. Open SRV's operate HPCI as necessary to control RPV pressure.

c. Maintain heat exchanger levels to the extent possible. Do not allow sudden level changers.

d. If possible, reset steam isolation.

e. If steam supply cannot be reestablished, shutdown the Steam Condensing mode.

5. Loss of Shutdown Cooling (SP29.020.01)

a. Indicated by any of the following:

1) RHR SYS I DISCH HDR or SHUTDOWN SUCT HI PRESS

2) RHR PUMP TRIP

3) RHR HX DISCH CW HX A or B HI TEMP

4) RX Cooldown rate decreases

5) RHR loop flow indicator drops to zero.

b. The operator should immediately attempt to restore the affected shutdown cooling loop to operation.

D. EMERGENCY OPERATION

Upon receipt of a LOCA signal (High DW Pressure and/or Low Rx Water Level). RHR will invert to the LPCI mode of operation. For this discussion, we are assuming the 'B' RHR loop is in Shutdown Cooling.

1. The Shutdown Cooling mode of RHR will respond to a LOCA during shutdown cooling operations as follows: REACTOR WATER LEVEL - -132.5"

a. Assume the following RHR system lineup:

1) RHR 'B' loop in shutdown cooling with RHR Pumps 'B' and 'D' operating.

2) Suppression pool suction valves closed (MOV-031 B/D)

3) Shutdown Cooling inlet valves open (MOV-047, 048)

4) Shutdown Cooling pump suction valves open (MOV-032, B/D)

5) Heat Exchanger inlet & outlet valves open (MOV-033B, 034B)

6) Heat Exchanger Bypass valve throttled (MOV-034B)

7) Injection and Injection Isolation valves open (MOV-036B, 037B)

8) Loop 'A' in Standby condition

b. With Rx Recirc suction pressure $\angle$ 125 psig and Rx water level normal (+36"), assume the Rx water level begins to decrease due to a primary leak.

c. When Rx water level decreases to +12.5", the following will occur:

   1) Shutdown Cooling Suction valves (MOV-047, 048) Head Spray valves (MOV-053, 054), and LPCI inboard injection valves (MOV-037 A/B) close.

   2) RHR pumps B, D will trip when MOV-047 or MOV-048 comes from full open anticipating a loss of suction path.

d. When Rx level decreases to -132.5", the LPCI initiation logic is actuated.

e. This will auto start RHR Pumps A and C, but not B and D because no suction path is available (MOV-031B and D and MOV-047, 048 not full open).

f. Suppression Pool Suction valves (MOV-031 B/D) do not auto open on a LPCI Initiation signal.

g. Heat Exchanger Bypass valve (MOV-034B) will auto open and be interlocked open for 3 minutes due to the LPCI initiation signal.

h. Injection valve (MOV-036A(B)) will receive auto open signal when both the LPCI initiation signal and reactor pressure signal are present which will result in interlocking the valve open for 5 minutes.

i. RHR HX service water outlet isolation valve (1P41-MOV-034A,B) will isolate.

j. Injection isolation valves (MOV-037A,B) will not auto open due to seal in closed signal.

k. RHR Pumps A and C will be running with flow through the minimum flow valve (MOV-045A) since no injection flow path is available.

In order to complete the LPCI injection flow path for both RHR loops.

1. Suppression Pool Suction valves (MOV-031B,D) must be manually opened. When they are full open RHR pumps B and D will auto start and provide flow through the Minimum flow valve (MOV-045B).

m. In order to open the injection valves (MOV-037A,B), the low reactor level (12.5") shutdown cooling mode isolation seal in must be reset by depressing both isolation reset switches on Panel 601. The isolation signal no longer exists because the shutdown cooling inlet valves MOV-047, 048) have been closed.

n. When these pushbuttons have been depressed, the isolation signal is removed and MOV-037A and B will auto open (Rx pressure is ≤ 465 psig) to commence injection into the vessel in the LPCI mode.

2. RHR system response to a LOCA during shutdown cooling operation DRYWELL PRESSURE 1.69 psig.

a. Assume RHR Loop B in Shutdown Cooling as per previous example.

b. Rx Recirc Suction pressure < 125 psig and reactor level is normal (+36").

c. Assume drywell pressure increases to 1.69 psig

1) RHR shutdown cooling loop 'B' will remain in shutdown cooling status.

2) Bus loading program will initiate the RHR pumps in sequence.

'A', 'B', 'C' RHR pumps - 2 seconds.
'D' RHR pump - 7 seconds.

3) LPCI injection valve MOV-036 A/B and 037 A/B will receive an open signal on 1.69 drywell pressure in conjunction with reactor pressure ≤ 465 psig. (MOV-036 A/B has a 5 minute time delay sealed in).

4) RHR HX bypass valve (MOV-034 A/B) will receive an open seal in signal on 1.69 psig drywell pressure (sealed in for 3 minutes).

5) RHR HX service water outlet valve (1P41*MOV-034A/B) will isolate.

6) RHR Loop 'A' will be in the LPCI Mode and RHR Loop 'B' will remain in shutdown cooling modes.

VI SYSTEM INTERRELATIONS

A. POWER SUPPLIES

1. Pumps

a. 4160V. Bus 101 - 'A' RHR pump

b. 4160V. Bus 102 - 'B' RHR pump

c. 4160V. Bus 103 - 'C' + 'D' RHR pump

2. Motor Operated Valves

a. Most RHR valves supplied from its appropriate Divisional Motor Control Center except for some RHR valves necessary to operate in the LPCI mode. The following valves are powered from the LPCI M-G sets discussed under LPCI student handouts.

1) LPCI INJECTION TO RX VESSEL *MOV-036A(B)

2) OUTBOARD LPCI ISOLATION TO RX VESSEL *MOV-037A(B)

3) RHR PUMPS MIN FLOW *MOV-045A(B)

B. LOGIC POWER

1. 125V DC Div I - 'A' Loop Logic

2. 125V DC Div II - 'B' Loop Logic

3. 125V DC Div III - 'C' + 'D' pump breaker control

C. ADS

RHR system sends a pump discharge pressure signal permissive to ADS at 119 psig to ensure ADS does not activate until adequate low pressure ECCS pumps are available for injection.

D. RBCLCW

Supplied to RHR pump seal coolers to keep mechanical seals cool.

E. INSTRUMENT AIR

Provided to the Pressure Control Valves for use in the Steam Condensing mode.

F. SERVICE WATER

Used as the heat transfer medium for the RHR heat exchangers and also supplies ultimate cooling in the unlikely event of a sustained Loss of All A.C. when all forms of decay heat removal has been exhausted.

G. REACTOR RECIRCULATION

Rx Recirc Discharge valves receives a close signal from LPCI initiation logic. (Will close when recirr pressure decreases $<$310 psig and accident signal actuated).

H. RADWASTE

RHR system has flushing connections with Radwaste and a path from the 'A' RHR loop to drain to Radwaste.

I. NSSSS

NS^4 isolations used to close RHR valves previously mentioned under Interlocks section.

J. REMOTE SHUTDOWN PANEL

Contains controls to operated the 'B' RHR loop in the event of the Main Control Room becoming uninhabitable.

VII TECHNICAL SPECIFICATIONS

A. ECCS INSTRUMENTATION

3.3.3 The emergency core cooling system (ECCS) instrumentation channels shown in table 3.3.3-1 shall be OPERABLE with their trip setpoints set consistent with the values shown in the Trip Setpoint, column of Table 3.3.3-2 and with EMERGENCY CORE COOLING SYSTEM RESPONSE TIME as shown in Table 3.3.3-3.

APPLICABILITY: As shown in Table 3.3.3-1.

LOW PRESSURE COOLANT INJECTION MODE OF RHR SYSTEM

a.	Reactor Vessel Water Level - Low Low Low, Level 1	2(b)	1, 2, 3, 4*, 5*	30
b.	Drywell Pressure - High	2(b)	1, 2, 3	30
c.	Reactor Steam Dome Pressure - Low (Permissive)	2	1, 2, 3	31
			4*, 5*	32
d.	LPCI Pump Discharge Flow - Low (Minimum Flow)	1/pump	1, 2, 3, 4*, 5*	33
e.	Manual Initiation	1/subsystem	1, 2, 3, 4*, 5*	34

B. RESIDUAL HEAT REMOVAL (SHUTDOWN)

3.4.9.1 Two# shutdown cooling mode loops (subsystems) of the residual heat removal (RHR) system shall be OPERABLE and, unless at least one recirculation pump is in operation, at least* one shutdown cooling mode loop (subsystem) shall be in operation ## with each loop (subsystem) consisting of at least:

a. One OPERABLE RHR pump, and

b. One OPERABLE RHR heat exchanger.

APPLICABILITY: OPERATIONAL CONDITION 3, with reactor vessel pressure less than the RHR cut-in permissive setpoint.###

ACTION:

a. With less than the above required RHR shutdown cooling mode loops (subsystems) OPERABLE, immediately initiate corrective action to return the required loops (subsystems) to OPERABLE status as soon as possible. Within 1 hour and at least once per 24 hour thereafter, demonstrate the operability of at least one alternative method capable of decay heat removal for each inoperable RHR shutdown cooling mode loop** (subsystem). Be in at least COLD SHUTDOWN within 24 hours.

b. With no RHR shutdown cooling mode loop (subsystem) in operation, immediately initiate corrective action to return at least one loop (subsystem) to operation as soon as possible. Within 1 hour establish reactor coolant circulation by an alternate method and monitor reactor coolant temperature and pressure at least once per hour.

D. ECCS - OPERATING

3.5.1 The emergency core cooling systems shall be OPERABLE with:

a. The low pressure coolant injection (LPCI) system of the residual heat removal system consisting of two subsystems with each subsystem comprised of:

1. Two OPERABLE RHR pumps, and

2. An OPERABLE flow path capable of taking suction from the suppression pool and transferring the hot water to the reactor vessel.

APPLICABILITY: OPERATIONAL CONDITIONING 1, 2*, **, #, and 3*, **, ##.

*The HPCI system is not required to be OPERABLE when reactor steam dome pressure is ≤ 150 psig.

**The ADS is not required to be OPERABLE when reactor steam dome pressure is less than or equal to 113 psig.

#See Special Test Exception 3.10.6.

##One LPCI subsystem of the RHR system may be inoperable in that it is aligned in the shutdown cooling mode when reactor vessel pressure is less than the RHR cut-in permissive setpoint.

E. ECCS - SHUTDOWN

3.5.2 At least two of the following four subsystems shall be OPERABLE:

a. Two core spray subsystems (CSS) with a subsystem comprised of:

1. One OPERABLE CSS pump, and

2. An OPERABLE flow path capable of taking suction from at least one of the following water sources and transferring the water through the spray sparger to the reactor vessel:

a) From the suppression pool, or

b) When the suppression pool water level is less than the limit or is drained, from the condensate storage tank containing at least 100,000 available gallons of water, equivalant to a level of 9 feet.

b. Two low pressure coolant injection (LPCI) subsystems with a subsystem comprised of:

1. At least one OPERABLE LPCI pump, and

2. An OPERABLE flow path capable of taking suction from the suppression pool and transferring the water to the reactor vessel.

APPLICABILITY: OPERATIONAL CONDITION 4 and 5*.

*The ECCS is not required to be OPERABLE provided that the reactor vessel head is removed, the cavity is flooded, the spent fuel pool gates are removed, and water level is maintained within the limits of Specification 3.9.8 and 3.9.9.

ACTION:

a. With both of the above required subsystems inoperable, suspend CORE ALTERATIONS and all operations with a potential for draining the reactor vessel. Restore at least one subsystem to OPERABLE status within 4 hours establish SECONDARY CONTAINMENT INTEGRITY within the next 8 hours.

F. SUPPRESSION CHAMBER SPRAY

3.6.2.2 The suppression chamber spray mode of the residual heat removal (RHR) system shall be OPERABLE with two independent loops, each loop consisting of:

a. One OPERABLE RHR pump, and

b. An OPERABLE flow path capable of recirculating water from the suppressior chamber through an RHR heat exchanger and the suppression chamber spray spargers.

APPLICABILITY: OPERATIONAL CONDITIONS 1, 2, and 3.

G. SUPPRESSION POOL COOLING

3.6.2.3 The suppression pool cooling mode of the residual heat removal (RHR) system shall be OPERABLE with two independent loops, each loop consisting of:

a. One OPERABLE RHR pump, and

b. An OPERABLE flow path capable of recirculating water from the suppressior chamber through an RHR heat exchanger.

APPLICABILITY: OPERATIONAL CONDITIONS 1, 2, and 3.

VIII REFERENCES

A. System Description 1020.121

B. FSAR 6.3 Vol 8

C. Technical Specifications - Proof & Review Rev. 2

D. Drawings

1. MFSK's - 20A, 20B - Rev. 7

2. ESK's - 5E1101 thru 5E1104

6E1101 thru 6E1148

11E1101 thru 11E1103

3. GE Prints 791E418TF Sh. 1-18

E. Operating Procedures

1. 23.121.01 Rev. 6

2. 24.121.01 Rev. 4

3. 24.121.02 Rev. 3

4. 24.121.03 Rev. 4

5. 24.121.04 Rev. Ø

6. 29.020.01 Rev. 2

7. ARP's

ARP 1120 RHR HX A/B DISCH COOL WTR TEMP HI	Rev. 2
ARP 1121 RHR A/B INLET WTR TEMP HI	Rev. 2
ARP 1122 RHR SYS A DISCH HDR/SDC SUCT PRESS HI	Rev. 2
ARP 1123 RHR SYS B DISCH HDR/SDC SUCT PRESS HI	Rev. 3
ARP 1126 RX SYS A PRESS LO	Rev. 4
ARP 1127 RX SYS B PRESS LO	Rev. 4
ARP 1128 DRYWELL SYS A PRESS HI	Rev. 3
ARP 1129 DRYWELL SYS B PRESS HI	Rev. 3
ARP 1130 RHR SYS A RX LO LEVEL INIT	Rev. 2
ARP 1131 RHR SYS B RX LO LEVEL INIT	Rev. 2
ARP 1132 RHR SYS A MAN INIT SW ARMED	Rev. 1
ARP 1133 RHR SYS B MAN INIT SW ARMED	Rev. 1
ARP 1134 RHR PUMP A TRIP	Rev. 2
ARP 1135 RHR PUMP B TRIPPED	Rev. 2

ARP 1136 RHR PUMP C TRIPPED	Rev. 2
ARP 1137 RHR PUMP D TRIPPED	Rev. 2
ARP 1138 RHR PUMP A MOTOR OVLD	Rev. 2
ARP 1139 RHR PUMP B MOTOR OVLD	Rev. 2
ARP 1140 RHR PUMP C MOTOR OVLD	Rev. 2
ARP 1141 RHR PUMP D MOTOR OVLD	Rev. 2
ARP 1142 RHR SYS A LOGIC POWER FAIL	Rev. 2
ARP 1143 RHR SYS B LOGIC POWER FAIL	Rev. 2
ARP 1144 RX SYS A LEVEL LOW	Rev. 3
ARP 1145 RX SYS B LEVEL LOW	Rev. 3
ARP 1146 RHR SYS A DEGRADED	Rev. 2
ARP 1147 RHR SYS A INOP	Rev. 3
ARP 1148 RHR HX B OUTLET CNDCT HI	Rev. 2
ARP 1149 RHR HX A OUTLET CNDCT HI	Rev. 2
ARP 1150 RHR SYS B CNTMT SP VV MAN OVERRIDE	Rev. 2
ARP 1151 RHR SYS B CNTMT SP VV MAN OVERRIDE	Rev. 2
ARP 1152 RHR SYS A IN TEST	Rev. 1
ARP 1153 RHR SYS B IN TEST	Rev. 1
ARP 1154 RHR SYS B DEGRADED	Rev. 2
ARP 1155 RHR SYS B INOP	Rev. 2
ARP 1370 RHR SYSTEM COMMON VALVE TROUBLE	Rev. 1
ARP 1379 RHR SYS CROSSTIE VV SW IN OPEN POSN	Rev. 1
ARP 1433 LPCI LOW PRESS PERMISSIVE SYS A	Rev. Ø
ARP 1434 LPCI LOW PRESS PERMISSIVE SYS B	Rev. Ø

Fig 1-8
being redrawn
by draftsman

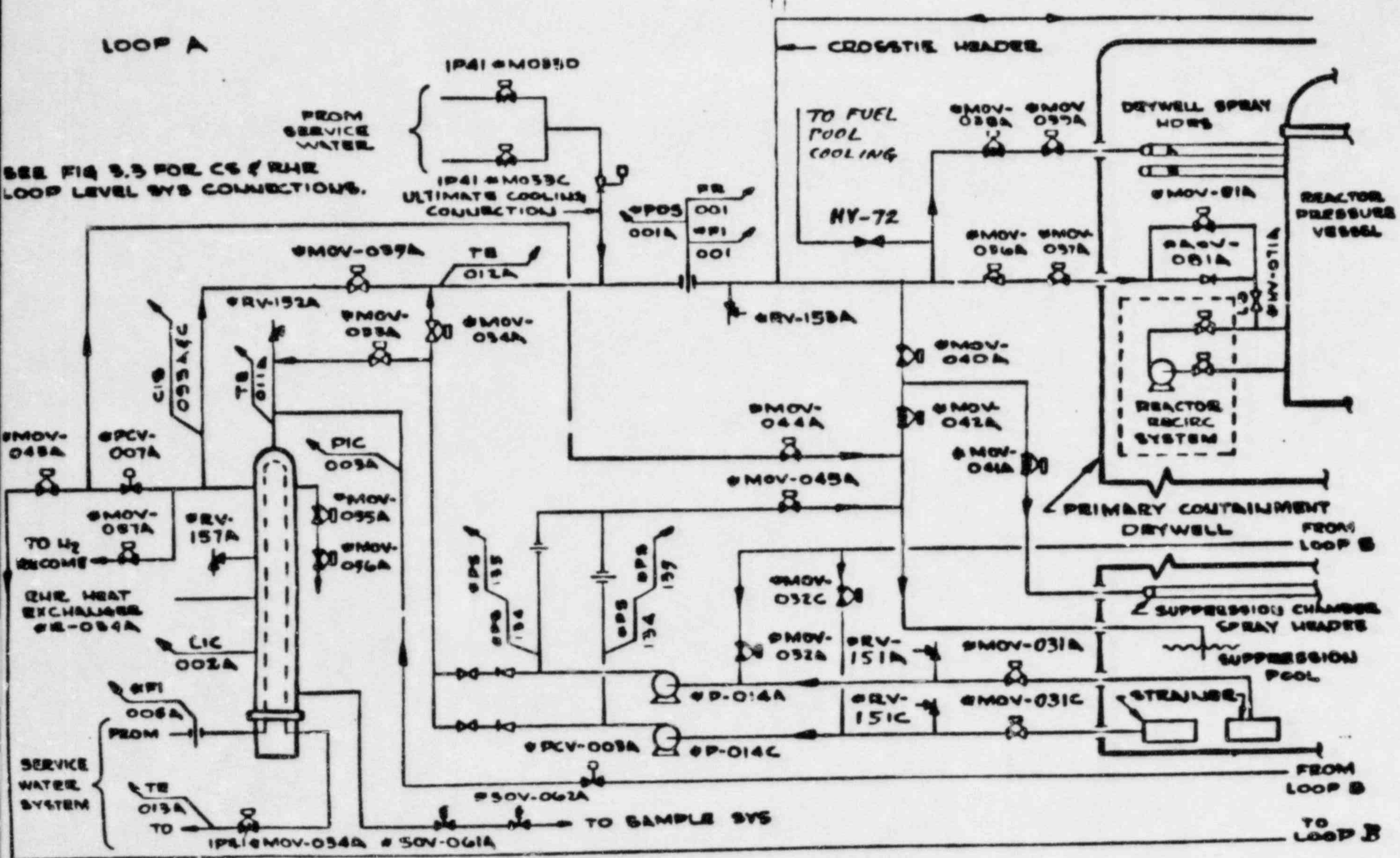
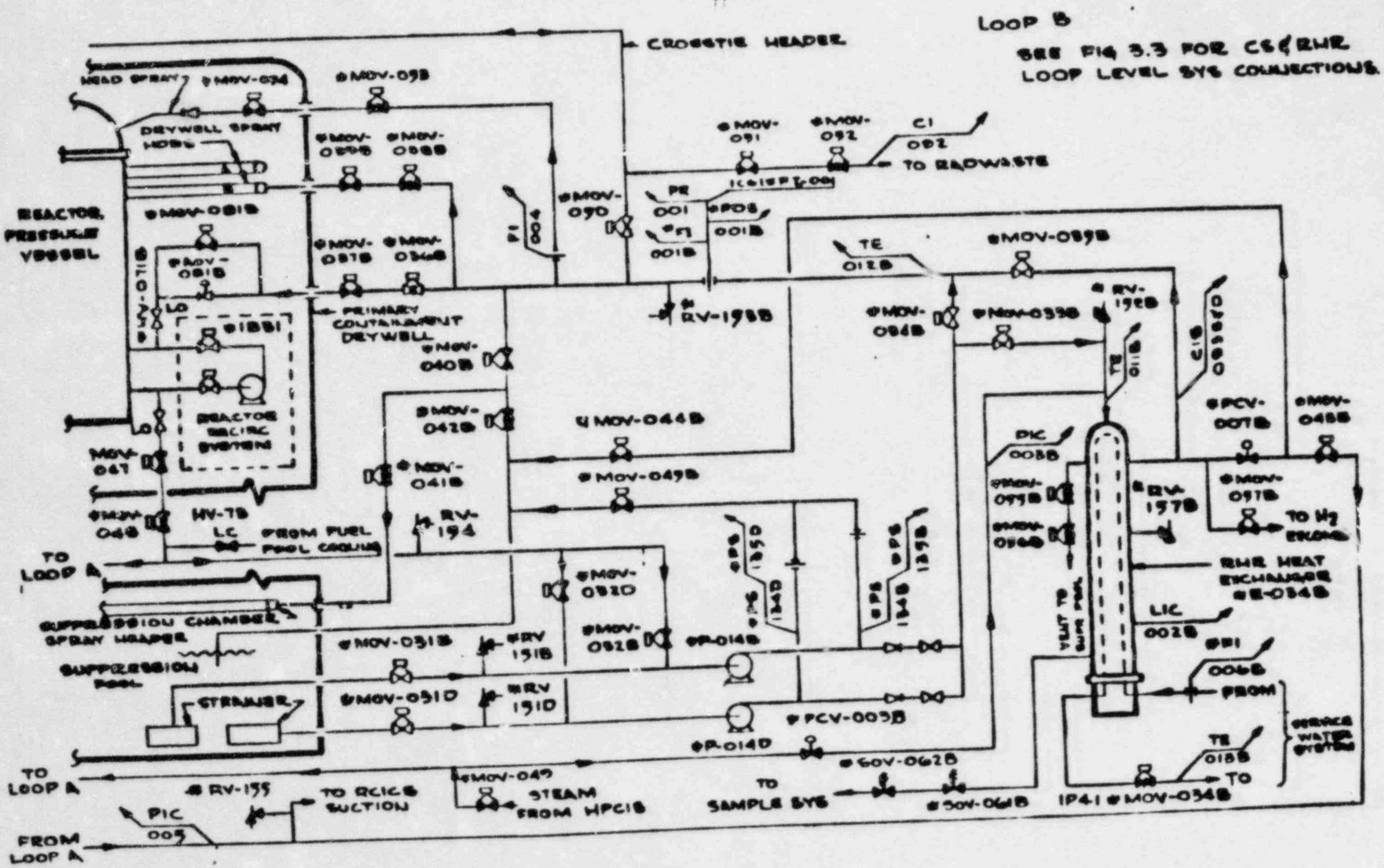
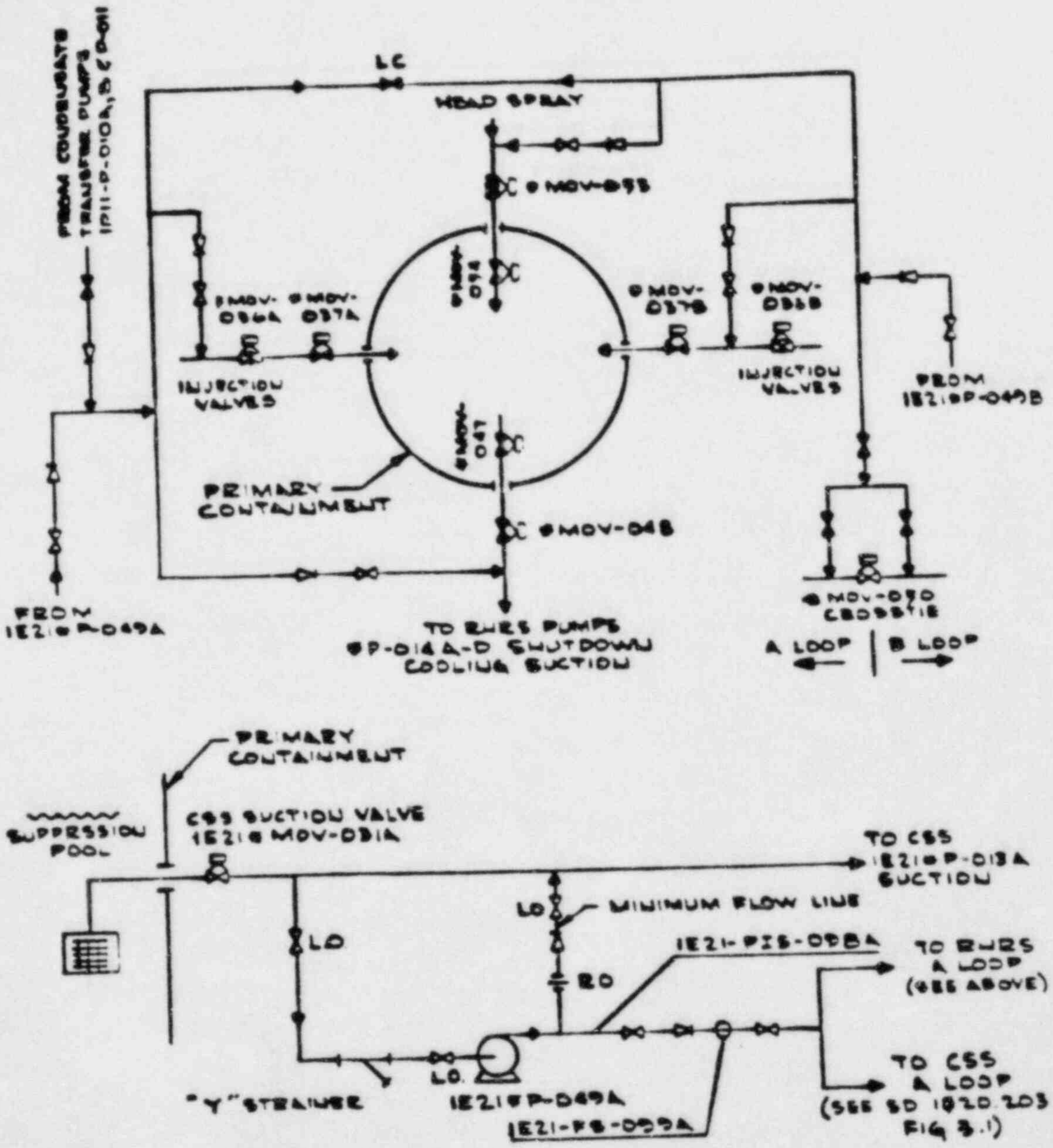

LOOP A
CROSSTIE HEADER
1P41 #M035D
FROM SERVICE WATER
1P41 #M035C
ULTIMATE COOLING CONNECTION
SEE FIG 3.3 FOR CS & RHR LOOP LEVEL SYS CONNECTIONS.
TO FUEL POOL COOLING
HY-72
#MOV-038A
#MOV 039A
DRYWELL SPRAY HDRS
#MOV-81A
REACTOR PRESSURE VESSEL
#PDS 001A
FR 001
#FI 001
#MOV-036A
#MOV-037A
#AOV-081A
#MOV-037A
TE 012A
#RV-152A
#MOV-033A
#MOV-034A
#RV-158A
#MOV-040A
REACTOR RECIRC SYSTEM
#MOV-044A
#MOV-042A
#MOV-041A
#MOV-045A
PRIMARY CONTAINMENT DRYWELL
FROM LOOP B
#MOV-048A
#PCV-007A
#MOV-057A
#RV-157A
TO H2 RECOMB
RHR HEAT EXCHANGER #E-034A
LIC 002A
PIC 003A
#MOV-035A
#MOV-036A
#MOV-032C
#MOV-032A
#RV-151A
#RV-151C
#MOV-031A
#MOV-031C
SUPPRESSION CHAMBER SPRAY HEADER
SUPPRESSION POOL
STRAINER
#P-014A
#P-014C
#PCV-003A
#FI 006A
FROM
SERVICE WATER SYSTEM
TE 013A
TO
1P41 #MOV-034A
#SOV-061A
#SOV-062A
TO SAMPLE SYS
FROM LOOP B
TO LOOP B

Figure 9


LOOP B
SEE FIG 3.3 FOR CS & RHR LOOP LEVEL SYS CONNECTIONS.
CROSSTIE HEADER
HEAD SPRAY
DRYWELL SPRAY NOZS
REACTOR PRESSURE VESSEL
PRIMARY CONTAINMENT DRYWELL
REACTOR RECIRC SYSTEM
TO RADWASTE
FROM FUEL POOL COOLING
TO LOOP A
SUPPRESSION CHAMBER SPRAY HEADER
SUPPRESSION POOL
STRAINER
TO LOOP A
TO RCIC SUCTION
STEAM FROM HPCIS
TO SAMPLE SYS
FROM LOOP A
RHR HEAT EXCHANGER
TO H2 RECOMB
SERVICE WATER SYSTEM
FROM
TO
CROSSTIE HEADER
#MOV-093
#MOV-034
#MOV-091
#MOV-092
CI 092
#MOV-090
FI 004
PR 001
#PDS 001B
#FI 001B
#MOV-081B
#AOV-081B
#MOV-031B
#MOV-034B
#MOV-040B
#MOV-042B
#MOV-041B
#MOV-044B
#MOV-049B
#RV-198B
#RV-194
LC
#MOV-032D
#MOV-032B
#MOV-031B
#MOV-031D
#RV 151B
#RV 151D
#P-014B
#P-014D
#PCV-003B
#SOV-062B
#SOV-061B
#RV-155
PIC 005
#MOV-049
TE 012B
#MOV-089B
#MOV-084B
#MOV-033B
#RV-192B
TE 011B
CI 085B
PIC 003B
#PCV-007B
#MOV-048B
#MOV-037B
#RV-157B
LIC 002B
#FI 006B
TE 018B
IP41 #MOV-034B



CS & RHR LOOP LEVEL SYSTEM

Figure 11

~~VIII~~ APPENDIX A

A. DATA SHEET

1. RHR Pump

   a. 10,000 gpm @ 0 psig

   b. 2 pumps - 15,400 gpm @ 20 psi Rx press.

   c. Shutoff head - 238 psig

2. RHR Pump Motor

   a. A - Bus 101

   b. B - Bus 102

   c. C & D - Bus 103

3. LPCI Initiation Logic

   a. Reactor Low Level -132.5"

   b. High Drywell Pressure +1.69 psig

4. Minimum Flow Valves

   a. Opens: $\leq$2200 gpm with a pump breaker closed in its loop and a 10 sec. T.D.

   b. Close: $\geq$ 2400 gpm

5. Injection Valve Permissive: $<$465 psig

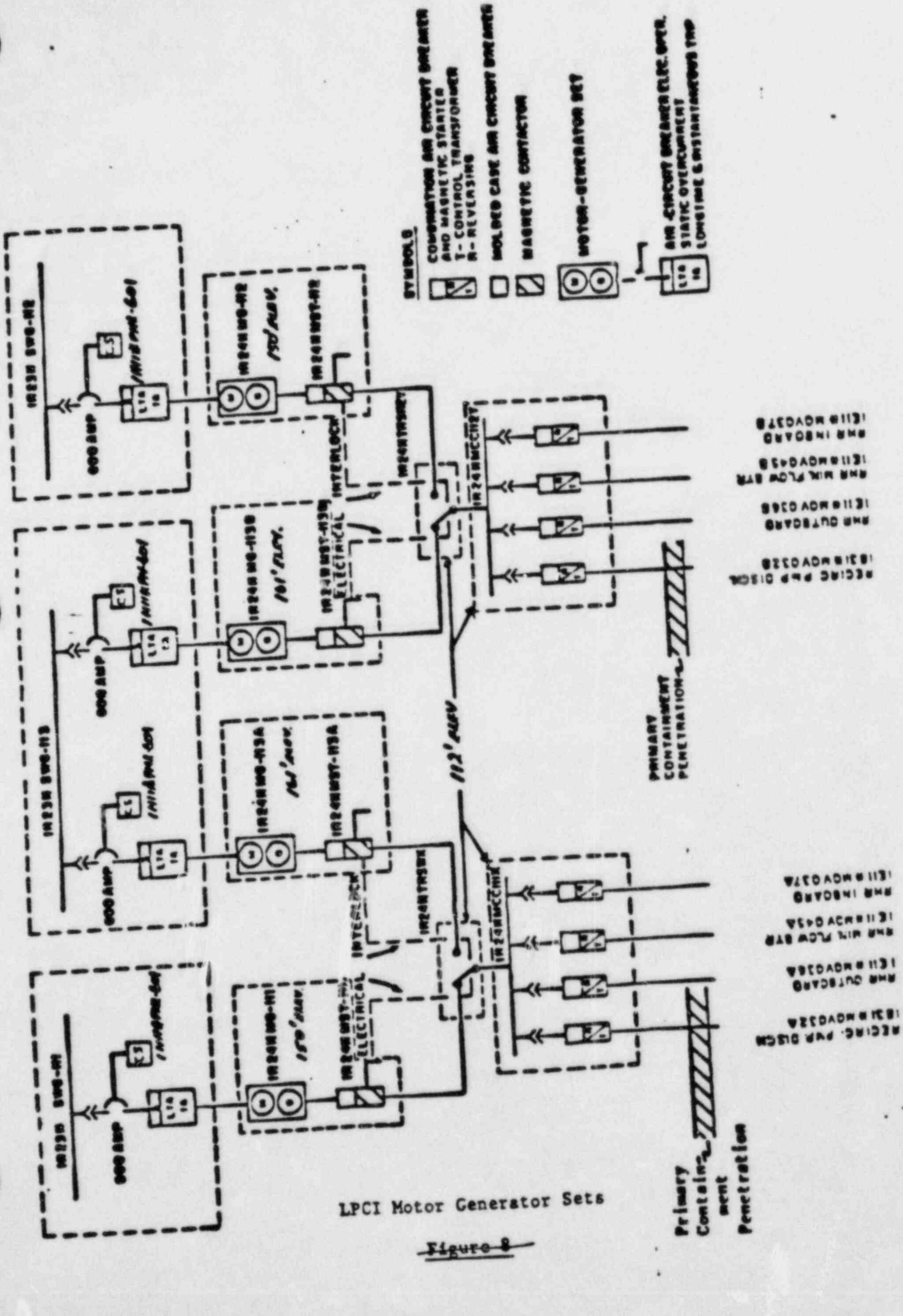
6. Permissive to ADS: 119 psig RHR discharge pressure

7. RHR Heat Exchangers

   a. tube bundle 70/30 CuNi

   b. 2 pass tube side, single pass shell side

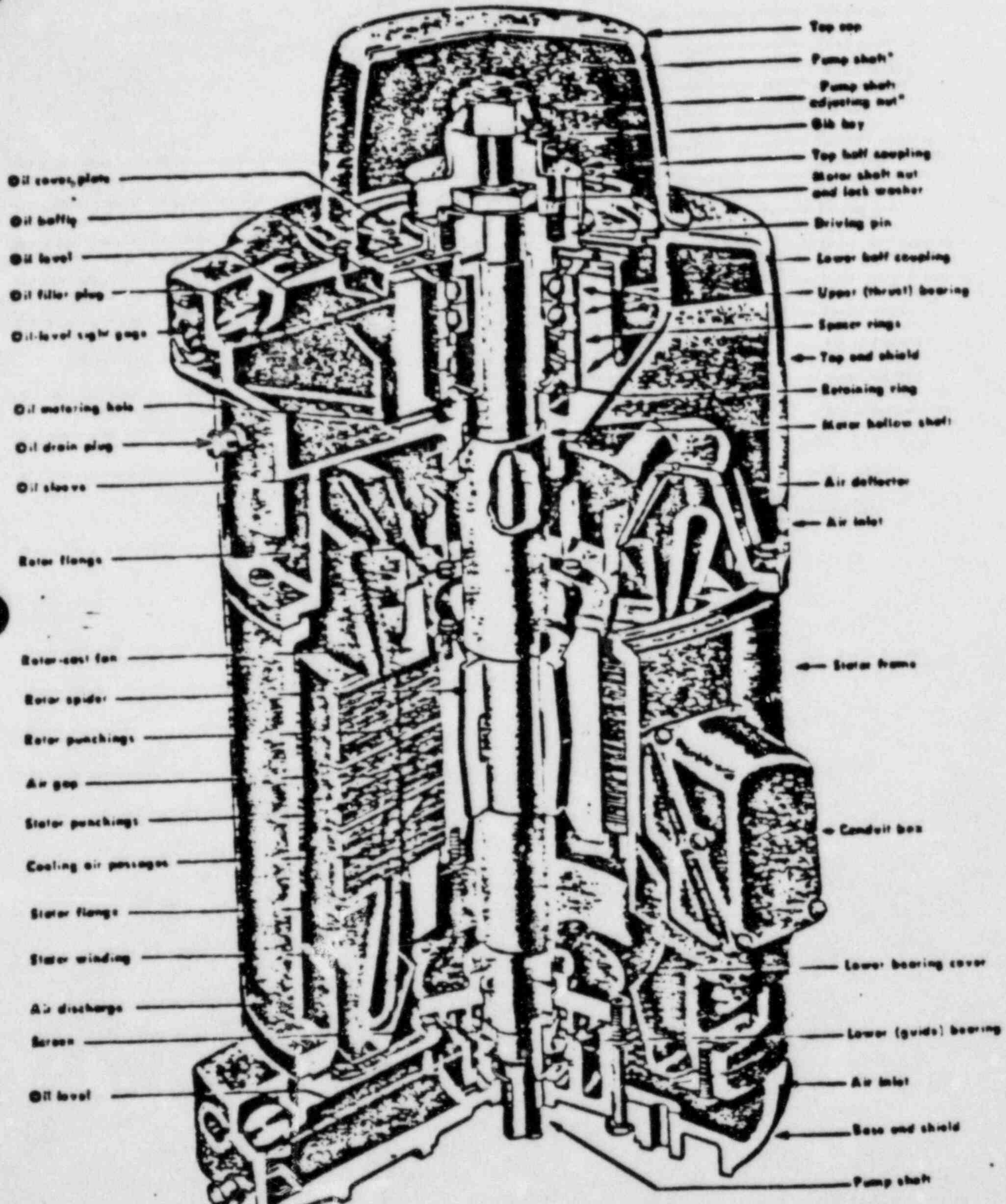
   c. 9 ft above tube sheet = 68,000 lbs/hr.



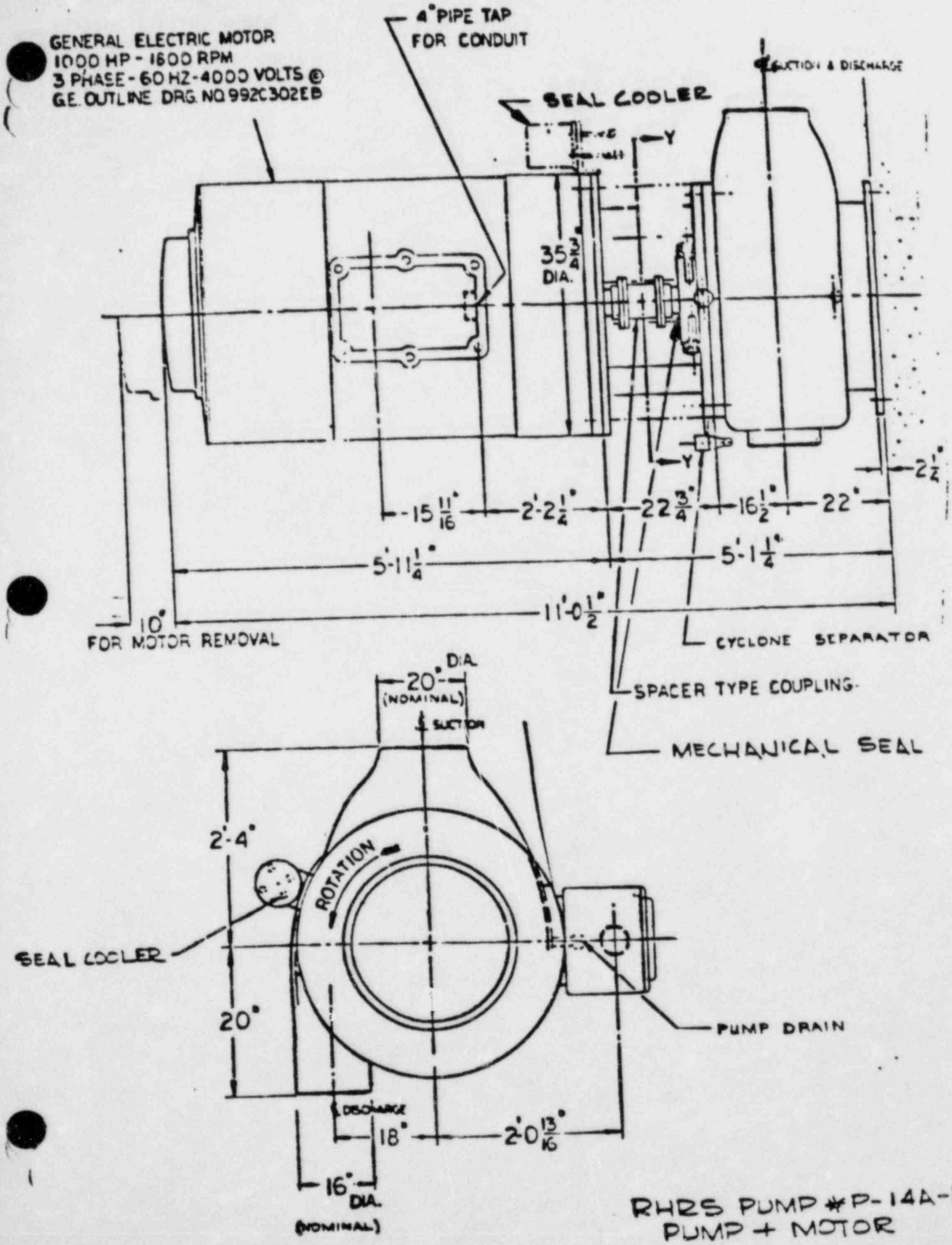
LPCI Motor Generator Sets

~~Figure 8~~

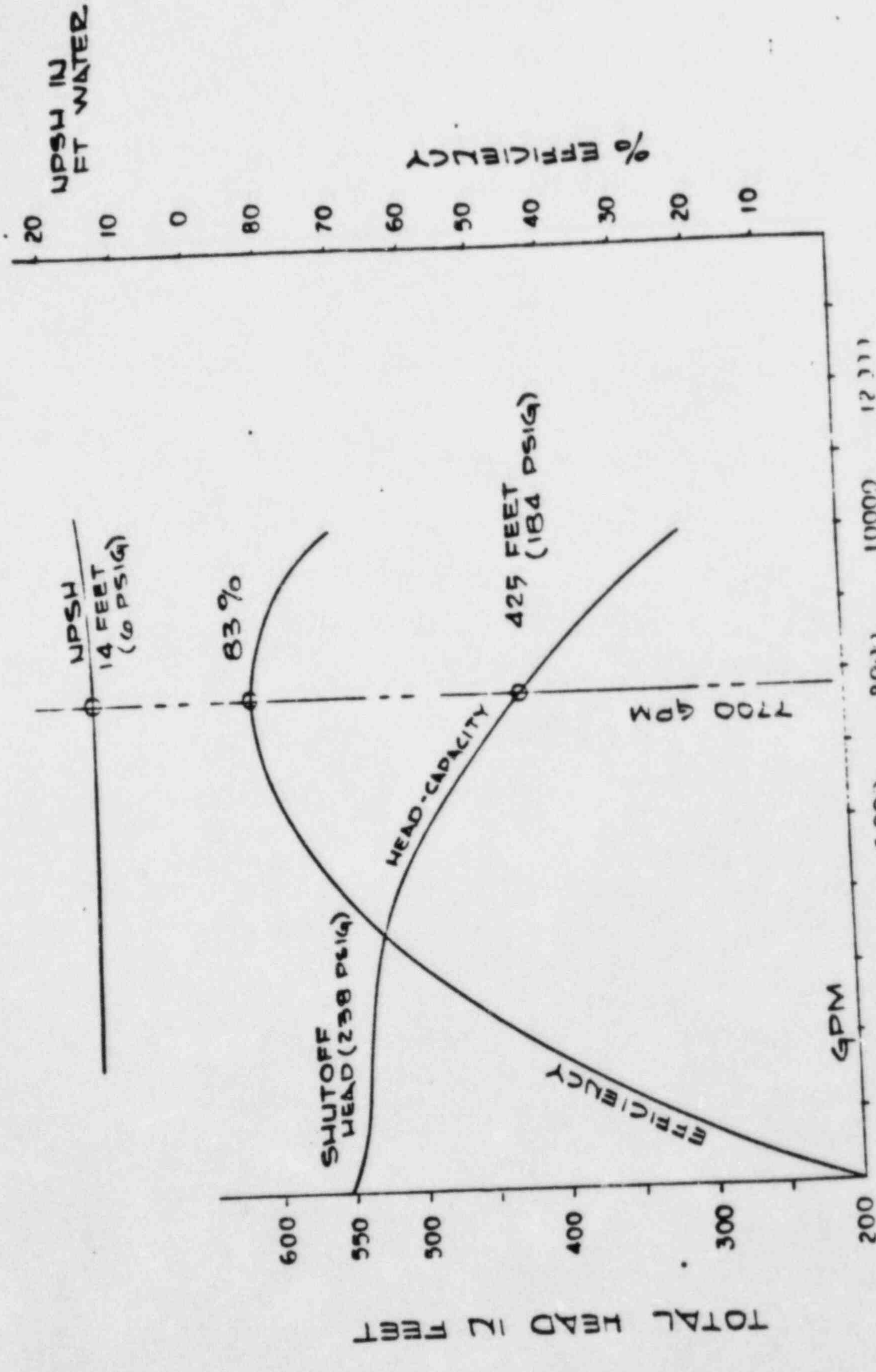
Vertical, High-thrust Polyphase Induction Motors



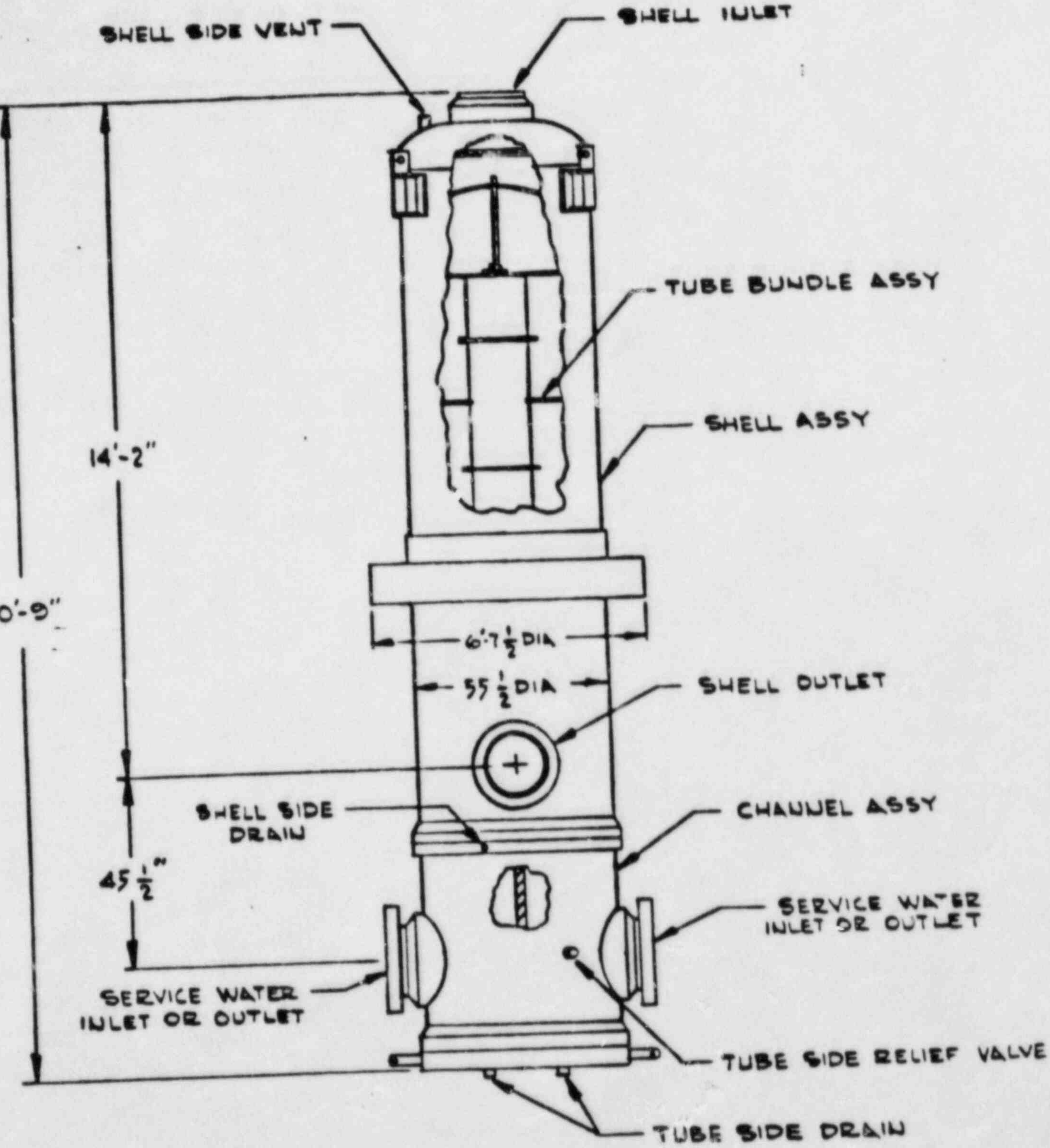
RHRS PUMP * P-14 A-D MOTOR



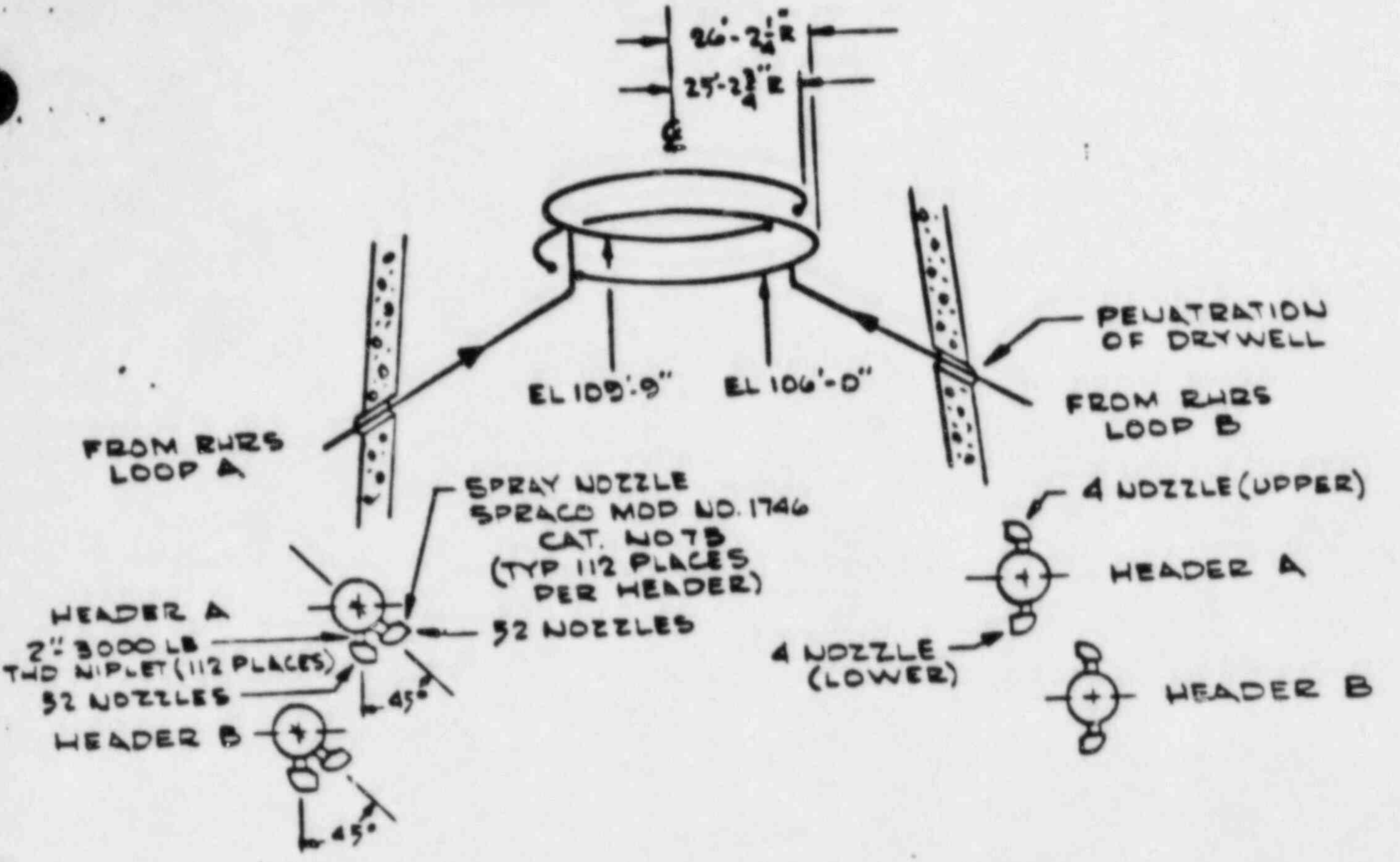
RHRS PUMP # P-14A-D
PUMP + MOTOR



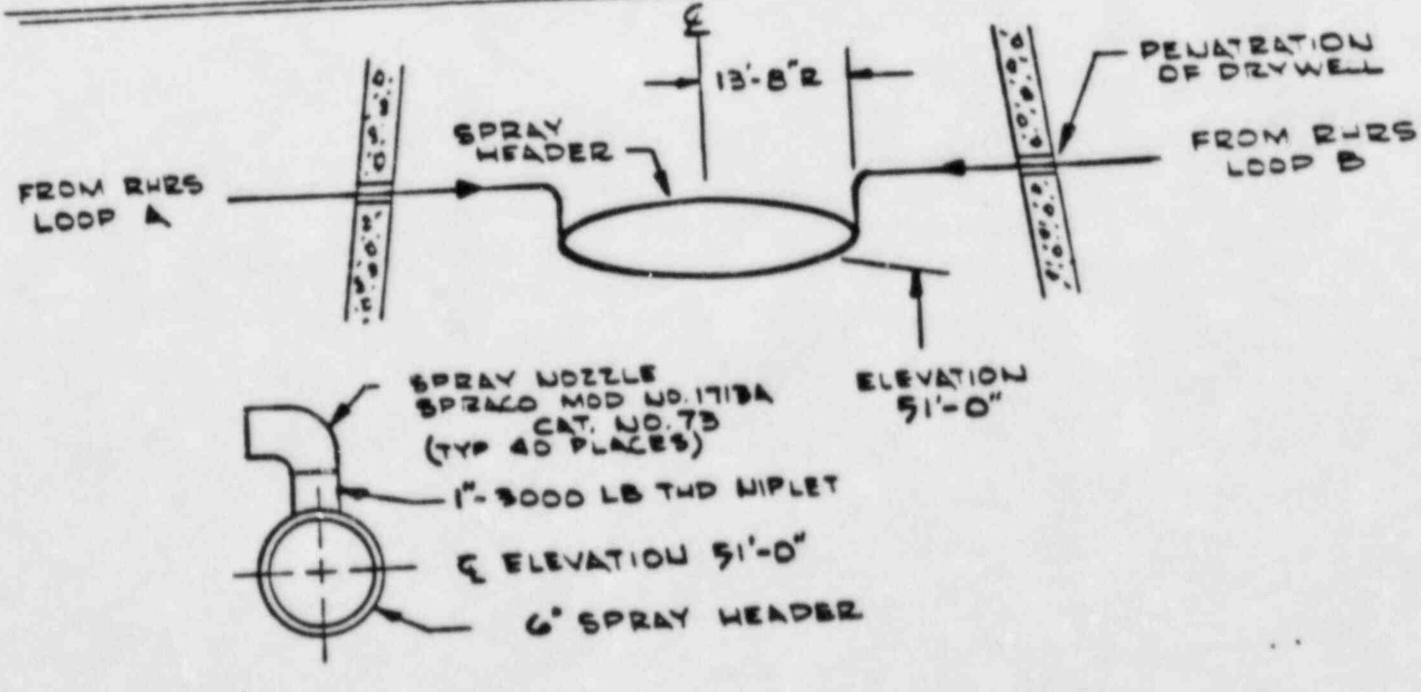
RHRS PUMP #P-14A-D CURVES



RHRS HEAT EXCHANGER
E-3B A+B

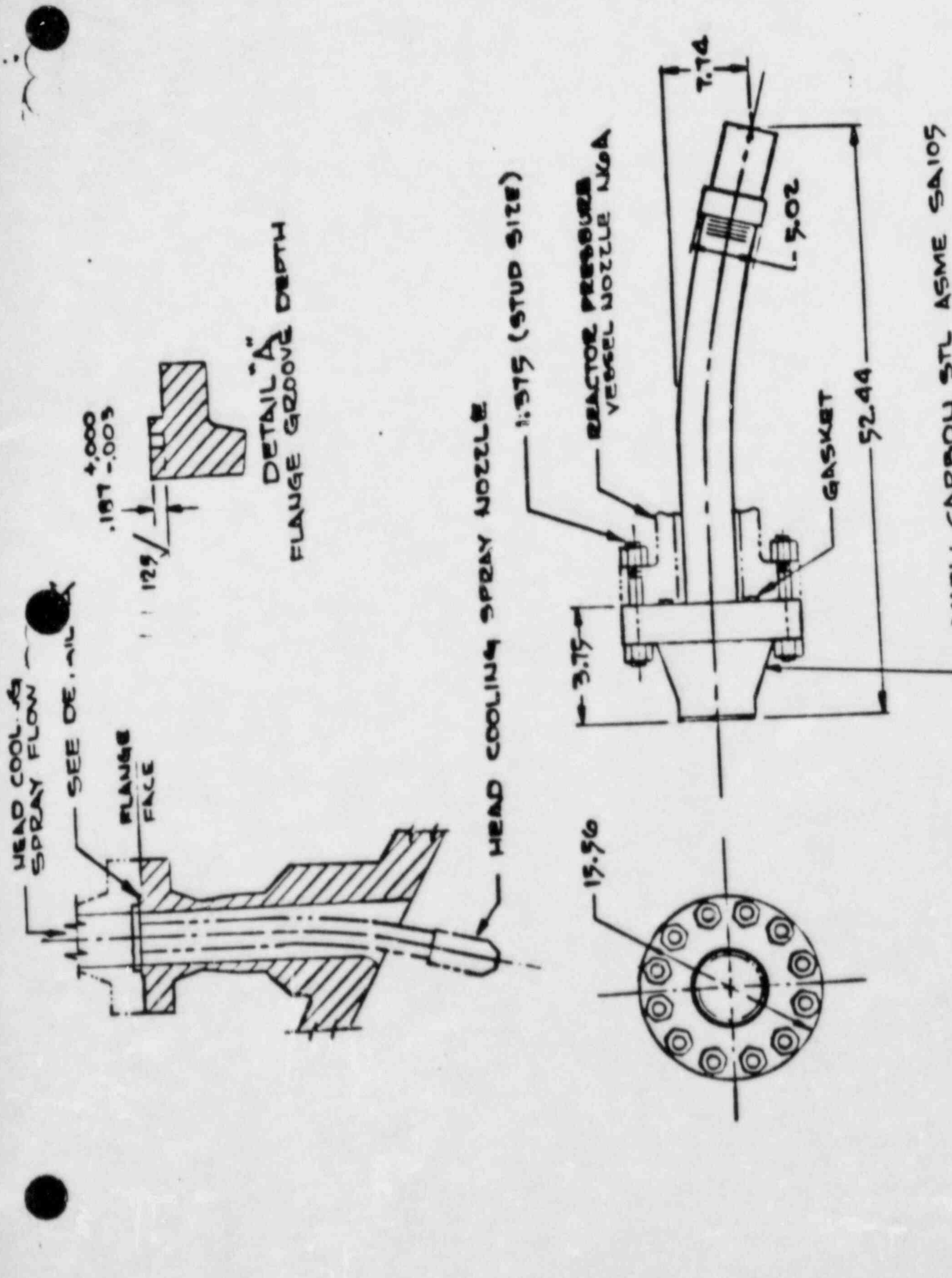


DRYWELL SPRAY SPARGER

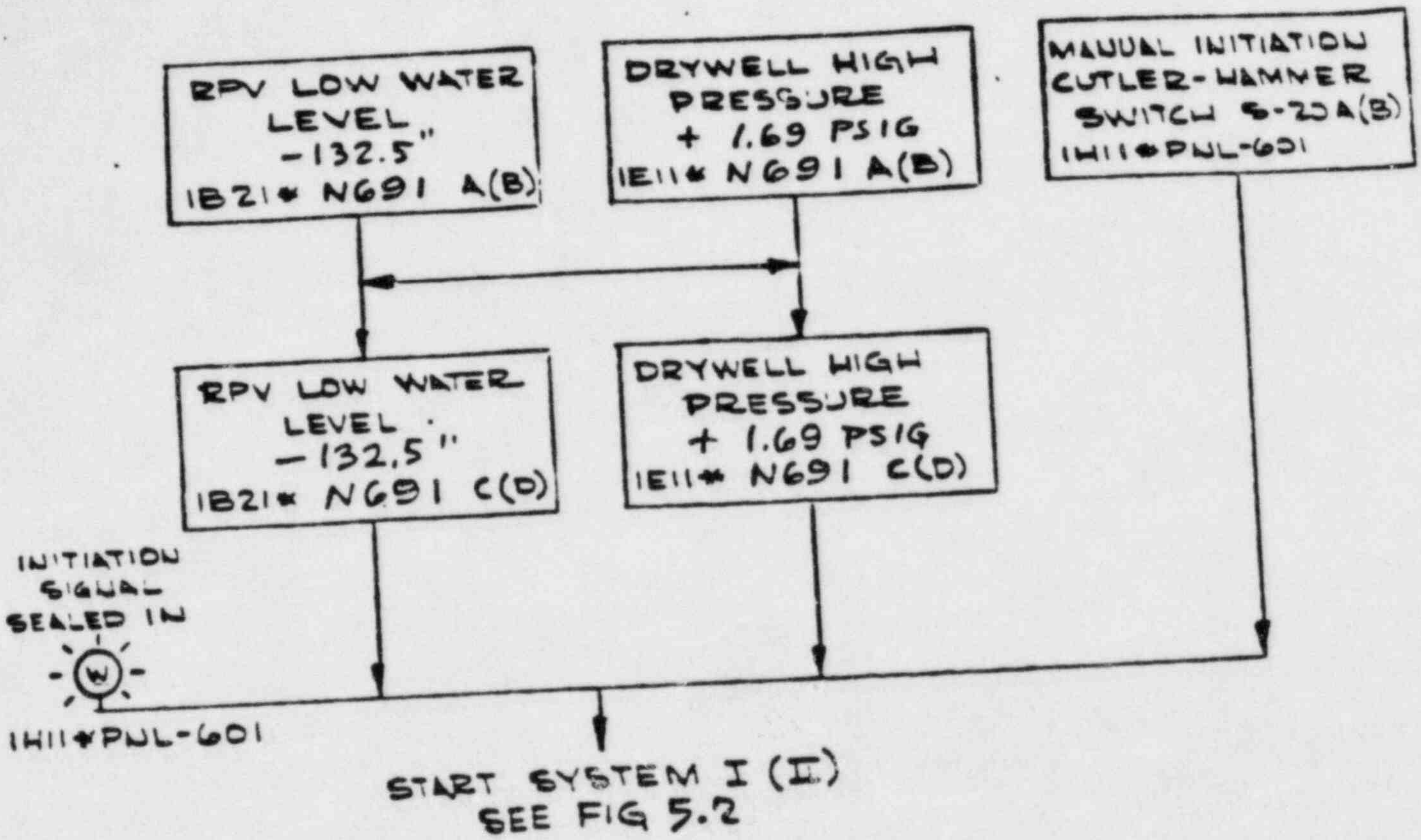


SUPPRESSION CHAMBER SPRAY SPARGER

RHRS SPARGERS



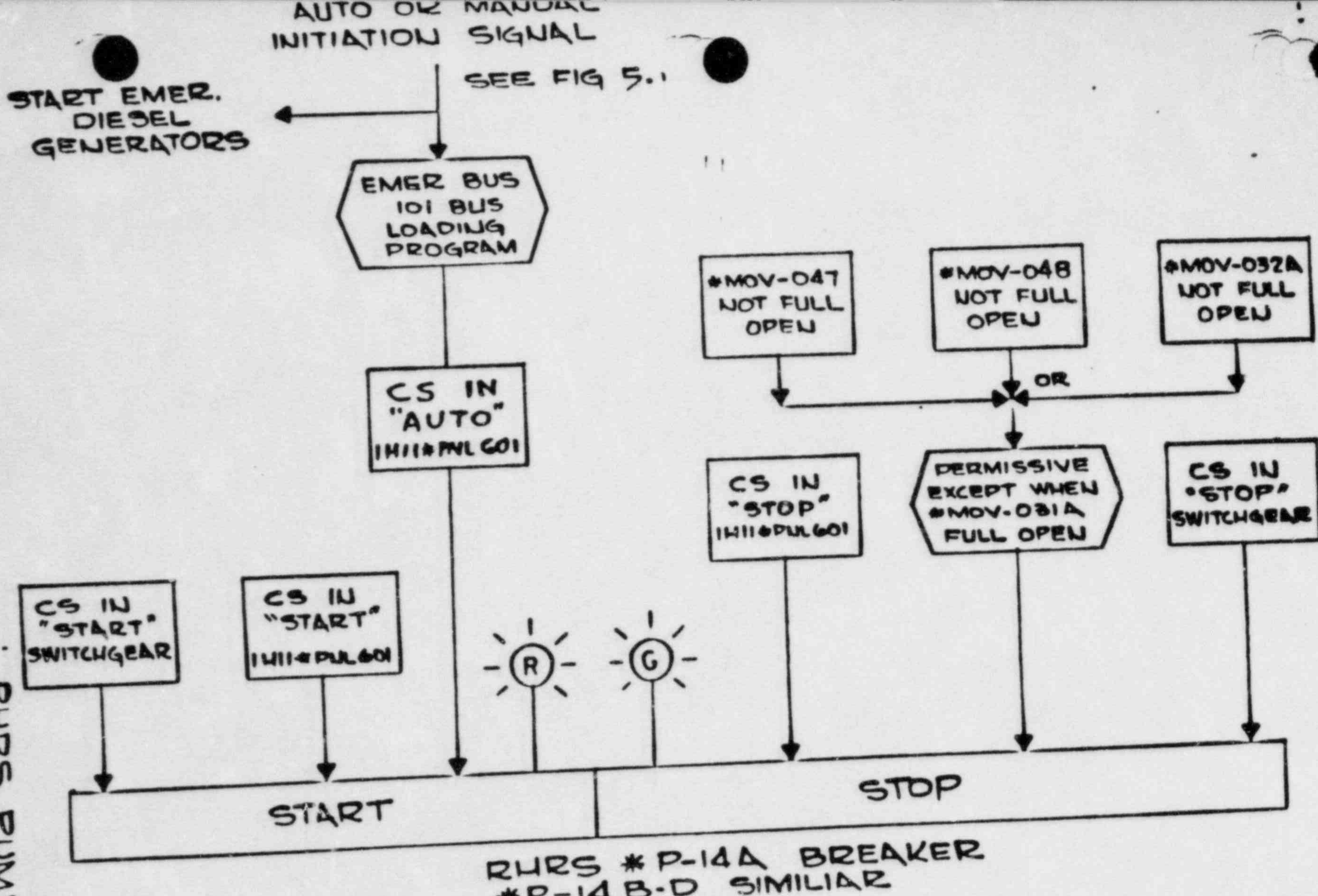
RHRS HEAD SPRAY NOZZLE



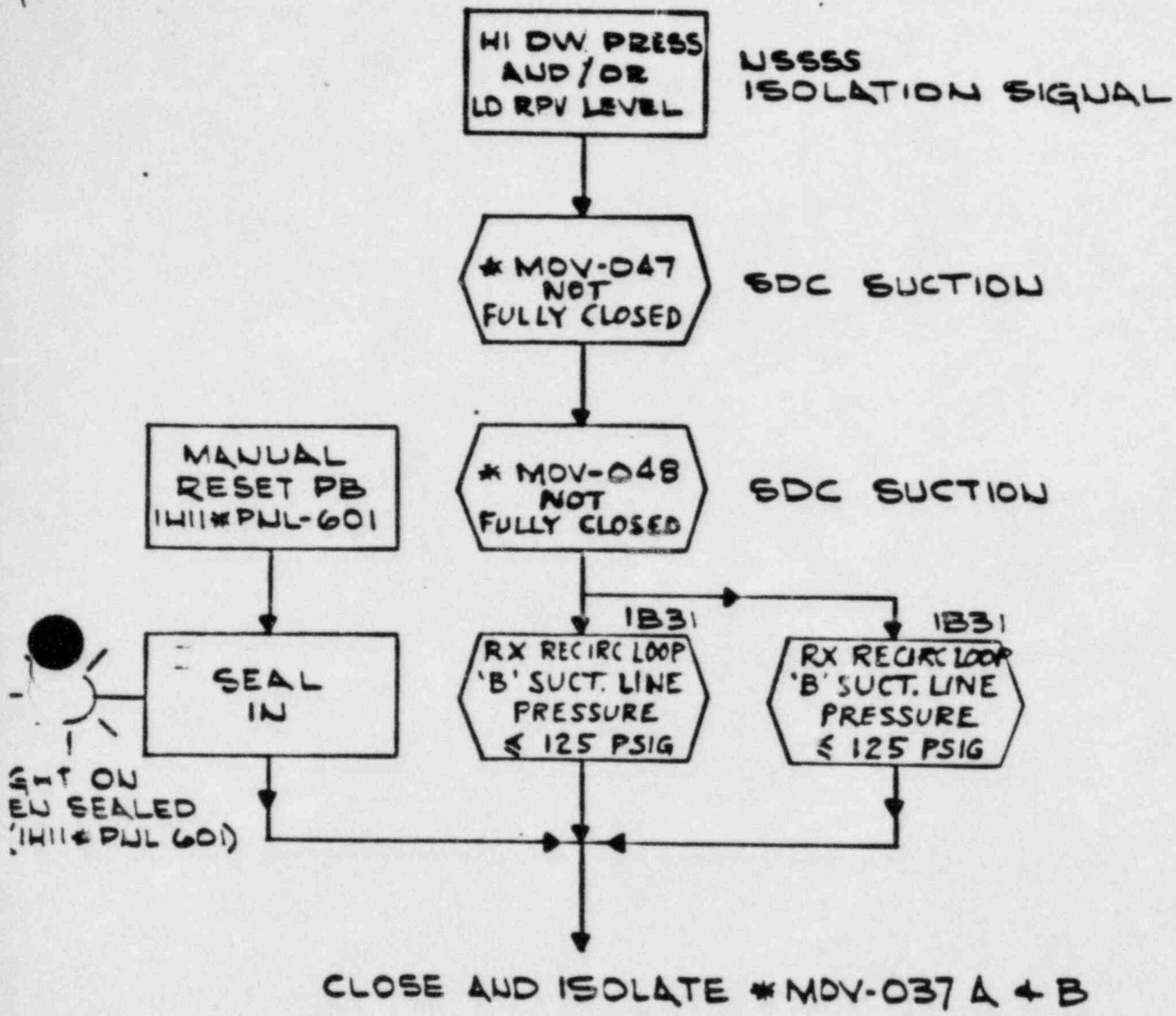
RPV = REACTOR PRESSURE VESSEL

LPCI INITIATION LOGIC

Figure 18



RHRS PUMP *P-14
FUNCTIONAL CONTROL DIAGRAM



LEGEND:
SDC: SHUTDOWN COOLING
PB: PUSHBUTTON
DW: DRYWELL
RPV: REACTOR PRESSURE VESSEL

VALVE -*MOV-037 A+B ISOLATION FUNCTIONAL CONTROL DIAGRAM

Figure 20

SERVICE WATER STUDENT HANDOUT

FOR SHIFT (SRO) ADVISOR

TRAINING PROGRAM

Date: 5/10/84

Revision: ϕ

Prepared by: MP
Training Instructor/Date

Approved by: Ken Kautz 5/10/84
Operations Training Specialist/Date

1.0 LESSON PLAN: SERVICE WATER

2.0 LECTURE DURATION: 4 hrs.

3.0 MATERIALS REQUIRED FOR STUDENTS:

3.1 Service Water System Lesson Plan

3.2 Service Water Operational Procedure 23.122.01

3.3 Technical Specifications 3/4.7.1

4.0 MATERIALS REQUIRED FOR INSTRUCTOR:

4.1 Related Graphics

5.0 REFERENCE MATERIALS:

5.1 Service Water System Description 1020.122

5.2 Service Water System Procedure

5.3 FSAR Sections 2.4.12, 7.3 - 7.3.1.1, 7.3.2.8 and 9.2.1

5.4 Technical Specifications 3/4.7.1

5.5 Flow Diagrams FM-47A to 7N

5.6 Logic Diagrams LSK-9-7A to 7N

5.7 Electrical Elementary Diagram ESK-5P4101

6.0 SCOPE OF LECTURE:

To teach the student the piping arrangement, major components, instrumentation system operation, and system interrelationships of the Service Water System.

7.0 STUDENT SYNOPSIS:

At the end of the lecture the student should:

7.1 State the purpose of the Reactor Building Service Water System.

7.2 State the purpose of the Turbine Building Service Water System.

7.3 Given a diagram of the system or control panel display, trace out the flowpath for:

a) Normal Operation

b) Loss of Offsite Power

c) LOCA

7.4 Given a diagram of the Service Water system and a control panel display, identify the following SW SYSTEM ALIGNMENTS:

a) Loss of offsite power

b) LOCA

7.5 State the condition that will cause the RBSWS to split.

7.6 List the heat loads supplied by the RBSWS.

7.7 List the heat loads supplied by the TBSWS.

8.0 LESSON OUTLINE:

8.1 Theory

8.1.1 Purpose:

.1 Transfer heat from various plant components to the Long Island Sound.

.2 The Reactor Building Service Water system provides a reliable, unexhaustable source of emergency cooling water for the reactor core and the spent fuel in the spent fuel pool.

.3 The RBSW system transfers heat from the reactor building loads during normal operations and also provides heat removal capacity from safety related loads during a LOCA.

.4 The TBSW system transfers heat from BOP plant components.

8.1.2 Design Bases:

.1 Reactor Building service water is designed to supply adequate cooling during a LOCA with L.I. Sound at its maximum Tech. Spec. limit & any single failure.

.2 Reactor Building service water is nuclear safety related and must be:

a. seismic Cat I

b. protected from Tornado Winds & Missiles

c. protected from floods

d. meet single failure criteria

8.2 Physical Description

8.2.1 General

8.2.1.1 Reactor Building Service Water <u>FIG. 1,2</u>

.1 Consists of:

a. four motor driven, vertical, wet pit, centrifugal pumps

b. four motor operated strainers

c. necessary pipes, valves and instrumentation

1) piping is copper nickel: compatability with sea water

2) Valves are carbon steel lined with rubber for same reason.

3) all buried piping is encased in concrete

4) screenwell components have cathodic protection

.2 RB service water pumps

a. each in a separate bay in the intake structure

b. 8,600 gpm @ 65 PSIG

c. suction is in the forebay after the traveling screens

d. capacity: 50% during DBA & for normal ops.

.3 Flow Path:

a. through motor operated discharge valve (MOV-31A-D)

b. through automatic self cleaning rotary type strainers

c. through a check valve

d. to a common header

e. discharge valve has a 4" normally open bypass valve: Provides for min flow & system fill

f. the header can be divided by two series motor operated valves (MOV-32A & B)

   1. 32A supplied by DIV I MCC

   2. 32B supplied by DIV II MCC

   3) normally open

   4) auto close during LOCA

   5) pumps A&C supply header A

   6) pumps B&D supply header B

g. One 20" supply line comes off each header to supply one set of the redundant safety related loads and <u>either line can supply:</u>

   1) each diesel

   2) main chill water condenser

   3) ultimate cooling connection

   4) fuel pool emergency makeup

h. One 24" tie line comes off the B header and goes to the TB service water through two series motor operated valves.

   1) normally closed

   2) auto close during a LOCA

   3) has a locked closed 16" manual bypass valve around the MOV's.

i. loads:

   1) RBCLCW heat exchangers

   2) Drywell Booster heat exchangers

   3) RBSVS & CRAC chill water condensers

   4) main chill water condensers

5) emergency diesel jacket coolers

6) RHR heat exchangers

7) ultimate cooling supply

8) spent fuel pool emergency supply

9) aux boiler blowdown tank cooling

j. The outlets of loads 1 through 6 above, go to the discharge tunnel and return to the sound. Standpipes on discharge lines ensure flow path.

k. If the emergency cooling supplies are used the water would be contaminated and retained in the reactor building for processing.

l. Blowdown tank will have phosphates and therefore drains to the sanitation system.

m. The heat exchangers and diesel coolers have relief valve protection. Thermal relief in event service water is isolated to a cooler that is still rejecting heat.

n. Samples for radiation monitors are taken on the outlet of each RHR heat exchanger to detect tube leaks.

8.2.1.2 Turbine Building Service Water FIG.3

.1 Consists of:

a. three motor driven, vertical, wet pit centrifugal pumps

b. two motor operated strainers

c. necessary piping valves and instrumentation

1) piping copper nickel

2) buried pipe is concrete encased

.2 Pumps:

a. separate suction on circ water cubicles

b. 8000 gpm at approximately 50 PSIG.

c. capacity: 50% at rated operating conditions

100% when shutdown or with low inlet temperature

.3 Flow Path

a. expansion joint

b. check valve

c. motor operated discharge valve (MOV-112A-C)

d. common header

e. two parallel strainers with individual motor operated inlet isolation valves (MOV-113A & B)

f. to the supply header

g. pump discharge valve has a 6" normally open bypass valve

h. loads

1) TBCLCW heat exchangers

2) Cir water pump bearing cooling

3) screen wash pumps motor oil coolers

4) vacuum priming pump seal water coolers

5) supply to fish retention pool

6) supply to vacuum priming drain tank

i. the outlet from loads 1 and 4 go to the discharge tunnel

j. outlet from 2 and 3 go to screenwell while 5 goes to the intake canal

k. outlet from 6 goes to the salt water drain tank before returning to the discharge tunnel

l. TBCLCW heat exchangers have 100 psi relief valves for overpressure protection when their outlet is shut

8.2.1.3 Both systems receive hypochlorite injections at timed intervals to prevent fouling of heat exchanger tubes

8.2.2 Major Components

.1 RB service water pumps

a. vertically mounted, wet pit, dual stage centrifugal type pumps

b. 8600 gpm

c. shutoff head 252 ft. (96 psi)

d. minimum required flow 800 gpm

e. self-lubricating

f. has vibration monitor

.2 RB service water pump motor

a. 450 horsepower, full load current 58.1 amps

b. powered from 4160V emergency buses

1) A - Bus 101 (DIV I)

2) B - Bus 102 (DIV II)

3) C&D - Bus 103 (DIV III)

c. control switches on RSP and in main control room

d. has a non-reversing ratchet

e. has a 200 watt space heater

.3 Strainers:

a. prevent fouling of Hx's

b. self-cleaning: Requires 450 gpm during backwash

c. motors powered from 480V Normal MCC's

d. flashing light on MCB-Ø1 indicates 4 PSID

e. alarm at 8 PSID

.4 Turbine Building service water pumps

a. single stage, vertically mounted wet pit centrifugal type pumps

b. 8,000 gpm

c. shutoff head approximatelv 50 PSIG

d. air release valve, vent air from pump and auto close when liquid pumped. Also prevents vacuum forming in the pump discharge when the pump is stopped

.5 TB service water pump motor

a. 350 HP

b. power supplv: 4160V normal bus

1) A-Bus 11

2) B&C-Bus 12

.6 Strainers

a. automatic backwashing, 100% flow capacity strainers

b. requires 420 gpm during backwash

c. clean dp 2.2 psig

d. power supply: 480 Volt Normal MCC's

8.3 PRINCIPALS OF OPERATION

8.3.1 System operating modes

8.3.1.1 Normal operation

.1 Two RBSW pumps operating to supply:

a. one Drywell Booster heat exchanger

b. one RBCLCW HX

c. one RBSVS & CRAC chill water condensers

d. Main chill water condensers

.2 Two TBSW pumps operating to supply:

a. one TBCLCW heat exchanger

b. Circ water bearing cooling

c. Vacuum Priming seal water HX

.3 All other loads can be valved in as necessary

8.3.1.2 Abnormal operation: Loss of off site power

.1 All SW pumps trip

.2 EDG start and close in on emergency buses

.3 When diesels are up to speed, pumps P-003A, B, C and D start

.4 RBSW will supply:

a. EDG coolers

b. Both RBCLCW HX

c. One Drywell Booster HX

d. RBSVS & CRAC chill water condensers

.5 The following will be available to the operator:

a. RHR HX

b. Spent Fuel Pool Emergency Supply

c. Ultimate cooling supply

8.3.1.3 Accident Condition: Loss of Coolant

.1 The A, B, C & D RBSW Pumps receive start signals from the emergency Bus Program (12 sec From time bus is energized)

.2 RBSW will supply water to:

a. Both RBCLCW HX

b. All Four RBSVS and CRAC chill water condensers

c. EDG

.3 RBSW will be available to the following:

a. RHR HX

b. Ultimate Cooling

c. Spent Fuel Pool

8.3.2 Instrumentation and Controls FIG 4,5 & 6

8.3.2.1 Control Room

.1 Major instrumentation

a. RB Service Water (on MCB)

1. Motor Current

2. Header Pressure

3. RHR HX Flow

4. RBCLCW HX Flow

5. Strainer dp

6. RBCLCW Outlet Valve Position

7. RHR Hx Outlet Valve Position

b. TB Service Water (on MXP)

1. Motor Current

2. Header Pressure

.2 Controls

a. Individual Pump Control switches:

1. spring return to auto or neutral pos.

2. targets are red after start, green after stop

3. PTL/STOP/AUTO/START positions (Note: RBSW-C has neutral vice auto)

4. RBSW on MCB; TBSW on MXP

5. White light near control switch goes right when motor lockout occurs. (Note: must reset at switchgear)

b. TBSW standby pump select switch

1. Maintain contact

2. OFF/A/B/C

3. on MXP

c. The following valves have control switches of various types for position control. (open or close)

1. on the MCB

MOV 31 A - D	RBSW Pump Discharge
MOV 32 A - B	RBSW header isolation
MOV 33 A - D	Ultimate Cooling Supply isolation
MOV 34 A - B	RHR HX outlet
MOV 35 A - B	RB - [illegible] Isola[illegible]
MOV 36 A - C	Main Chill Water
MOV 37 A - B	RBCLCW HX OUTLET
MOV 39 A - B	Ultimate Cooling Line Drain
MOV 129 A - B	Drywell Booster HX outlet
AOV 16 A - C	EDG Cooler Outlet

2. on the MXP

MOV 42 A - B	Spent Fuel Pool Emerg. Supply Isol.
MOV 43	Spent Fuel Pool Emerg. Supply Drain
MOV 111 A - B	TBCLCW HX outlet
MOV 112 A - C	TBSW Strainer inlet

3. MOV 33 and 42 valves have keylock control switches

4. MOV 35 valves also have

   a. Keylock switch and an override switch to allow the operator to open these valves during a LOCA

5. MOV 34 and 37 valves also have

   a. Keylock switch (Normal/Throttle) and a pushbutton (intermediate) to throttle the valves to 50%

   b. An override switch to allow the operator to open these for post LOCA cooling

8.3.2.2 Remote Shutdown Panel (RSP)

.1 Control switches for

a. P41-P-003 B&D: RBSW Pumps B&D

b. MOV - 31 B&D: B&D RBSW Pump Discharge Valves

c. MOV - 32B: Service Water header isolation

d. MOV - 34B: 'B' RHR HX Discharge

e. MOV - 35B: 'B' RB-TB SW Cross tie

f. MOV - 37B: 'B' RBCLCW HX Discharge

.2 Transfer switches: (Norm/Emerg Positions)

a. one for the B RBSW pump & discharge valve

b. one for the D RBSW pump & discharge valve

c. one for MOVs 32B, 35B, 37B

d. one for MOV 34B

.3 Indication: RBSW header B Pressure

8.3.2.3. Local Controls

.1 RB Service Water pumps have target type control switches at their respective switchgear

.2 All strainers have control switches in the screen well (Hand/Off/Auto)

8.3.3 Interlocks

.1 RBSW Pumps

a. Auto Trip

1. sustained bus undervoltage

2. Motor Fault (86 Lockout)

b. Auto Start

1. CS in Auto

2. Either

a. LOCA Signal Present and Bus Powered and up to Voltage for 12 sec

b. No LOCA Present and Diesel 400 RPM for 7 sec

<u>NOTE:</u> either of the above will supply start signals to the SW pumps but pump discharge valve must be closed in order for breaker to be closed.

c. <u>RSP Transfer switch in emergency overrides CR Control Switch and Auto Start signals for B & D Pumps</u>

d. Pump discharge valve

1. Opens 20 sec after Breaker closes

2. Shuts when Breaker opens

.2 RHR & RBCLCW HX Outlet Valves

a. Go to 50% Position if key lock switch is in Normal and intermediate Pushbutton Pressed.

b. Can be throttled if its keylock switch is in throttle and the open or close pushbutton is pressed (releasing push button stops the valve)

.3 LOCA Interlocks

a. LOCA Signal Cause

1.	MOV 34 (A,B)	Close	RHR HX OUT
2.	MOV 37 (A,B)	Open	RBCLCW HX OUT
3.	MOV 32 (A,B)	Close	RBSW HEADER ISO.
4.	MOV 35 (A,B)	Close	RB-TB XCON
5.	MOV 36 (A,B,C)	Close	MAIN CHILL WATER SUPPLY
6.	MOV 129 (A,B)	Close	DRYWELL BOOSTER HX

b. Override switches allow MOV 34, 35 & 37 to be repositioned

c. Depressing their override pushbutton allows the RHR Hx outlet MOV's 34 and the RBCLCW Hx outlet MOV's 37 to be repositioned even if a LOCA signal is present. MOV's 35 cross tie valve has a keylock override switch.

d. White light above override pushbutton indicates LOCA signal has been overridden.

e. Other valves are interlocked closed (32,35,36 & 129)

.4 RBCLCW head tank levels are low low

a. RBCLCW Hx service water outlet MOV's 39 open

.5 Loss of Power Interlocks

a. Loss of Power Causes same valve lineup as

LOCA except for MOV 129 (A&B)

b. If Diesel supplies the bus, MOV 35 & 36 are interlocked closed

c. <u>Once condition clears & the valves reach their intended position valves can be repositioned</u> (except for 34 & 37 valves)

d. After loss of power clears, the RHR Hx outlet valves and the RBCLCW Hx outlet valves override pushbutton must be depressed in order to be able to reposition the valves.

.6 DG cooling supply valves open when diesel starts; close when diesel shuts down

.7 Emergency open on MOV - 33 (A-D) and both emergency open and emergency close on MOV-42 (A & B) override the motor overloads

.8 TB SW Pumps

a. Trip

1. Bus U.V. for 2 sec

2. Motor Fault (86 lockout)

b. Auto Start

1. No Pump Running

2. Selected for Standby

3. CS in Auto after Stop & Disch Valve Shut

4. Motor Fault on either of other pumps

c. Discharge Valve

1. Opens 2 min after pump starts

2. Shuts when pump stops

.9 TBCLCW Hx Outlet MOV 120

a. Opens with 2 or 3 pumps running

b. Closes with 1 or 0 pumps running

8.3.4 SYSTEM INTERRELATIONS

8.3.4.1 STARTUP

.1 The RB service water system is nuclear safety-related and requires no support, other than power available to the emergency buses, for start-up and operation. The TB service water system is not safety-related and requires support from the normal buses.

.2 The following systems should be operational to support the service water system during normal operation:

a. Traveling water screens and screen wash system

b. Hypochlorination system

8.3.4.2 SHUTDOWN

.1 The loss of service water cooling to nuclear safety-related components supplied by this system will result in the inability of these components to function during an accident. The effects are as follows:

a. Emergency Diesel Generators. The emergency diesel generators will overheat and trip out due to loss of cooling water, resulting in the loss of all a-c power during an accident if off-site power is not available.

b. RBCLCW. Loss of service water during an accident will prevent the RBCLCW system from cooling the RHR pumps and the spent fuel pool. Loss of cooling to the RHR pumps will result in immediate loss of those pumps and a reduction in core cooling capability. Loss of cooling to the spent fuel pool will have less immediate effects but will result in high temperatures and potential radioactive release from the spent fuel pool.

c. RBSVS and CRAC Chilled Water.

Loss of service water during an accident will cause loss of the RBSVS and CRAC Chilled Water System, resulting in above atmospheric pressures in the secondary containment and potential unmonitored radioactivity release to the environment.

d. Emergency Service Water (Ultimate Cooling). Loss of emergency service water should have no effect during an accident, as it is normally not used. However, there will be no backup cooling supply to the ultimate cooling connection or to the spent fuel pool.

.2 Loss of service water cooling during normal operation will result in the operational failure of the following systems due to lack of cooling. The effect will be to require immediate plant shutdown.

a. TBCLCW

b. RBCLCW

c. RBSVS and CRAC chilled water

d. Main ventilation chilled water

e. Main circulating water (loss of pump bearing cooling)

8.4 SUMMARY:

8.4.1 The service water system is divided into two systems, one supplying the Reactor Building and Control Building; the other supplying the Turbine Building.

8.4.2 The Reactor Building service water system is safety related and therefore is powered from the emergency buses. Two pumps are required during operation and two during accident conditions. Its supply header can be divided into two redundant systems to insure a supply to at least one of every safety related load and all three diesels. The supply header is equipped with series MOV's for isolation purposes. Power to the "A" valves is from DIV I and power to the "B" valves is from DIV II. Therefore, if a EDG fails to start the loops will still isolate.

8.4.3 The Turbine Building service water system requires two pumps during normal operations. It is not safety related and therefore is powered by the normal station buses.

TABLE 9.1

	COMPONENT	NO	NORMAL	LOSS OF OFFSITE POWER	LOCA
1.	EDG HX Outlet	AOV-16 (A-C)	Closed	Open	Open
2.	Discharge Header Cross Connect	MOV-32 (A,B)	Open	Closed	Closed
3.	Ultimate Cooling Isolation	MOV-33 (A,D)	Closed	Closed	Closed
4.	Ultimate Cooling Drain	MOV-39 (A,B)	Open	Open	Open
5.	RHR HX Outlet	MOV-34 (A,B)	Closed	Closed	Closed
6.	Main Chill Water Supply	MOV-36 (A-C)	Open	Closed	Closed
7.	RBCLCW HX Outlet Service Water	MOV-37 (A,B)	1 Open / 1 Closed	Both Open	Both Open
8.	RBCLCW HX Inlet	MOV-42 (A,B)	1 Open / 1 Closed		Both Open
[illegible].	Spent Fuel Pool Drain	MOV-43	Open	Open	Open
10.	Drywell Booster Heat Exchanger	MOV-129 (A,B)	1 Open / 1 Closed	1 Open / 1 Closed	Both Closed

SERVICE WATER

STUDENT SUPPLEMENT

Date: 4/16/84

Handout: HL-122

Revision: 0

Prepared By: Robert McNair 4/17/84
Training Instructor/Date

Approved By: Marcelin P Pechin / 4/17/84
Training Operation Specialist/Date

I	ANNUNCIATOR	ARP	VALIDATION
1.	RBSW STRAINER DIFF P HI	0032	1. Verify strainer DP red light illuminated.
			2. Verify pump strainer DP 8 PSID.
2.	RBSW PUMP A AUTO TRIP (Same for all 4 pumps)	0074/0075/ 0076/0205	1. Check pump control switch indicating lights on MCB-01
			2. Verify pump amps decreased + "0"
			3. Verify service water header pressure decreases.
			4. Verify RBSW pump strainer DP decrease
3.	RB-TB SERVICE WTR ISOL VV OPEN	158	1. Verify position indication of 1P41-MOV35A/B shows Red
			2. Return control switch to shut
4.	RBSW HEADER A/B PRESSURE LO	0193/0194	1. Verify service water pressure indication 40 psig.
5.	RBSW PUMP A MTR OVLD (Same for all 4 pumps)	0206/0207/ 0208/0209	1. Verify RBSW pump amps in _ 60 amps
			2. Check system
6.	TB SERVICE WATER PP MTR OVLD	0296	1. Verify excessive pump amps on MXP
			2. Start standby pump as needed.
7.	TB SERVICE WATER PP AUTO	0299	1. Verify control switch indicating lights on MXP are Green and White.
8.	TB SERVICE WTR STR DIFF P HI	0303	1. Send E.O. to check strainer DP and place standby strainer in service as required.

ANNUNCIATOR	ARP	VALIDATION
9. TB SERVICE WTR HEADER PRESS LO	0325	1. Verify TBSW header pressure 22 psig. 2. Start standby pump and verify header pressure 40 psig.
10. RBSW SYSTEM "A" INOP	0424/0425	1. Verify if inoperative switch in TEST. 2. See ARP 0426/0427.
11. RBSW SYSTEM A DEGRADED (Same for B)	0426/0427	1. Loss of position indication on any valves that move on an accident. 2. Loss of position indication on Ultimate Cooling Valves. 3. Loss of pump indication on any RBSWP.

II PRECAUTIONS

1. To prevent damage to the service water pump motors, two consecutive starts shall be allowed with the motor cold and one start shall be allowed with the motor at operating temperature. Subsequent starts with the motor running between starts shall be at least 15 minutes apart. Subsequent starts with the motor stopped between starts shall be at least 45 minutes apart.

   Check the NSO log to verify time when RBSWS pumps were started and stopped.

2. Supplying service water to the ultimate cooling connection will inject sea water into the reactor vessel if reactor pressure is at or near atmospheric pressure. The ultimate cooling connection shall only be used as a last resort to supply cooling water to prevent the reactor core from remaining uncovered.

   Must receive permission from the Watch Engineer for injection.

3. Injection of service water into the spent fuel pool shall only be done as a last resort to maintain fuel pool level or temperature.

   Must receive permission from the Watch Engineer.

4. Service water shall not be isolated simultaneously to both sets of redundant safety equipment during normal plant operation.

   Check NSO log and SECPS to verify isolations.

5. When adding or switching loads ensure there are sufficient pumps operating to prevent motor overloads and ensure sufficient flow path (58 amps for the RB Service Water Pumps and 45 amps for TB service water pumps).

   Check RBSW Amps on MCB-01
   Check TBSW Amps on MXP

6. Assure that the Salt Water Drain Systems are available.

   Check procedure prerequisite checklist for valve lineup and power supplies.

7. Manual operator engagement pins of 1P41*AOV-016A,B,C, listed in Appendix 12.2, must be disengaged prior to auto operation. If manual operator engagement pin is engaged at the time of auto operation the woodruff keys of the "Fisher Controls" operator will sheer and render the valve inoperable.

   Verify locally in the Emergency Diesel Rooms that the manual operator engagement pins are not inserted when the system is in standby status.

8. Do not place heat exchangers 1P41*E117A (RBCLCW Hx) and 1E11*E034A (RHR Hx) (1P41*E117B and 1E11*E034B) in operation concurrently without heat loads since this mode of operation has not been analyzed.

   Check procedure prerequisite checklist for valve lineup and power supplies.

   NOTE: Change made per S&W letter LIL-23717. (The S&W letter has not been traced down to date)

III MALFUNCTIONS

- The RBSW system valves and pumps have changed position and are operating during a LOSS OF OFFSITE POWER as follows: FIG's 1,2,3

1)	EDG Hx Outlet AOV 16 A,B & C	OPEN
2)	Discharge Header Cross Connect MOV's-32 (A&B)	CLOSED
3)	Main Chill Water Supply MOV's-36 (A,B&C)	CLOSED
4)	RBCLCW Hx Outlet MOV's 3 &B)	OPENED

All 4 RBSW system pumps are RUNNING with their respective discharge valves OPENED.

The RBSW system valves and pumps have changed position and are operating during a LOCA as follows: FIG's 4,5,&6

1)	EDG Hx Outlet AOV-16A,B,&C	OPEN
2)	Discharge Header Cross Connect MOV's 32(A,B)	CLOSED
3)	Main Chill Water Supply MOV's 30(A,B&C)	CLOSED
4)	RBCLCW Hx Outlet MOV's 37(A&B)	OPEN
5)	Drywell Booster Hx MOV's 129A&B	CLOSED

All 4 RBSW system pumps are RUNNING with their respective discharge valves OPEN

- Ultimate Cooling Isolation Valve Leak

Alarm: Rx Building Sump Level Hi #0444 on MCB-01 alarm panel 209E.

Call NASO at Radwaste Control Room and confirm Rx Building Salt Water Drain Tank Level Hi #4850 annunciated.

- Loss of Station Air

EDG's cooler outlet valves AOV's 16A,B&C fail OPEN.

EDG's service water flow alarm transmitters FT-018 A/B/C will cause a service water low flow alarm at the EDG control panel 1R43*PNL-1/2/3

Loss of air to the D/P instruments will fail the backflush valves on the RBSW Pump strainers closed if open

CAUTION: The increase in flow may be sufficient to cause runout if only one pump is running

IV TECHNICAL SPECIFICATIONS

3.7.1.1 Two independent plant service water system loops shall be OPERABLE with each loop capable of taking suction from the ultimate heat sink and comprised of:

a. Two OPERABLE plant service water pumps, and

b. An OPERABLE Reactor Building service water (RBSW) flow path capable of transferring the water to the associated safety related equipment, and

c. An OPERABLE residual heat removal service water (RHRSW) flow path capable of transferring the water through the associated RHR heat exchanger.

APPLICABILITY: OPERATIONAL CONDITIONS 1,2, and 3

3.7.1.2 At least one of the following shall be OPERABLE:

a. Two independent plant service water system loops with each loop capable of taking suction from the ultimate heat sink and comprised of:

1. One OPERABLE plant service water pump, and

2. An OPERABLE Reactor Building service water (RBSW) flow path capable of transferring the water to the associated safety related equipment, and

3. An OPERABLE residual heat removal service water (RHRSW) flow path capable of transferring the water through the associated RHR heat exchanger

b. At least one plant service water system loop capable of taking suction from the ultimate heat sink and comprised of:

1. Two OPERABLE plant service water pumps, and

2. An OPERABLE Reactor Building service water (RBSW) flow path capable of . transferring the water to the associated safety related equipment, and

3. An OPERABLE residual heat removal service water (RHRSW) flow path capable of transferring the water through the associated RHR heat exchanger.

APPLICABILITY: OPERATIONAL CONDITIONS 4,5, and *.

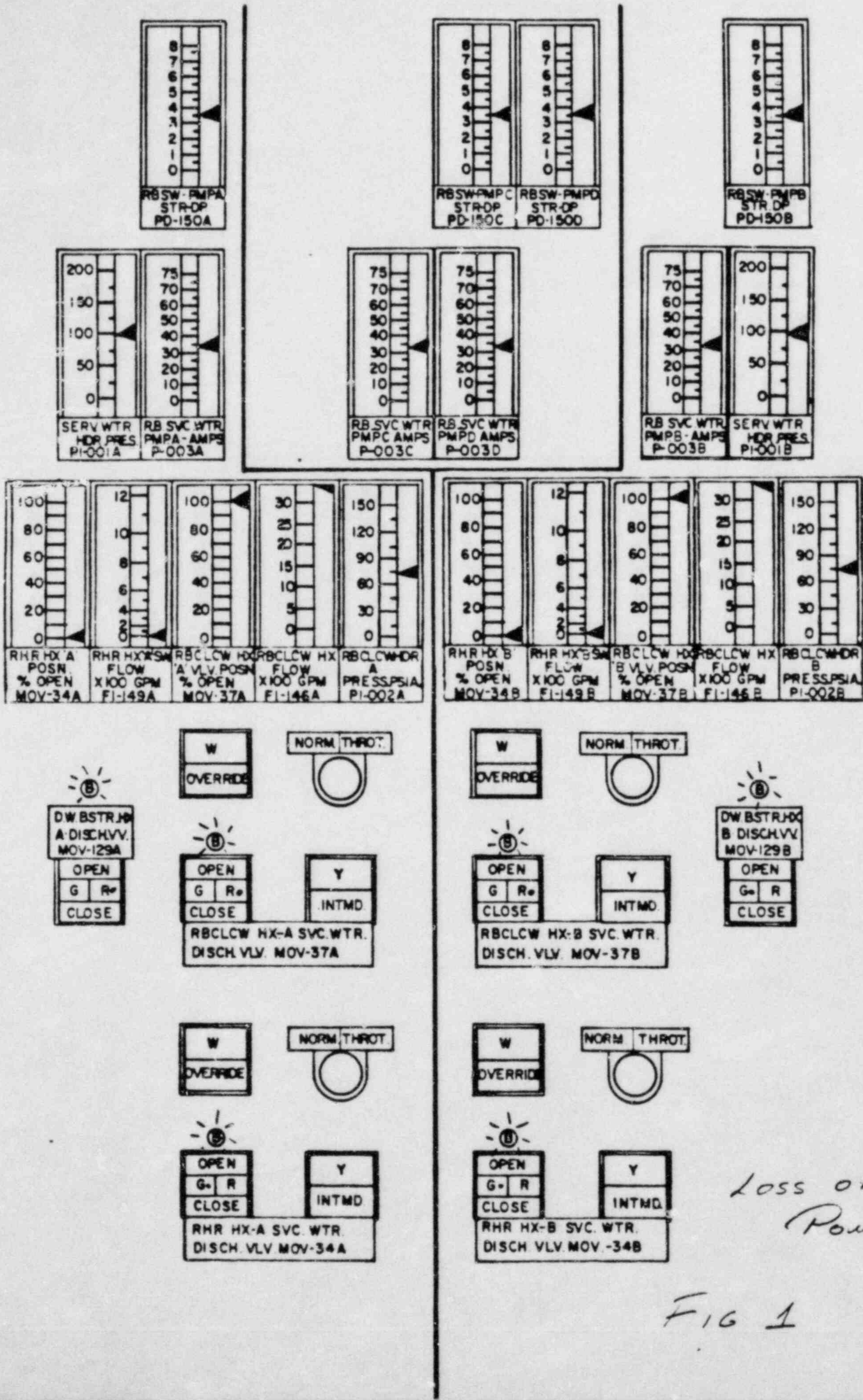
3.7.1.4 The ultimate heat sink shall be OPERABLE.

APPLICABILITY: OPERATIONAL CONDITIONS 1,2,3,4,5, and *.

ACTION:

a. With the ultimate heat sink inoperable because of damage to the jetties or armor which would compromise their ability to withstand a subsequent storm or earthquake, be in at least HOT SHUTDOWN within 12 hours and in COLD SHUTDOWN within the next 24 hours.

b. With the ultimate heat sink otherwise inoperable, restore the ultimate heat sink to OPERABLE status within 3 days, or, in lieu of any other report required by Specification 6.9.1, prepare and submit a Special Report to the Commission pursuant to Specification 6.9.2 within the following 10 days outlining the action taken, the cause of the inoperability and the plans and schedule for restoring the ultimate heat sink to OPERABLE status.



Loss of offsite Power

Fig 1

LOSS OF OFFSITE POWER

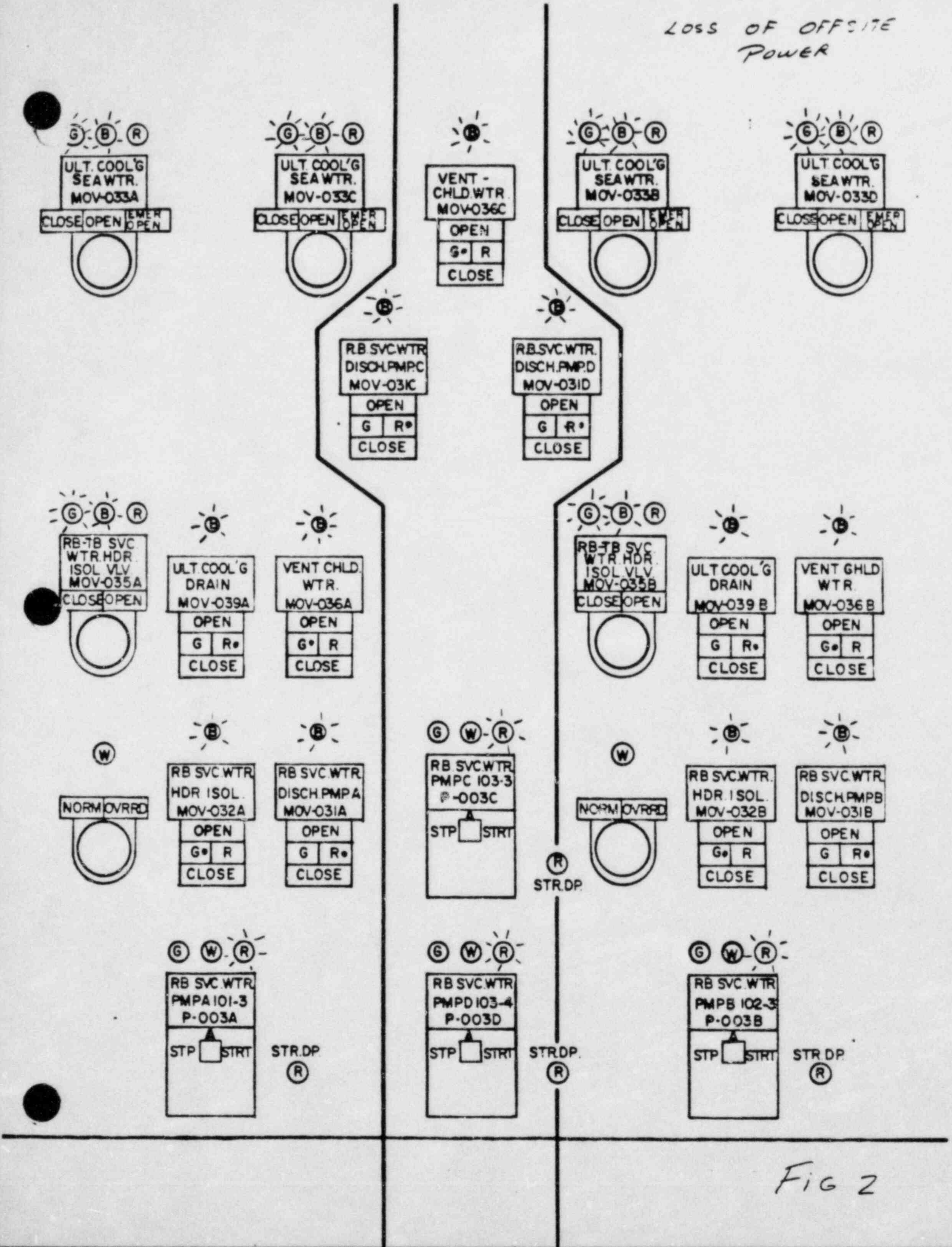


FIG 2

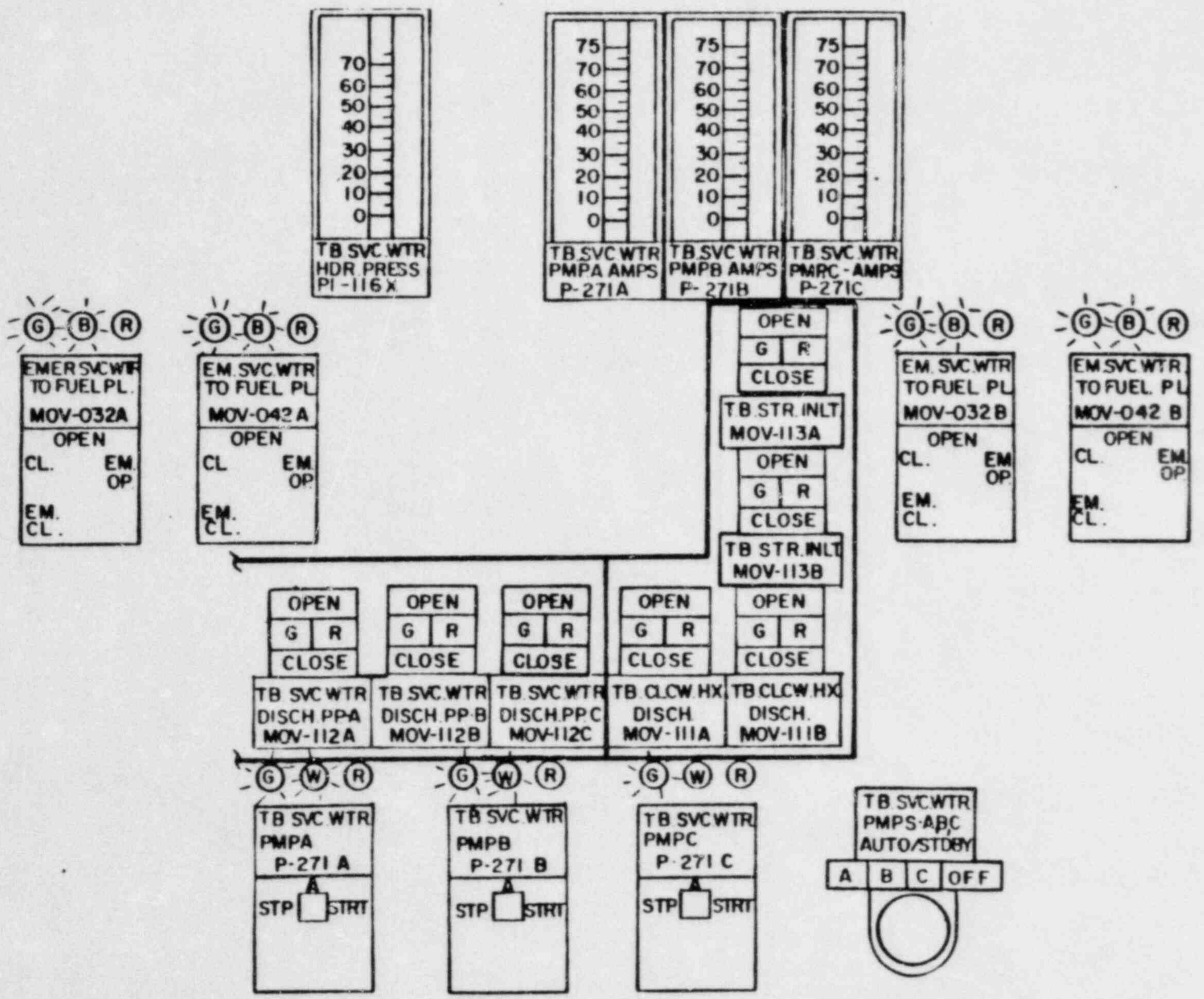


FIG 3

LOSS OF OFFSITE POWER

LOCA

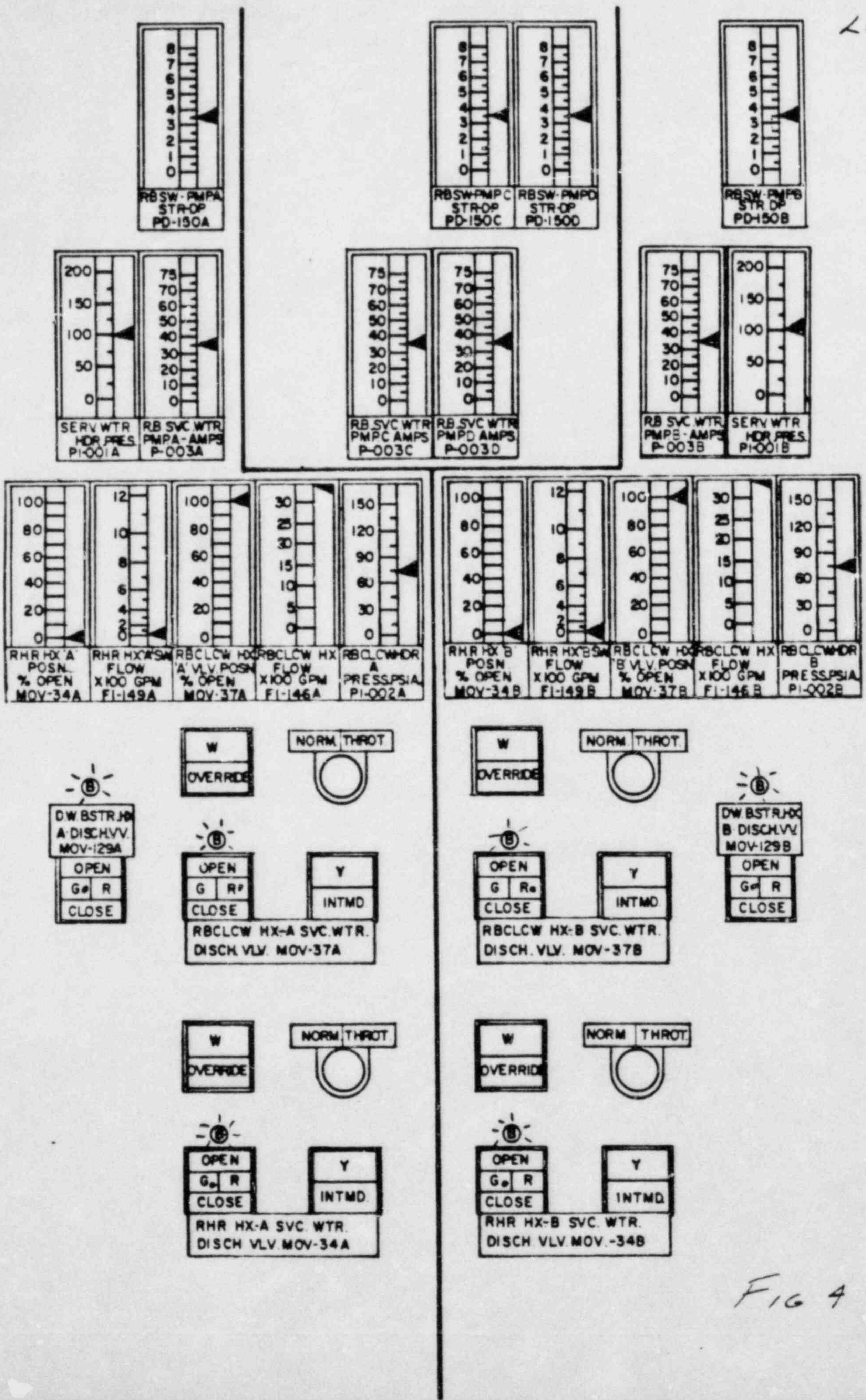

RBSW-PMPA STR-DP PD-150A
RBSW-PMPC STR-DP PD-150C
RBSW-PMPD STR-DP PD-150D
RBSW-PMPB STR DP PD-150B
SERV. WTR HDR PRES. PI-001A
RB SVC WTR PMPA-AMPS P-003A
RB SVC WTR PMPC AMPS P-003C
RB SVC WTR PMPD AMPS P-003D
RB SVC WTR PMPB-AMPS P-003B
SERV WTR HDR PRES. PI-001B
RHR HX 'A' POSN. % OPEN MOV-34A
RHR HX 'A' SW FLOW X100 GPM FI-149A
RBCLCW HX 'A' VLV POSN % OPEN MOV-37A
RBCLCW HX FLOW X100 GPM FI-146A
RBCLCW HDR A PRESS.PSIA PI-002A
RHR HX 'B' POSN. % OPEN MOV-34B
RHR HX 'B' SW FLOW X100 GPM FI-149B
RBCLCW HX 'B' VLV POSN % OPEN MOV-37B
RBCLCW HX FLOW X100 GPM FI-146B
RBCLCW HDR B PRESS.PSIA PI-002B
W OVERRIDE
NORM. THROT.
D.W. BSTR. HX A DISCH.VV. MOV-129A
OPEN G R CLOSE
Y INTMD
RBCLCW HX-A SVC.WTR. DISCH. VLV. MOV-37A
RBCLCW HX-B SVC.WTR. DISCH. VLV. MOV-37B
D.W. BSTR. HX B DISCH.VV. MOV-129B
RHR HX-A SVC. WTR. DISCH VLV. MOV-34A
RHR HX-B SVC. WTR. DISCH VLV. MOV.-34B

Fig 4

LOCA

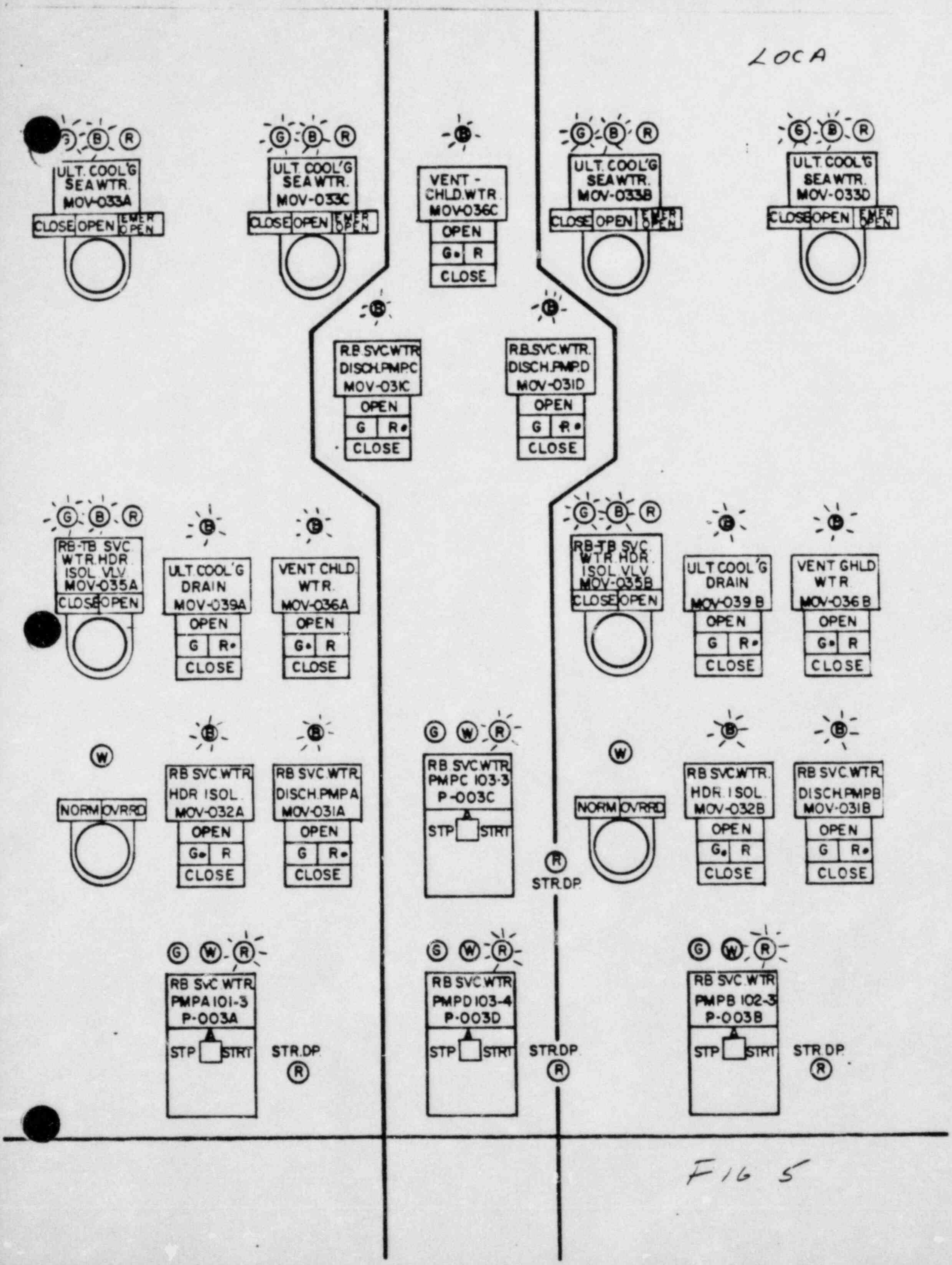
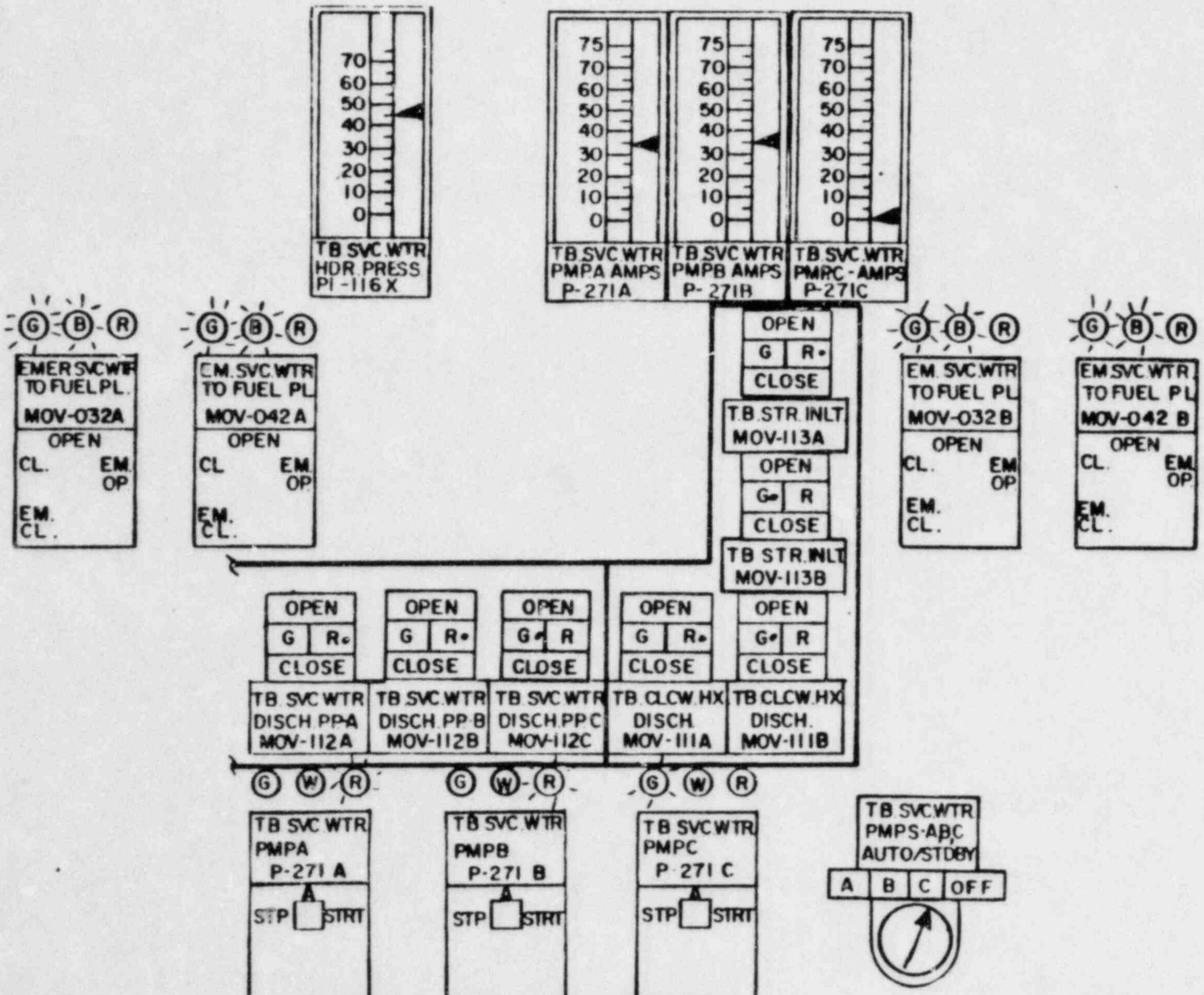

ULT. COOL'G SEA WTR. MOV-033A
CLOSE OPEN EMER OPEN
ULT. COOL'G SEA WTR. MOV-033C
CLOSE OPEN EMER OPEN
VENT - CHLD. WTR. MOV-036C
OPEN
G R
CLOSE
ULT. COOL'G SEA WTR. MOV-033B
CLOSE OPEN EMER OPEN
ULT. COOL'G SEA WTR. MOV-033D
CLOSE OPEN EMER OPEN
R.B. SVC. WTR. DISCH. PMP. C MOV-031C
OPEN
G R
CLOSE
R.B. SVC. WTR. DISCH. PMP. D MOV-031D
OPEN
G R
CLOSE
RB-TB SVC. WTR. HDR. ISOL. VLV. MOV-035A
CLOSE OPEN
ULT. COOL'G DRAIN MOV-039A
OPEN
G R
CLOSE
VENT CHLD. WTR. MOV-036A
OPEN
G R
CLOSE
RB-TB SVC. WTR. HDR. ISOL. VLV. MOV-035B
CLOSE OPEN
ULT. COOL'G DRAIN MOV-039 B
OPEN
G R
CLOSE
VENT GHLD WTR. MOV-036 B
OPEN
G R
CLOSE
W
NORM OVRRD
RB SVC. WTR. HDR. ISOL. MOV-032A
OPEN
G R
CLOSE
RB SVC. WTR. DISCH. PMP A MOV-031A
OPEN
G R
CLOSE
RB SVC. WTR. PMP C 103-3 P-003C
STP STRT
STR. DP.
W
NORM OVRRD
RB SVC. WTR. HDR. ISOL. MOV-032B
OPEN
G R
CLOSE
RB SVC. WTR. DISCH. PMP B MOV-031B
OPEN
G R
CLOSE
RB SVC. WTR. PMP A 101-3 P-003A
STP STRT
STR. DP.
RB SVC. WTR. PMP D 103-4 P-003D
STP STRT
STR. DP.
RB SVC. WTR. PMP B 102-3 P-003B
STP STRT
STR. DP.

FIG 5

16



TB SVC WTR HDR PRESS PI-116X
70 60 50 40 30 20 10 0
TB SVC WTR PMP A AMPS P-271A
TB SVC WTR PMP B AMPS P-271B
TB SVC WTR PMP C - AMPS P-271C
75 70 60 50 40 30 20 10 0
EMER SVC WTR TO FUEL PL. MOV-032A
EM. SVC WTR TO FUEL PL MOV-042 A
EM. SVC WTR TO FUEL PL MOV-032 B
EM. SVC WTR TO FUEL PL MOV-042 B
OPEN
CL.
EM. OP
EM. CL.
G B R
TB STR INLT MOV-113A
TB STR INLT MOV-113B
OPEN
G R
CLOSE
TB SVC WTR DISCH PP-A MOV-112A
TB SVC WTR DISCH PP-B MOV-112B
TB SVC WTR DISCH PP-C MOV-112C
TB CLCW HX DISCH MOV-111A
TB CLCW HX DISCH. MOV-111B
G W R
TB SVC WTR PMP A P-271 A
TB SVC WTR PMP B P-271 B
TB SVC WTR PMP C P-271 C
A
STP STRT
TB SVC WTR PMPS ABC AUTO/STDBY
A B C OFF

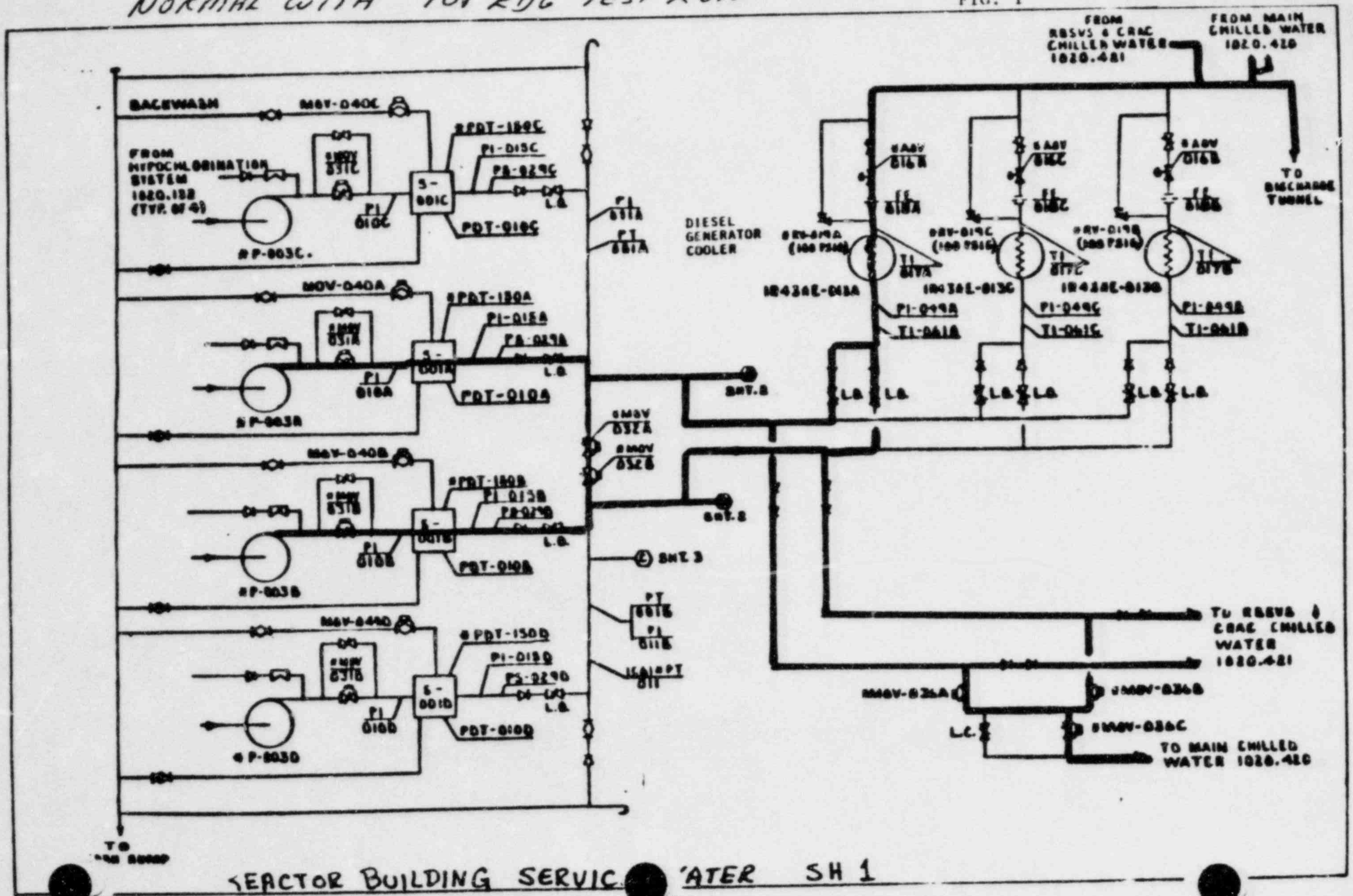
Fig 6

209E

	1	2	3	4	5	6	7	8	9	10
A	AIR CPRSR A TROUBLE	AIR CPRSR B TROUBLE	AIR CPRSR C TROUBLE	INSTM AIR HDR PRESS LO	RBCLCW PUMP A AUTO TRIP	RBCLCW PUMP C AUTO TRIP	RBCLCW PUMP B AUTO TRIP	SPENT FUEL STOR PL TEMP HI	CNTMT HEPA FLT IN FLOW HI	RB-TB SERVICE WTR ISOL VV OPEN
B	AIR DRYER TROUBLE	AIR CPRSR OC TRIP	AIR CPRSR MTR OVLD	STANDBY AIR CPRSR RUNNING	RBCLCW HEAD TK A LEVEL HI/LO	RBCLCW HX A TEMP HI/LO	RBCLCW HEAD TK B LEVEL HI/LO	SPENT FUEL STOR PL LEVEL HI/LO	WASTE VV TO CANAL OPEN	RB SUMPS LEVEL HI
C	RB SERVICE WTR PUMP A AUTO TRIP	RB SERVICE WTR PUMP C AUTO TRIP	RB SERVICE WTR PUMP D AUTO TRIP	RB SERVICE WTR PUMP B AUTO TRIP	RBCLCW HEAD TK A LEVEL LO-LO	RBCLCW HX B TEMP HI/LO	RBCLCW HEAD TK B LEVEL LO-LO	SPENT FUEL CLG PUMP A TROUBLE	STM TO AIR EJECTOR PRESS LO	YARD PPG SUMP LEVEL HI
D	RB SERVICE WTR PUMP A MTR OVLD	RB SERVICE WTR PUMP C MTR OVLD	RB SERVICE WTR PUMP D MTR OVLD	RB SERVICE WTR PUMP B MTR OVLD	RBCLCW SYS A HDR PRESS LO	RBCLCW VV INTERLOCK LCTL	RBCLCW SYS B HDR PRESS LO	SPENT FUEL CLG PUMP B TROUBLE	DW FLOOR UP SEAL PRESS HI/LO	DW FLOOR LWR SEAL PRESS HI/LO
E	RB SERVICE WTR SYS A DEGRADED	RB SERVICE WTR SYS A INOP	RB SERVICE WTR SYS B DEGRADED	RB SERVICE WTR SYS B INOP	RBCLCW SYS A DEGRADED	RBCLCW SYS A INOP	RBCLCW SYS B DEGRADED	RBCLCW SYS B INOP	RB SERVICE WTR STR DIFF P HI	TBCLCW HX BYP VV FULL OPEN/CLSD

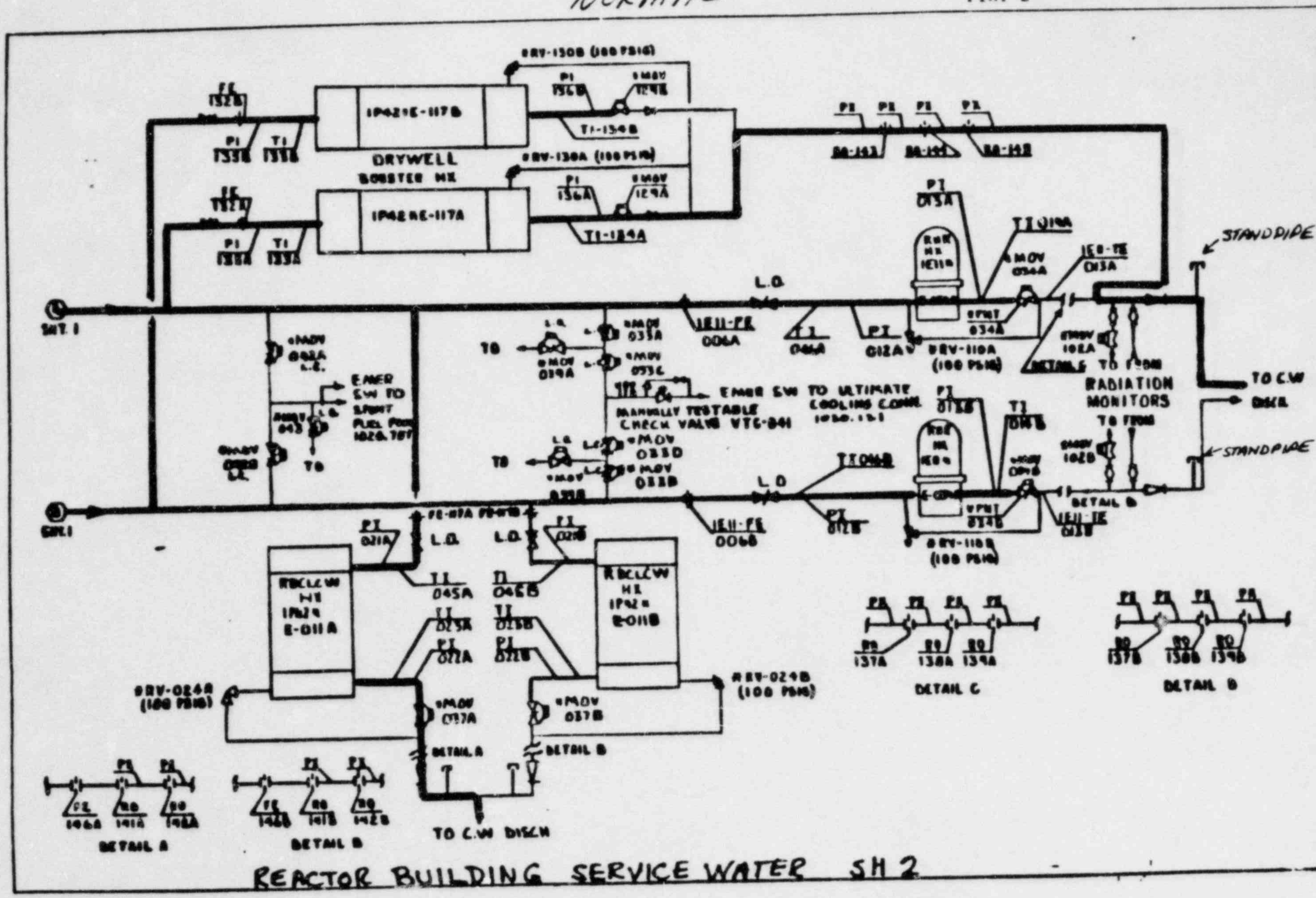
NORMAL WITH 101 EDG TEST RUN

FIG. 1



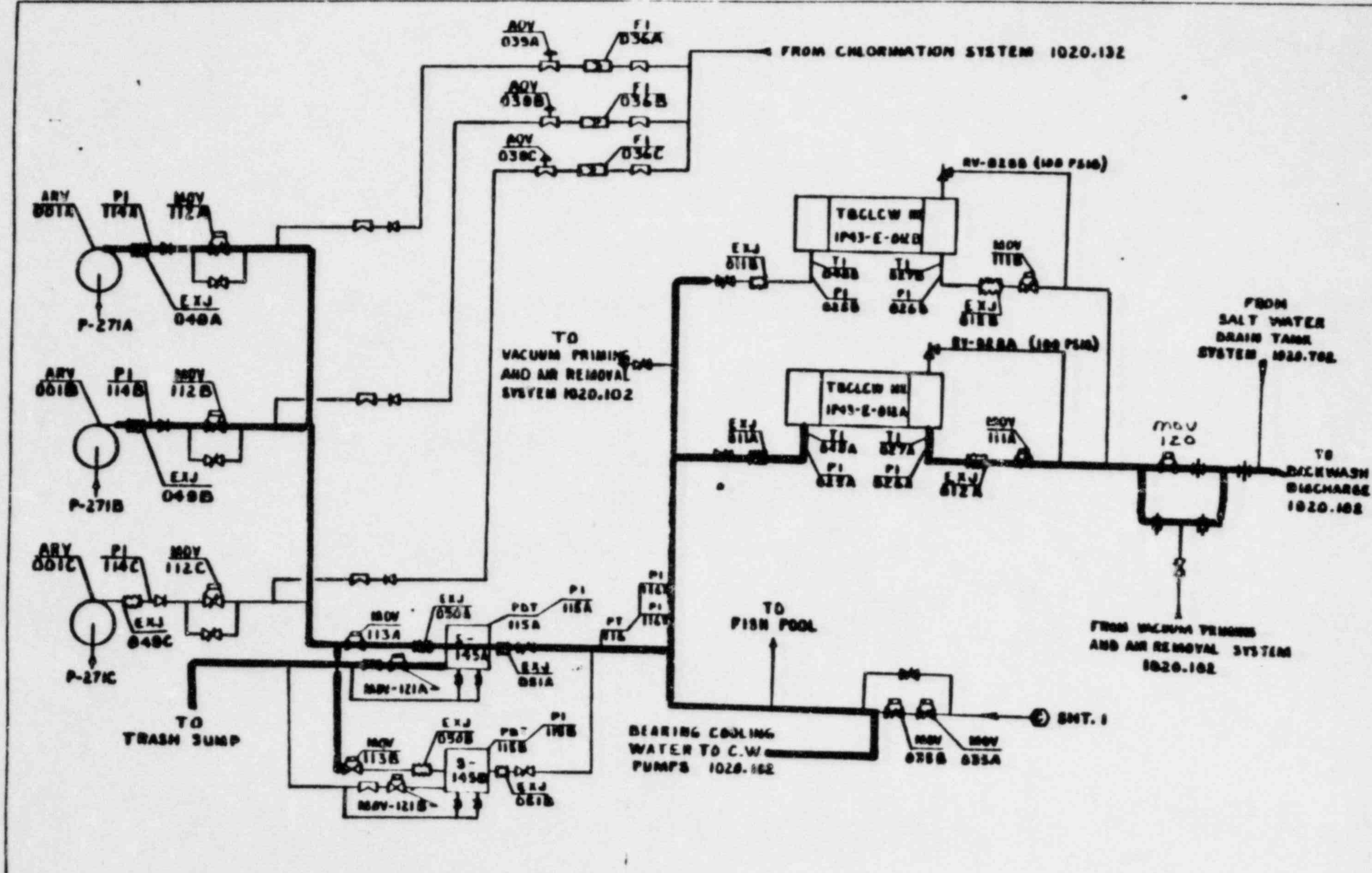
NORMAL

FIG. 2


DRYWELL
BOOSTER HX
L.O.
STANDPIPE
TO C.W
DISCH
RADIATION
MONITORS
EMER SW TO ULTIMATE
COOLING CONN
MANUALLY TESTABLE
CHECK VALVE VTC-041
DETAIL A
DETAIL B
DETAIL C
DETAIL D
TO C.W DISCH
REACTOR BUILDING SERVICE WATER SH 2

NORMAL

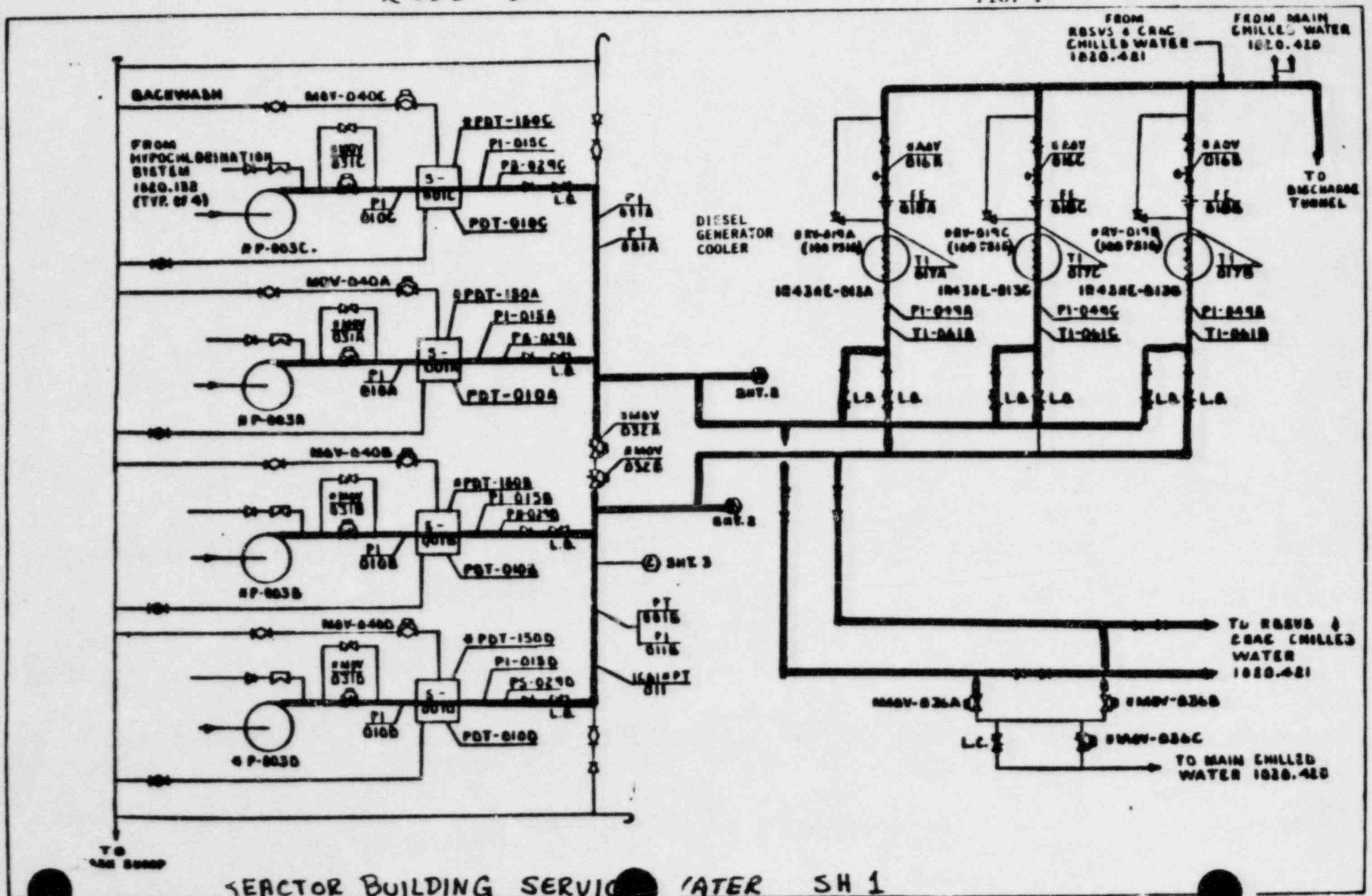
FIG. 3



TURBINE BUILDING SERVICE WATER

LOSS OF OFFSITE POWER

FIG. 1



LOSS OF OFF SITE POWER

FIG. 2

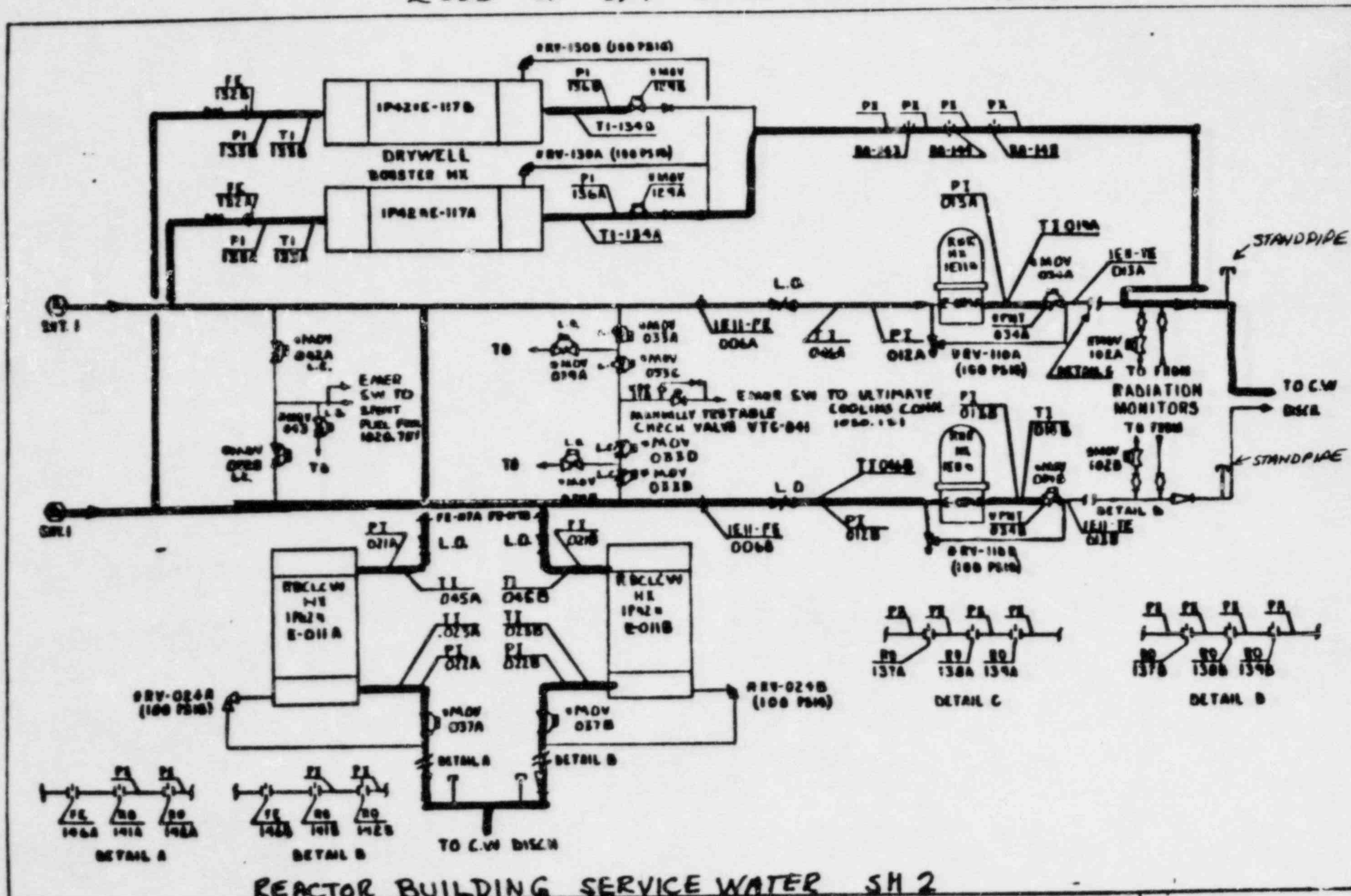
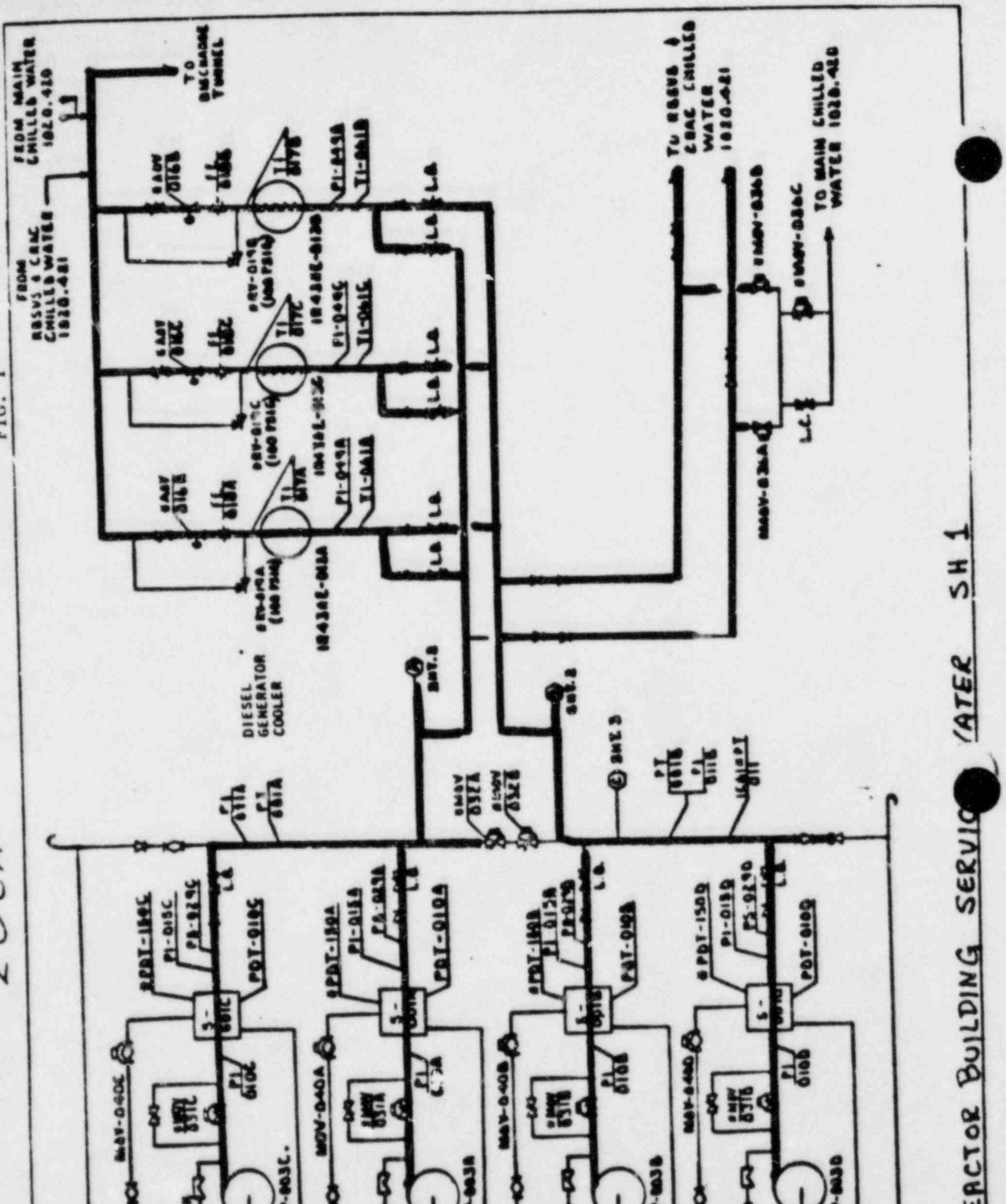


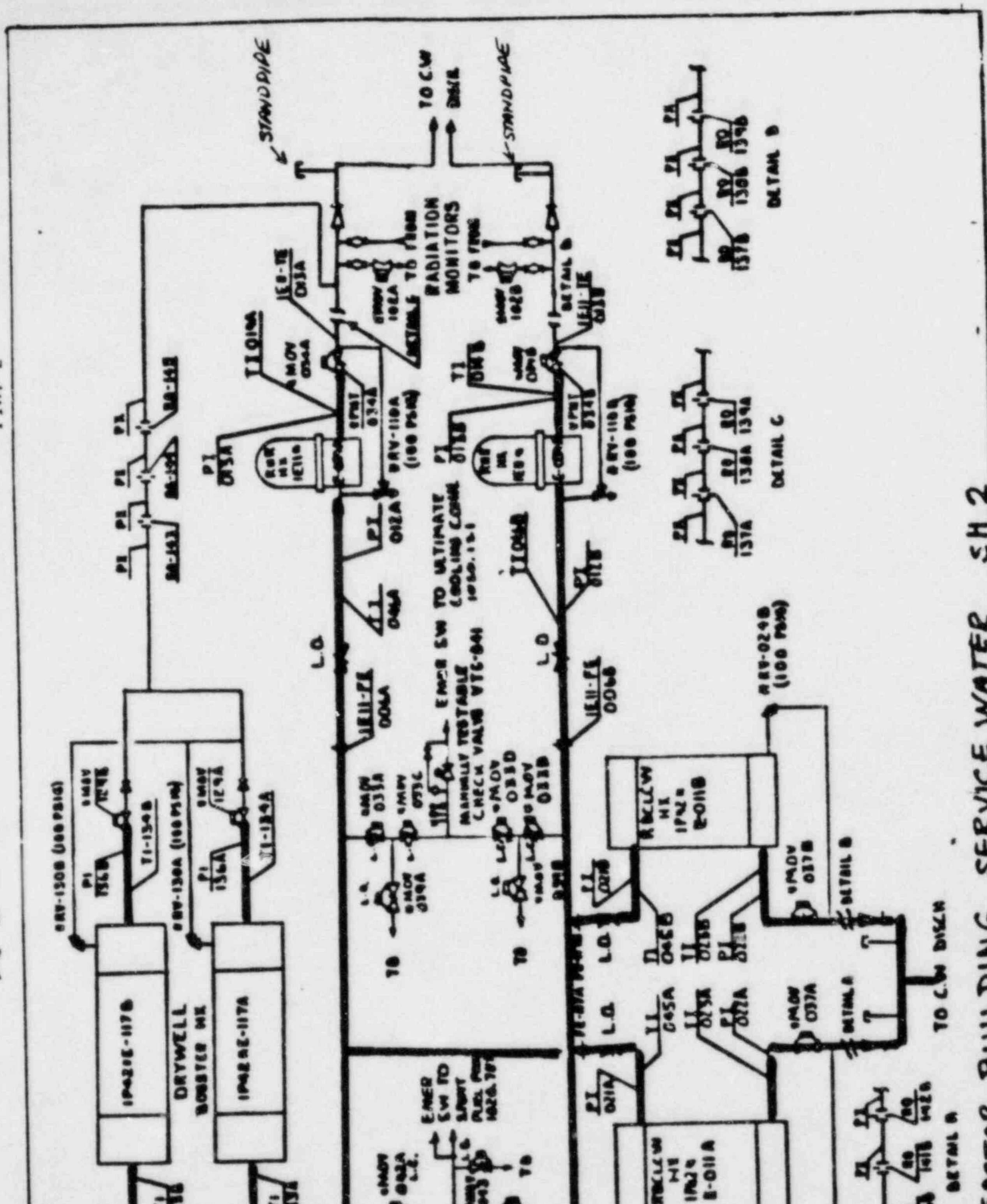
FIG. 1



LOCA
DIESEL GENERATOR COOLER
BACKWASH
TO BIOCHEMIC TUNNEL
FROM MAIN CHILLED WATER 1020.420
TO MAIN CHILLED WATER 1020.420
SEACTOR BUILDING SERVIC
VATER SH 1

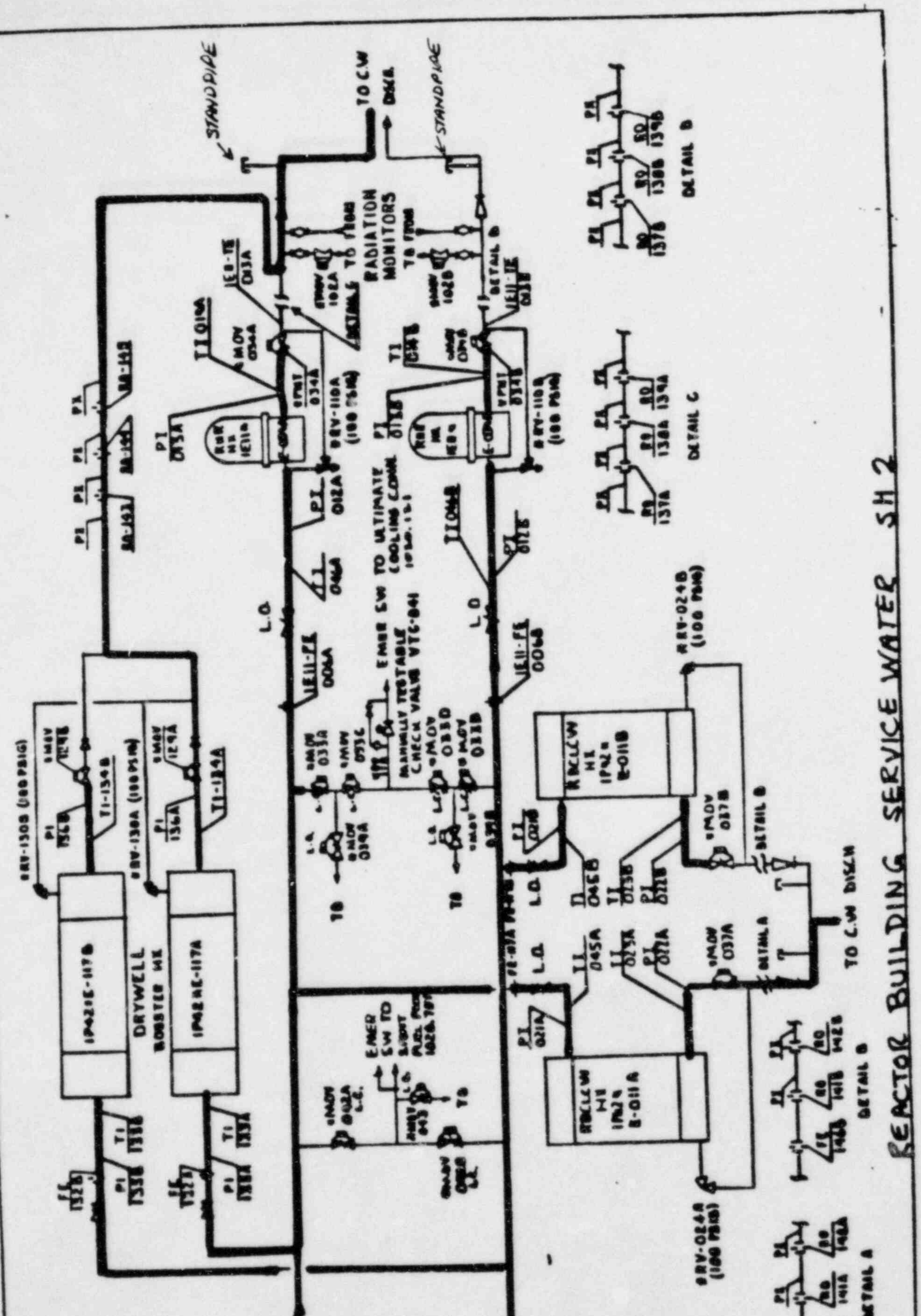
FIG. 2

LOCA


REACTOR BUILDING SERVICE WATER SH 2
DRYWELL BOOSTER HX
STANDPIPE
TO C.W. DISCH
RADIATION MONITORS
L.O.
DETAIL A
DETAIL B
DETAIL C

NORMAL

FIG. 2



REACTOR BUILDING SERVICE WATER SH 2
STANDPIPE
STANDPIPE
TO C.W DISCH.
RADIATION MONITORS
DRYWELL BOOSTER HX
EMER SW TO ULTIMATE COOLING CONN
MANUALLY TESTABLE CHECK VALVE
TO C.W DISCH
DETAIL A
DETAIL B
DETAIL C
DETAIL D

NORMAL ELECTRICAL DIST.
STUDENT HANDOUT
(From 138KV down to 24VDC)
FOR SHIFT (SRO) ADVISOR
TRAINING PROGRAM

Date: 01/05/84

Handout #: HL 308

Revision #: Ø

Prepared by: [signature] 3/12/84
Training Instructor / Date

Reviewed by: W. L. Chittenden 3/13/84
Operations Training Specialist / Date

Approved by: [signature] 3/14/84
Training Supervisor / Date

I OBJECTIVES

The student should be able to:

A. State the purpose of the Normal Distribution system.

B. State the amperage limit for the NSST, RSST and 4KV busses.

C. Given control indications or alarms be able to recognize for the Normal Distribution System.

1. the requirement of a fast transfer
2. a successful fast transfer
3. an unsuccessful fast transfer or bus lockout
4. an RSST or NSST transformer fault protection trip
5. A Loss of Offsite power
6. A Gas Turbine feeder fault backup trip
7. a 4KV/480 line, transformer or 480V bus fault
8. if a 4KV bus may be re-energized
9. a dead 125VDC bus
10. a 125VDC battery charger problem
11. a 125VDC bus ground

II PURPOSE

The purpose of the Normal Electrical Distribution system is to receive power from the LILCO system and distribute the power to the plant non-safety related equipment.

III SYSTEM DESIGN

A. GENERAL DESCRIPTION

FIG. 308-1

Power is supplied to the Normal Distribution system from the LILCO 138KV and 69KV transmission systems.

The 138KV transmission system is used to feed 4KV buses 1A and 11 via the Normal Station Transformer (NSST). Each of these 4KV buses is used to supply the loads indicated below:

Bus 1A

- "A" Reactor Recirc. MG Set Drive Motor
- A Circulating Water Pump
- A Condensate Booster Pump

Bus 11

- A TB SW Pump
- Screen Wash Pumps
- Gas Turb Auxiliaries
- A Condensate Pump
- A TBCLCW Pump
- A and B Main Chillers
- A Air Compressor
- C Circulating Water Pump
- All equipment powered from 480V buses 11A, 11B, 11C, 11D

The 69KV transmission system is used to feed 4KV buses 1B and 12 via the Reserve Station Service Transformer (RSST). Each of these 4KV buses is used to supply the loads indicated below:

Bus 1B

- B Reactor Recirc. MG Set Drive Motor
- B Circulating Water Pump
- B Condensate Booster Pump

Bus 12

- Cond Transfer Pump
- B and C TB SW PP
- Fire Pump
- B Condensate Pump
- B TBCLCW Pump
- C Main Chiller
- B & C Air Compressor
- D Circulating Water Pump
- All equipment powered from 480V buses 12A, 12B, 12C, 12D

Station loads are split between the NSST and the RSST since neither of these transformers is designed to withstand the transient load associated with a transfer of all plant equipment.

In general, station loads of less than or equal to 480V are supplied via the same ultimate power source (138KV or 69KV) that supplies the 4KV loads that these lower voltage systems support.

4KV Motor	Power Supply	480V Support Component	Power Supply
A Condensate Pump	Bus 11	A Condensate for Discharge MOV	MCC11A3
B TBCLCW Pump	Bus 12	B TBCLCW Pump Discharge MOV	MCC12C3

The 11 and 12 4KV busses supply individual components along with one supply breaker to separate step down transformers which are connected to 480V Buses. The 11A through D buses are supplied from bus 11, 12A through D from bus 12, each buses can be cross tied to its sister buses. (i.e., Bus 11A-Bus 12A etc.).

The 480V buses supply 480V Motor Control Centers (MCC's), individual components, step down transformers to 120VAC distribution panels, and 125VDC battery chargers N1 and N2.

MCC's are numbered after their normal 480 swgr power source. As an example MCC 11A3 is powered from Bus 11A. Likewise MCC 12C3 would normally be powered from bus 12C. Some MCC's are powered from another MCC but they still retain the generic designation.

Referring to Figure 308-2 and 308-3 MCC's 11A3 and 12A3 supply battery chargers for the 125VDC busses N1 and N2. The 125VDC and battery chargers supply their respective busses and apply a small trickle current (float charge) to the battery.

B. COMPONENT DESCRIPTION

a) Normal Station Service Transformer

The NSST is a stepdown (138KV / 4KV) 3 winding transformer. The primary winding is supplied via the LILCO 138KV transmission system. Two secondary windings are used to minimize the voltage transient on equipment powered from the Normal Distribution system when a Rx Recirc MG Set Drive Motor is started.

The NSST is a Nitrogen blanketed, oil cooled transformer that can be operated in any one of 3 cooling modes (controlled locally at transformer control panel).

NSST Cooling Modes

1. Natural oil circulation - Natural air circulation (OA), 1650A
2. Natural oil circulation - Forced air circulation (FA), 2200A
3. Forced oil circulation - Forced air circulation (FOA), 3110A

The NSST is supplied with redundant protective relaying schemes (primary and backup) that are used to isolate the transformer from all electrical connections in the event of an electrical fault condition.

b) Reserve Station Service Transformer

The RSST is essentially the same as the NSST except it is supplied from the 69KV LILCO GRID. It .as the same current limitations based on the mode of cooling.

C) 4KV SWGR are metal enclosed, air cooled, cubicled compartments for 2000A supply, 1200A feeder breakers, and control devices. The switchgear supplies components in excess of 250 HP.

Auto transfer schemes are provided between the RSST and NSST along with fault protection lockouts. Refer to I&C Section.

Incoming supply line breakers have two protective functions:

a) Trip in the event of a fault on the supply side of breakers. Fast transfer initiated.

b) Trip in the event of a fault on bus being supplied - Fast transfer blocked so that alternate supply breaker doesn't close onto a fault.

Fast transfer is locked out if not complete within 10 cycles this prevents breaker closure in which motors are significantly "out of step" with the bus.

Motor feeder breakers have multiple functions:

a) Protect connected motor in event of fault

b) Protect motor feeder cables in event of overload or fault conditions

c) Open in event loss of bus voltage is sustained beyond the period required for fast transfer.

All breakers use 125VDC control power TRIP or CLOSE. The breakers are capable of one close and trip per charge. Manual operation of the breaker can be performed locally at the cubical, however, all automatic protective functions are inoperative if 125V DC is not available.

D) 480V SWGR - are metal enclosed, air cooled, cubicled compartments with a step down transformer. Supply and feeder breakers are of the horizontal rack in and out type.

Between the 4KV/480V air cooled transformer and the 480V bus there is an Inductrol automatic voltage control transformer.

480V Buses supply components between 100 and 250 H.P. The Maximum bus current is 1600A as indicated on the local ammeter.

There is no auto transfer scheme for the 480V Swgr breakers. Fault protection trips and lockouts will occur for transformer and/or bus faults. Refer to I&C Sections. Feeder breakers will trip on a sustained undervoltage.

All breakers use 125VDC for control power which is needed to TRIP or CLOSE a breaker.

E) Motor Control Centers. (MCC) are metal enclosed load centers, supplied from their respective busses. (i.e. 12B4 is the fourth MCC supplied from 480V Swgr 12B)

1. Some MCC's are supplied from other MCC's rather than a SWGR. (i.e. MCC 12B6 is fed from 12B4)

2. MCC cubicles have a breaker (the outside handle) and may have a contactor inside. Control power is from a 480/120V transformer downstream of the breaker.

3. MCC's feed smaller loads, up to 100 HP.

4. MCC's may be manually cross tied to other MCC's.

F) 125VDC consists of 4 divisions. The only portion that is a part of the Normal Distribution System is the non-safety system, part consisting of black batteries N1 and N2.

The two black batteries supply equipment required to achieve the safe shutdown of major plant items when offsite power is lost.

The batteries, busses and chargers are similar to and discussed in the Emergency Distribution Lesson. Take note of the below designations.

The black batteries were an add on, so the numbering sequence (N1, N2) end at the bus.

N1 - Supplied from 11A3 and feeds 1R42-PNL-A3, A4, A5 and C2

N2 - Supplied from 12A3 and feeds 1R42-PNL-B3, B4, and C3

Refer to FIG 308-2 and 308-3

IV CONTROLS AND INSTRUMENTS

A. CONTROLS

The following controls for the Normal Distribution System are located in the main control room.

1. MOABS - 640 (69KV to RSST primary, motor operated air break switch)
2. All 4KV supply breakers to 4KV busses
3. All 480V supply breakers to 480V busses
4. All 480V cross tie breakers to 480V sister busses (i.e. 11A to 12A cross tie)

B. The following Normal Electrical Distribution system parameters are monitored in the Main control room.

1. NSST/RSST Load (MW)
2. NSST/RSST secondary side amps. (3110A MAX)
3. NSS amp load to each 4KV bus. (2000A MAX)
4. RSS amp load to each 4KV bus. (2000A MAX)
5. NSST/RSST Cooling Mode Status lights
6. 4KV bus voltage
7. 480V bus voltage
8. 125VDC bus voltage (indicator and background recorders)
9. (+) bus volts to ground and (-) bus volts to ground for the 125VDC system

The 4KV system voltage is normally controlled at 4160V by the Station Operator. If there is a problem the transformers can be off loaded and the tap changers adjusted.

The 480V system voltages will normally be regulated by their respective automatic voltage control transformers. This will determine the 120VAC voltages.

The 125VDC system voltage is regulated by the respective battery charger and should be 130-135 VDC for a fully charged battery.

The DC system is an ungrounded system. Grounds on the N1 or N2 bus are distinguished by a difference in brilliance of the two white lights on the MCB. A ground on only one side should be located as soon as possible. Damage and/or breaker tripping will occur if both the + and - lead have a ground.

C. INTERLOCKS - all assume normal lineup. Review Fig 308-9 so you can identify the normal lineup.

1. Terms

   a. Transformer Primary Protection (Pri Prot) - this is a protection scheme which isolates a transformer by opening an upstream and a downstream breaker. There is normally no lockouts associated with a Pri Prot. This scheme is normally initiated on a primary to secondary differential overcurrent circuit (Pri to Sec Diff OC).

b. Transformer Backup Protection (B/U Prot) - This is a protection scheme which normally is called to operate if the Pri Prot failed. It will usually isolate the upstream power source or a larger portion of a distibution system.

c. Fast Transfer Scheme (Fast Xfr) - occurs normally with a Pri Prot. The source of power for a bus is transfered with no loss of equipment, supplied by the bus.

d. Slow Transfer Scheme (Slow Xfr) - occurs normally with a B/U Prot. The source of power for a bus is transferred but equipment is tripped because a dead bus transfer was accomplished. Equipment may restart dependent on its control circuit.

2. <u>RSST Primary Protective Trips</u> Figure 308-4

a. This trip will isolate the RSST from all sources of power due to the following. (86T4P)

Signal	Identification
Pri to Sec Diff OC 69KV Bus Diff OC	RSS PRI PROT TRIP (0220) ANN
	4KV RSS SUPPLY BRK AUTO TRIP (0082) ANN

b. System Response - The Transformer input and output breakers will trip open, the cooling fans will trip.

3. <u>NSST Primary Protection Trips</u> Figure 308-5

a. This trip will isolate the NSST from all sources of power and protect the equipment tripped. (86T3P)

Signal	Identification
Pri to Sec Diff OC	NSST PRI PROT (0218) ANN
	4KV NSS BRK AUTO TRIP (0081) ANN

b. System Response - All input and output circuit breakers will trip open, the cooling fans will trip. The main generator and turbine will trip most probably causing a scram.

4. RSST Backup Protective Trips Figure 308-6

a. This trip will isolate the RSST from all sources of power due to the following. (86T4B)

Signal	Identification
Numerous Electrical Sudden Pressure, 69KV Breaker Failure Gas Turb Breaker Failure	RSS BU PROT TRIP (0221) ANN
	4KV RSS SUPPLY BRK AUTO TRIP (0082) ANN 4KV BUS UNDERVOLT (0085) ANN

b. System Response - The Transformer input and output breakers will trip open, the cooling fans will trip.

On a backup protection trip Bus 1B and 12 will lock out, most probably causing a scram, because the NSST breakers will not close.

5. NSST Backup Protection Trips Figure 308-7

a. This trip will isolate the NSST from all sources of power. (86T3B)

Signal	Identification
Numerous Electrical Sudden Pressure 1310/1330 Brkr Failure	NSST BU PROT (0219) ANN
	4KV NSS BRK AUTO TRIP (0081) ANN 4KV BUS UNDERVOLT (0085) ANN 1310/1330 Fail Scheme Operated (0281/0061) ANN

b. System Response - All input and output circuit breakers will trip open, the cooling fans will trip. The main generator and turbine will trip most probably causing a scram.

On a backup protection trip Bus 1A and 11 will lockout, most probably causing a scram, because the RSST breakers will not close.

6. 4KV Bus Auto Isolation Lockout Figure 308-6 or 7

a. The 4KV normal busses will trip and not transfer due to the following signals.

Signal	Identification
NSST Backup Prot RSST Backup Prot Sys Backup Prot 1310/1 30 BRK Failure Scheme 4KV Bus Fault Bus 11 or 12 4KV/480 Feeder Backup Prot	4KV NSS or RSS BRK AUTO TRIP (0081/0082) ANN ANN for respective signal
Bus 11 Gas Turb Area Feeder Backup Prot Fast Transfer failed (10 cycles) Bus 11 and 12 on same Xfmr + Accident Signal	4KV Bus UV(0085) ANN

b. System response - Supply breaker that was closed is OPEN with bright white light, alternate breaker is OPEN. Individual 4KV loads trip on undervoltage.

NOTE: The only way to tell if you can re-energize a dead bus is by checking all signal trip devices in Relay Room or on Swgr.

There is no trip device you can check for fast transfer failure, or Bus 11 and 12 on the same transformer with an accident signal.

7. 4KV Bus Auto Transfer Initiation Figure 306-4 or 306-5

a. The 4KV normal busses will fast transfer to its alternate supply due to the following signals.

Signal	Identification
The breaker supplying the bus OPENS due to 1. Operator Action 2. NSST Pri Prot Trip 3. Gen Line Prot Trip	Green light on NSST or RSST supply breakers
4. RSST Pri Prot Trip	4KV NSS or RSS BRK AUTO TRIP (0081/0082) ANN

b. System response - The supply breaker that was closed will have a bright white light, the alternate supply breaker will close, giving red light, if there is a voltage on its transformer.

8. 480V Bus Isol Figure 308-8 A and B

a. All of the 480V SWGR supply breakers will trip open on the signals below, there is no auto transfer.

Signal	Identification
Respective Brk Ø OC Respective BRK Gnd OC Respective 4KV Feeder OC Any 4KV/480 Transformer Gnd OC	480V NSS SPLY BUS UNDER VOLT ANN (0279) + Brk or Transformer OC ANN

b. System Response - individual breakers on phase overcurrent which trip opens the breaker and gives a bright white light. A transformer ground is indicated below for 11B. The 11A, C, D and 12A-D would be similar except for which X-TIE breaker is locked out.

4KV/480 Feeder Open
11A 480 Supply Brk Open
11B 480 Supply Brk Open
11C 480 Supply Brk Open
11D 480 Supply Brk Open
11B-12B X-TIE Locked Out.

NOTE: A 4KV feeder L/O would be the same except the Bus Tie Brk would not be locked out.

NOTE: Fig. 308-8B

1. Backup protection on the 4KV/480 Feeder breaker will trip the 4KV Normal and/or Reserve supply breaker for the respective 4KV bus.

2. There are no protection trips on the X-TIE breaker other than individual OC.

D. ANNUNCIATORS - Refer to Fig 308-9

The following Ann are located in the Main CR.

ANN	ARP #	CR Verification (Excluding Computer)
- NSS XFMR PRI PROT TRIP	Ø218	EO finds 86T3P tripped on RR PNL RS1
- NSS XFMR BU PROT TRIP	Ø219	EO finds 86T3B tripped on RR PNL RS1
- NSS OR RSS XFMR PROT LOSS OF CONTROL	Ø222	EO finds 1 of 4 Amber light off on RR PNL's RS1/RS2
- NSS XFMR TROUBLE	Ø226	EO sent to transformer - Various
- REMOTE TRIP - SWYD RELAY OPER	Ø461	EO sent to 138KV Yard House
- RSS XFMR PRI PROT TRIP	Ø220	EO finds 86T4P tripped on RR PNL RS2
- RSS XFMR BU PROT TRIP	Ø221	EO finds 86T4B tripped on RR PNL RS2
- RSS XFMR TROUBLE	Ø227	EO sent to transformer - Various
- 4 KV NSS SPLY BRKR AUTO TRIP.	ØØ81	4KV NSS Brk white and green light on 1A, 1B, 11, and 12
- 4 KV RSS SPLY BRKR AUTO TRIP.	ØØ82	4KV RSS Brk white and green light on 1A, 1B, 11, and 12
- 4 KV NSS FDR BRKR AUTO TRIP.	ØØ84	Either 4KV/480 supply brk white and green light OR EO finds Gas Turb Fdr Open

ANN	ARP #	CR Verification (Excluding Computer)
- 4 KV NSS BUS UNDERVOLT	ØØ85	BUS 1A, 1B, 11, and 12 voltage indicates low Bus Load trip, RBSVs starts if on 11 and 12 (2900)
- 4 KV BRKRS NSS & RSS PARALLELED	Ø243	Both brks on Bus 1A, 1B, 11, or 12 closed at the same time.
- 4 KV NSS SPLY UV CKT LOS CONT.	Ø244	EO finds Local Amber light on SWGR OFF
- 48Ø V NSS SPLY BRKR OC TRIP.	Ø161	EO finds local white tab tripped
- 48Ø V NSS SPLY BRKR XFMR GND.	Ø162	EO finds 86 device tripped
- 48Ø V NSS TIE BRKR OC TRIP.	Ø163	EO finds local white tab tripped on brk
- 48Ø V NSS SPLY UV CKT LOSS CONT.	Ø278	EO finds local Amber light on SWGR OFF
- 48Ø V NSS SPLY BUS UNDERVOLT.	Ø279	Any 480V Bus indicates low, loads trip
- BUS 11A-12A SPLY - TIE BREAKERS PARALLELED.	Ø33Ø	Supply and X-TIE Brks Red light
- BUS 11B-12B SPLY - TIE BREAKERS PARALLELED.	Ø331	Supply and X-TIE Brks Red light
- BUS 11C-12C SPLY - TIE BREAKERS PARALLELED	Ø364	Supply and X-TIE Brks Red light
- BUS 11D-12D SPLY - TIE BREAKERS PARALLELED.	Ø38Ø	Supply and X-TIE Brks Red light
- BLACK BATTERY TROUBLE	Ø476	Dispatch EO to field

Fig 308-10 4KV fault on Fdr B/u Prot
11 Loss of Offsite Power
12 4KV fault on Fdr B/u Prot or Gas Turb
13 Bus 11 & 12 on one Xfmr + LOCA
14 480V Bus fault
15 Dead 125VDC
16 Batt Charger or Gnd

V SYSTEM PROCEDURES

A. SYSTEM PRECAUTIONS, CAUTIONS, AND/OR LIMITATIONS

1. The motor-operated and manually operated air break disconnect switches are "Off Load" switches not designed with load interrupting capability. No attempt should be made to operate them when they are carrying load.

   a. Purpose - To prevent personnel injury and/or damage of the ABS due to excessive arcing.

   b. Recognition - Disconnect switches should only be opened via a switching order received from the System Operator (SO).

2. Tap changers must <u>not</u> be operated while the transformer is energized. Serious personal injury and/or damage to the transformer may result if this is attempted. The tap changers are designed for "off-load" operation only.

   a. Purpose - above

   b. Recognition - Tap changing is done by substation maintenance section in conjunction with a switching order.

3. Damage to the transformer may result if both tap changers are not selected to the same setting.

   a. Purpose - to have the same voltage on the secondary winding output.

   b. Recognition - Difference of voltages of 4KV busses when supplied from different secondary windings.

4. Current transformer secondary windings must <u>not</u> be open circuited under any circumstances when the transformer is energized or damaged will result and dangerous voltages may be developed.

   a. Purpose - above

   b. Recognition - local shorting bar not in place

5. The radiator inlet and outlet valves should not both be left closed on any radiator, or damage due to thermal expansion may result. No relief valves are fitted.

   a. Purpose - above

   b. Recognition - local valves closed with XFMR energized

6. Before resetting any protection relay, ensure that the condition which caused the trip has been determined and corrected.

a. Purpose - not to re-energize a faulted bus

b. Recognition - 86 device tripped or flag up on a protective device. Should only be reset after obtaining permission from the Watch Engineer.

7. When opening or closing a manually operated air-break disconnect switch, a positive visual check should be made to verify all three phases are in the desired position.

   a. Purpose - to prevent single phase energizing of transformer

   b. Recognition - motor trips due to locked rotor protected on motor start.

8. Should an arc-over occur during a closing operation of the air-break disconnect switch or if any blade should fail to close properly, do not attempt to open the air-break disconnect switches.

   a. Purpose - to prevent damage to the ABS due to arcing

   b. Recognition - local

9. The Fire Protection Water Deluge System tends to expell all air from the vicinity of the transformer when it is initiated. Personnel working in the vicinity should be aware of this and vacate the area if the deluge system is initiated.

   a. Purpose -

   b. Recognition - Fire Panel alarm

10. Both incoming supply breakers on any 416Ø V normal station bus shall not be closed simultaneously except when transferring from one supply to the other, and then only for a short period of time.

    a. Purpose - to prevent damage due to circulating currents between secondary windings of NSST and RSST.

    b. Recognition - RSST and NSST breakers for ! bus closed at the same time and/or Paralleled Ann.

11. Breaker operations are normally carried out from the main control board. Local operation is possible but should only be used when normal control is lost and never to transfer between the normal and reserve supplies.

    a. Purpose - prevent damage to bus during periods of minimal indication.

    b. Recognition - NSST and RSST Breakers closed without CR operation.

12. If all loads are being supplied from one transformer, closely monitor the amperage on the transformer to insure that it is not overload.

    a. Purpose - above

    b. Recognition - secondary winding amperage approaching 3110A.

13. Do not close incoming breakers manually if control power is lost.

    a. Purpose - to protect the bus since the breaker will not trip without control power. Also provides personnel safety.

    b. Recognition - No indication of breaker or LCTL Ann and bus re-energized.

14. For all 480 V switchgear: Before racking in a breaker, the control switch for that breaker must be in the "PULL-TO-LOCK" position, where applicable.

    a. Purpose - prevent inadvertant breaker closure

    b. Recognition - control switch position not in P-T-L

15. Before tying buses together, ensure that both buses 11 and 12 are being fed from the same transformer. If not, the affected 480 VOLT BUS must be de-energized before closing the Tie Breaker. (480V caution 8.12)

    a. Purpose - to protect against large currents due to circulating current.

    b. Recognition - Bus 11 and 12 supply breakers closed form different transformers.

16. Prior to energizing switchgear from a bus tie, ensure total load is less than the transformer limit. (480V caution 8.1.2)

    a. Purpose - protect transformer from overcurrent

    b. Recognition - local ampmeter for the 11 and 12 sister buses indicate greater than 1600 amps.

B. NORMAL OPERATION Fig. 308-9

The normal distribution systems are in operation when they are energizing their respective loads through the previously discussed power trains.

The Prerequisite checklist requires a check of the flexi test switches which disconnect Unit, Sys, Gen line, etc. protection. These circuits are verified energized by their respective amber indicating light on PP panel RU-1, 2 and 3.

The requirements for a megger reading on equipment is by the WE or maintenance department. The acceptability of the findings is stated on the maintenance surveillance form.

A prerequisite for the battery is that the checks are completed. There may be found in SP 23.315.01 section 8.1.2 in addition to any maintenance section checks.

Before starting any equipment on a 4KV or 480V switchgear, the operator should determine that the rated amperage for the equipment, when added to the amperage that the bus is carrying does not exceed the bus or transformer maximum amperage. This may occur when the switchgears are cross tied.

NOTE: A 4KV bus load is also a transformer load, so check both.

C. ABNORMAL OPERATION - refer to Emergency Distribution for T.S. limitations

1. Loss of the NSST or RSST -

If due to a fault the 4KV bus will fast transfer to its alternate source. If due to a loss of voltage on the LILCO grid, operator action is required to strip the bus, open the lost supply breaker and close in the alternate supply breaker.

NOTE: If an accident occurred at this time both 11 and 12 buses would trip and only one could be re-energized after 30 seconds.

If bus 11 or 12 is locked out transfer the respective 480V Bus to its alternate source via the tie breakers.

The 120VAC panels N1 and N2 will transfer to their alternate source. The major loads on N1 and N2 is the Display Memory Module Fan and control room recorders.

The 120VDC buses will stay energized on the batteries until power is restored to the respective switchgear.

2. Loss of Offsite Power

All normal distribution systems are de-energized except for the 125VDC and 24VDC systems which are on their respective batteries. Indication would be by:

4KV NSS BUS UNDERVOLT ANN
4KV EMERG BUS UNDERVOLT ANN

3. Battery Charger Problems

A battery charger failure would be indicated by:

BLACK BATT TROUBLE ANN

The black batteries may show a low voltage indication on the MCB or back panel recorder.

A ground on one line is indicated by a difference in brilliance of the MCB white lights.

The response in either case would be to dispatch an EO to check the charger.

4. Loss of a Distribution Bus or Panel

If an abnormal condition can not be identified to a logical failure (i.e., trip of a pump etc.) then a loss of power would be suspected.

The identification of a loss of a bus or panel could be one of the following:

1. Auto trip alarm on numerous components
2. Several equipment problems in one area of the plant
3. Loss of indicating lights on equipment (leads you to a loss of MCC)
4. Downscale (below zero) failure of indicators or recorders
5. AOV's change state to their failure positions

A loss of a 120VAC panel can be picked up by 4 and 5 above.

The first response of the operator is to handle any trip, scrams or isolations that may have occurred.

Additionally he would scan his indications checking for overloaded equipment i.e.: one service water pump running when 3 are required, a transformer at or near its rated capacity.

When a loss of power is determined by the operator a selection of one load can be traced, via prints, computer sorts or readouts, or SP checklist to find the specific load source. Then the operator would have to go up and downstream from there to find the initial cause.

A list of loads for a bus or panel can be found in the control room Power Distribution book, Load List by Power Source book, and/or by the S&W FE - 1A X one line diagram.

The alternate source for an MCC can most easily be seen on the FE one line prints.

If a transformer capacity is reduced because of lack of cooling fans use the Load List book to determine what equipment can be removed from service.

D. EMERGENCY OPERATIONS

High drywell pressure or Lo Lo Lo reactor level will not have a major effect on the normal distribution system.

VI SYSTEM INTERRELATIONS

The LILCO 69KV and/or 138KV grids must be energized to supply the primary motive force for all electrical loads.

The 125VDC buses N1 and N2 are needed for control power for the 4KV and 480V Swgr.

VII TECHNICAL SPECIFICATIONS

There are no Technical specifications related to the normal distribution buses. Offsite power will be covered in Emergency Distribution.

NOTE: A loss of power causes a component to be INOP therefore you may be in Tech. Specs. (i.e., SRM drives).

VIII SIGNIFICANT INDUSTRIAL EVENTS

A. Offsite Fire Causes Station Blackout

Incident:

While in cold shutdown, a brush fire started near the main switchyard. Local firefighting agencies who were called in to fight the fire requested that two transmission lines into the site be de-energized to aid in firefighting. During the next 14 hours all other transmission lines were successively lost resulting in a total loss of offsite power. The transmission circuits automatically tripped because of out of phase comparisions in the transmission protection logic. Smoke from the fire had provided sufficient conductive path between the three phases to cause a differential trip. All diesel generators worked and supplied power to the site for four and one half hours until offsite power was restored.

In the past 10 years there have been six documented cases of a loss of all offsite power to nuclear power plants caused caused be offsite forest/grass fires. The main cause of the transmission logic trips has been smoke which induces out of phase differential trips. All of Shoreham's transmission lines stretch through woodland which are susceptible to fires, especially during the summer months.

B. 4160 Volt Breaker Problem

Plant: Shoreham

Incident:

Trip flags on 4160 volt breaker protective relays have been observed to spuriously fall (indicate a breaker relay trip) in response to minor mechanical jarring such as that experienced when a switchgear door is closed. Failure to assume that all relay flags are properly reset could mislead or confuse trouble shooters/operators in the event of a breaker fault trip.

C. 480 Volt Breaker Problem

Incident:

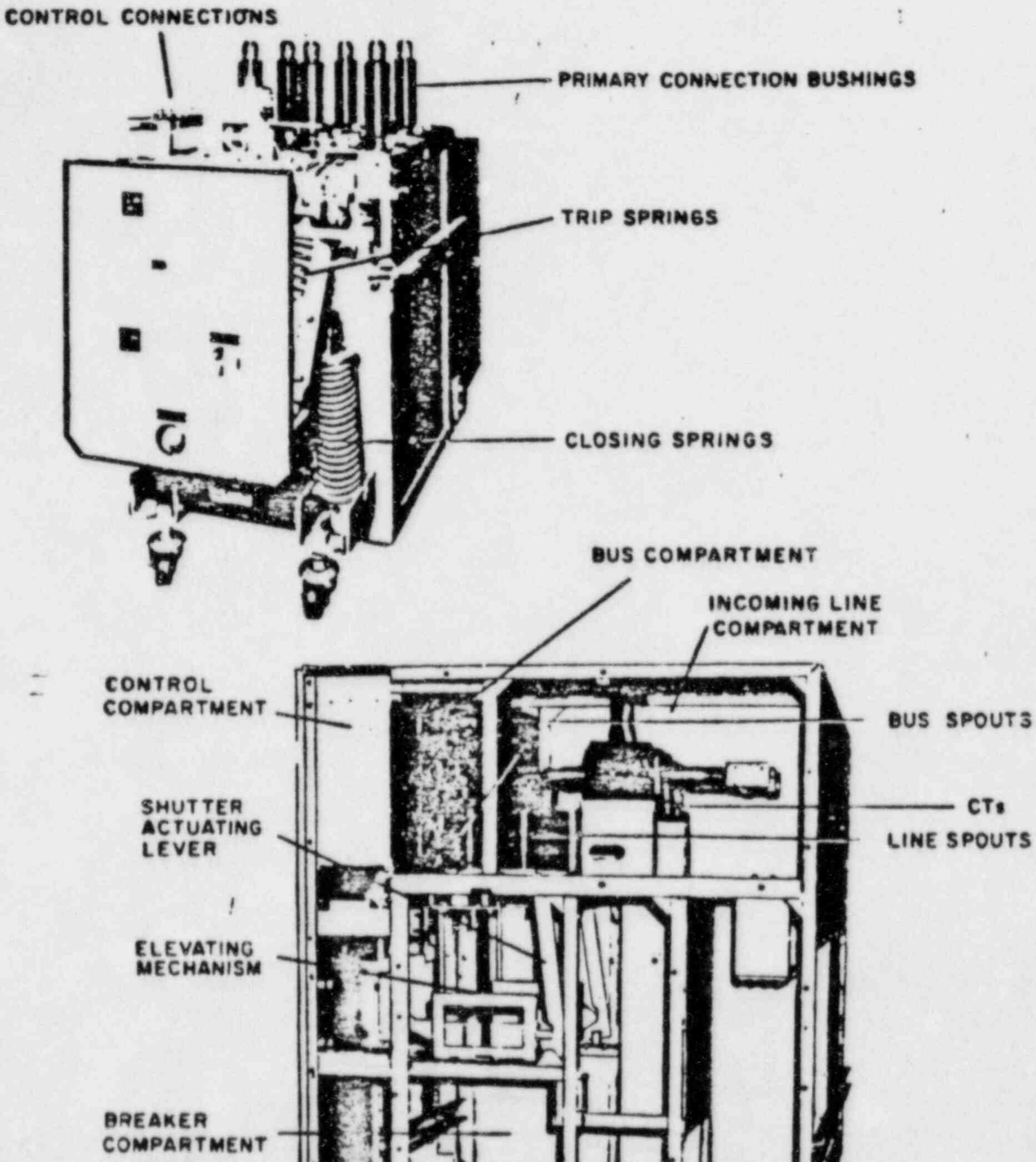
A 480 volt bus tie breaker failed to operate on demand. Investigation revealed that the breaker charging spring motor had been inadvertantly de-energized. A toggle switch, which is located on the breaker face was inadvertantly switched to the off position and, thereby, prevented the recharging of the breaker close spring.

Shoreham's 480 volt breakers are similar to those installed at Fort St. Vrain in that there is a charging spring motor on/off toggle switch located in the breaker face. Mispositioning of the toggle switch could defeat the function of those systems supplied by 480V breakers including safety related or power process related equipment.

D. Overloading of MOV Close Circuits

Incident:

If a MOV with seal-in circuit design is held in the closed position after the valve is full closed, the valve operator power supply can overload and trip. This trip would require a local reset and would result in a loss of the remote operability of the MOV. MOV's which are equipped with a seal-in feature should normally be allowed to stroke without use of the "emergency" features which is initiated by continually holding the control switch.



METAL-CLAD SWITCHGEAR

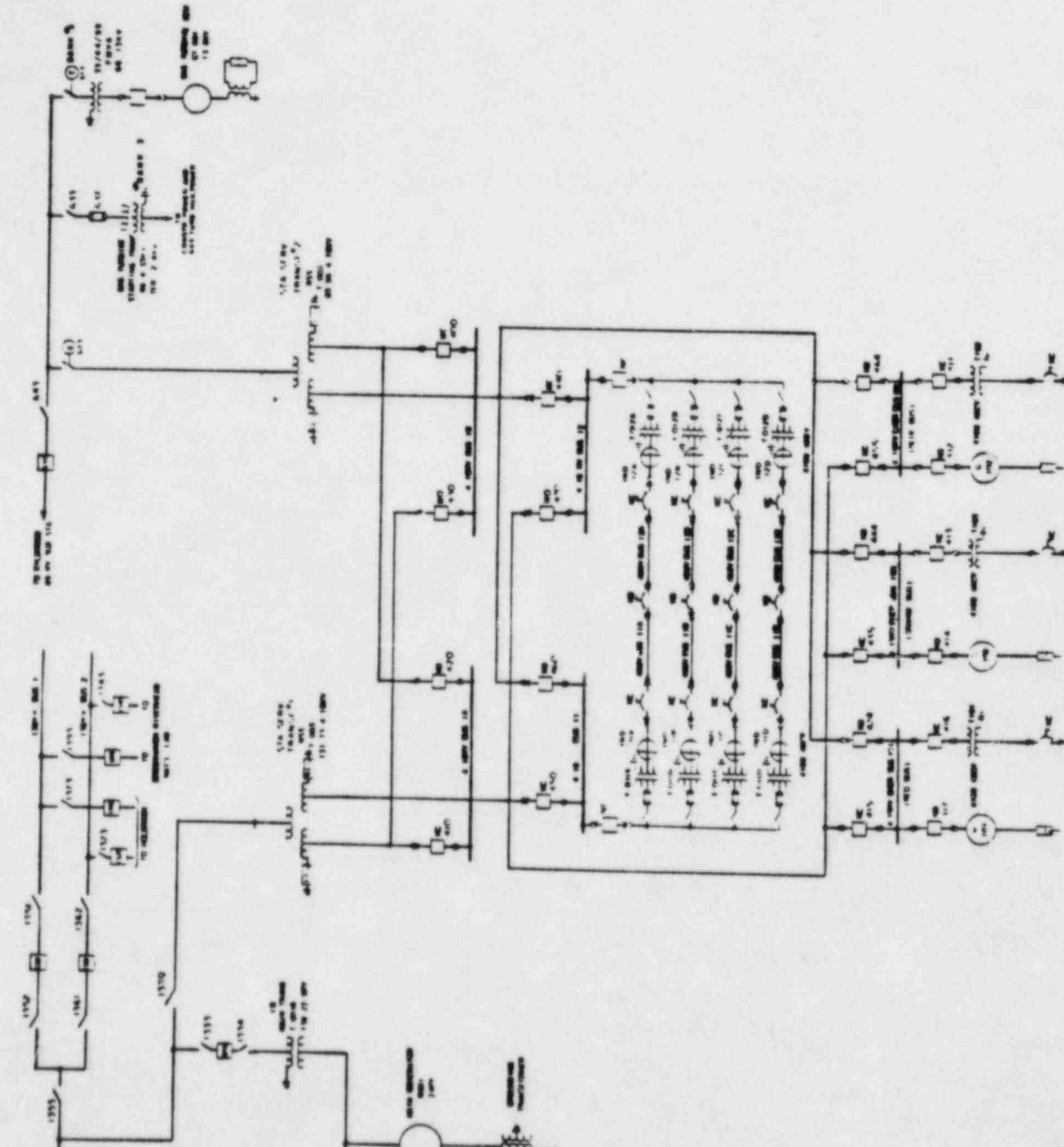


FIGURE 308-1

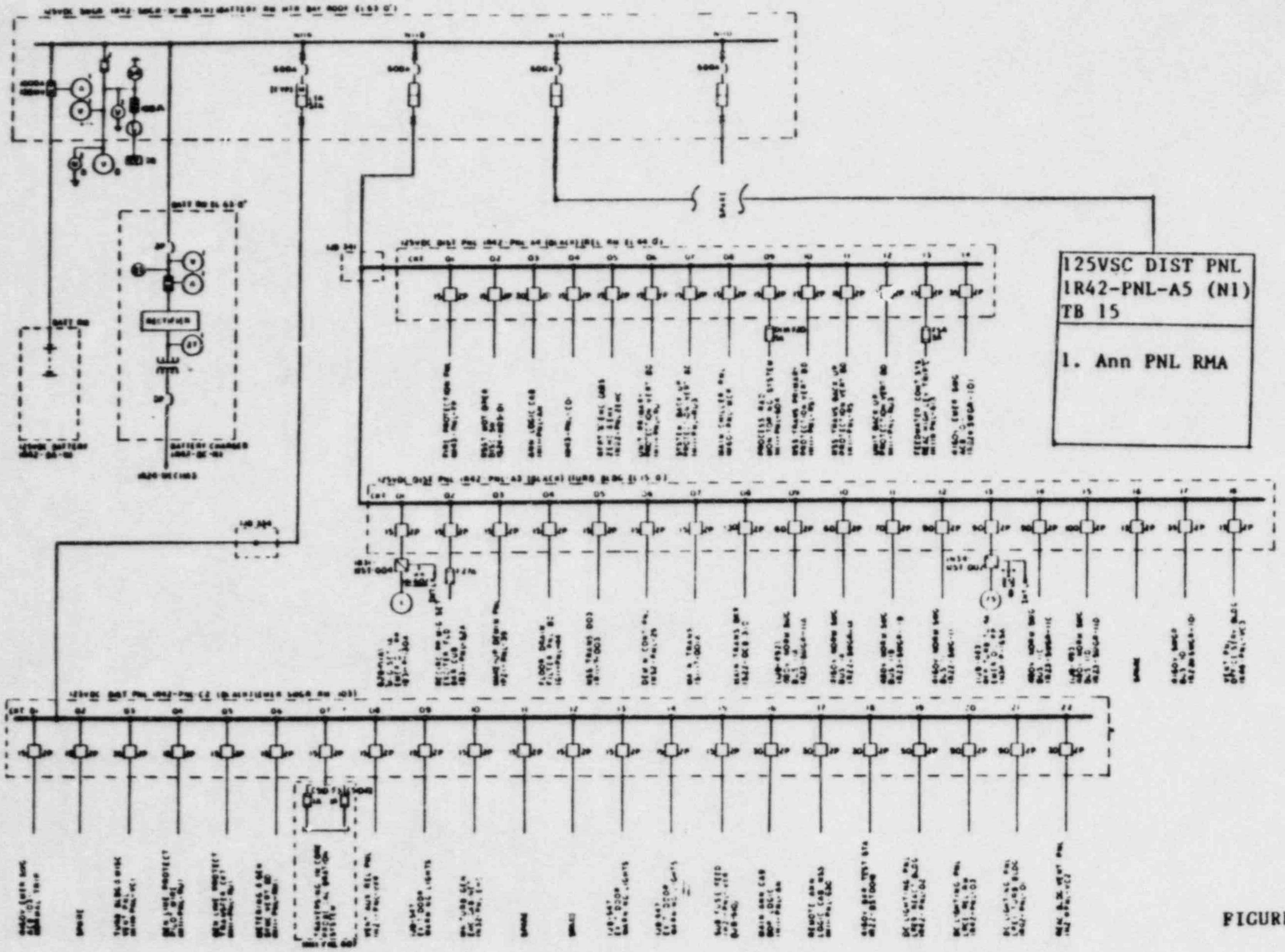


FIGURE 308-2

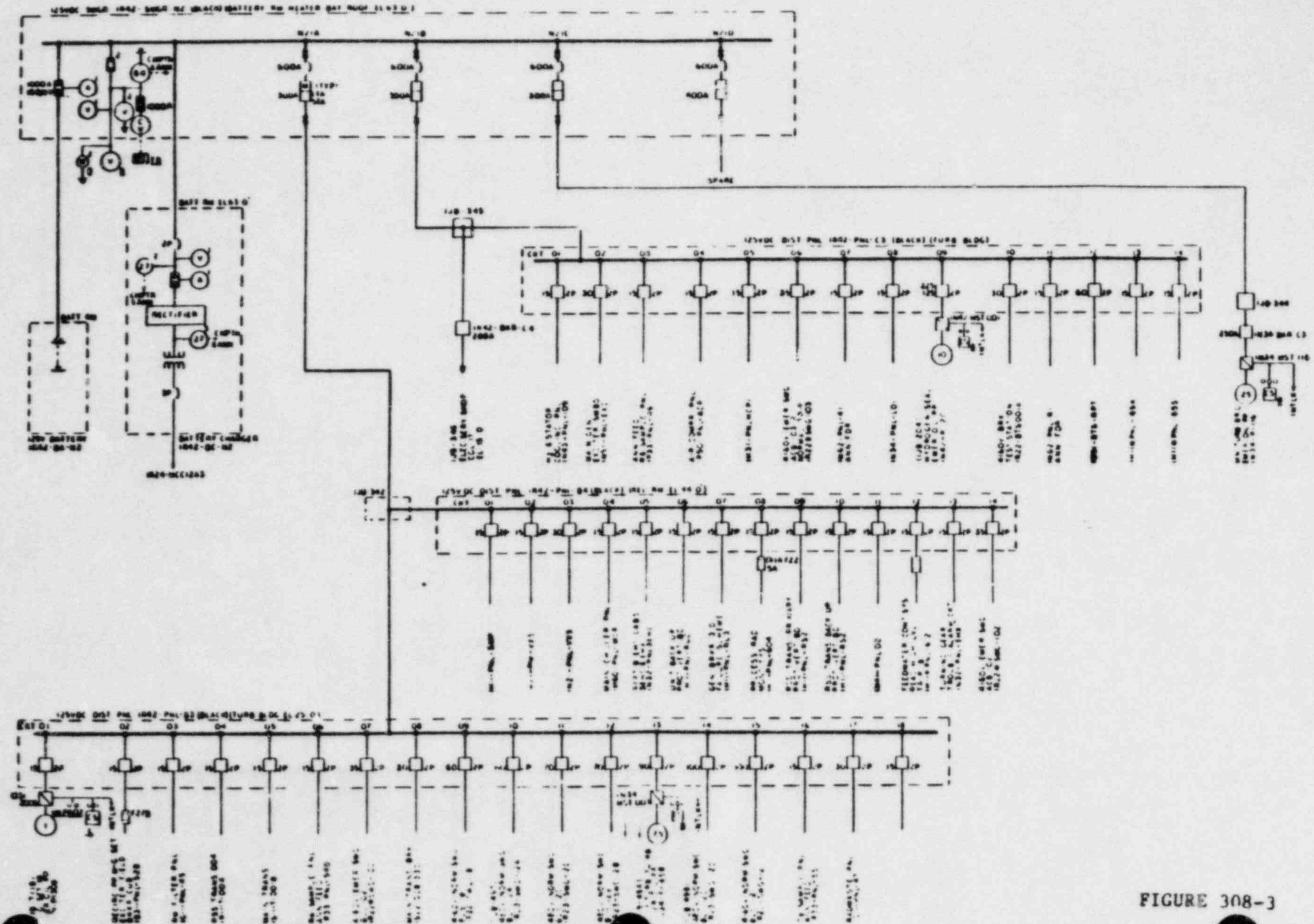


FIGURE 308-3

EMERGENCY ELECTRICAL DISTRIBUTION

STUDENT HANDOUT

Date: March 13, 1984

Handout #: 309/311/314/315

Revision #: 3

Prepared by: W J Chittenden 3/21/84
Training Instructor / Date

Approved by: Marcelin P Pechin Jr 3/21/84
Operations Training Specialist / Date

1.0 LESSON PLAN: Emergency Electrical Distribution

2.0 LECTURE DURATION: 4 Hours

3.0 MATERIALS REQUIRED FOR STUDENTS:

3.1 Emergency Electrical Distribution Lesson Plan

4.0 MATERIALS REQUIRED FOR INSTRUCTOR:

4.1 Related Graphics

5.0 REFERENCE MATERIAL:

5.1 4160V AC, 480V AC, 125V DC, System Descriptions

5.2 FSAR, Chapter 8

5.3 Technical Specifications, Section 8

6.0 SCOPE OF LECTURE:

To give the student the arrangement, instrumentation and operation of the emergency electrical distribution system.

7.0 STUDENT OBJECTIVES

At the completion of this lesson the student should be able to:

7.1 State the purpose of the Emergency Electrical Distribution System.

7.2 Given an Emergency Electrical Distribution bus, state the normal and alternate power supplies to that bus.

7.3 Given an Emergency Electrical Distribution 4KV bus, state the loads on that bus.

7.4 In the Control Room either point out or correctly operate all controls for the Emergency Electrical Distribution System that are identified in the following procedures: SP 23.309, 23.311.01, 23,314.01, 23.315.01, 24.309.01, 24.315.01, 29.015.01 or 29.015.02.

7.5 Validate any given control room annunciator related to the Emergency Electrical Distribution system.

7.6 Given a diagram of various control room annunciators and/or indications, identify the following Emergency Electrical Distribution Conditions:

a. Normal Bus Configuration
b. A successful fast transfer
c. An unsuccessful fast transfer
d. A bus fault
e. An NSST or RSST fault protectin trip

f. A loss of offsite power
g. A 4KV/480V transformer or bus fault
h. If a bus can be reenergized
i. If a slow transfer signal is present
j. A successful slow transfer
k. An unsuccessful slow transfer

7.7 Given any of the Precautions or Cautions contained in SP 23.309.01, 23.311.01, 23.314.01, 23.315.01, 24.309.01, 24.315.01, 29.015.01 or 29.015.02:

a) State the purpose

b) State how the operator can identify from control room indications that a limit of that Precaution or Caution is being approached or exceeded.

7.8 State the load limit for the 4KV Emergency Busses.

7.9 State the 4KV emergency loads that do not trip on an undervoltage condition.

7.10 State how proper LPCI MG set operation can be verified from the main control room.

7.11 State under what conditions a 4KV breaker can be operated locally.

7.12 Given a diagram of the Emergency Dist. control panel, identify if an LCO applies for Emergency Electrical Distribution and state any actions required that must be completed in less than 1 hr.

7.13 State the non-safety related loads supplied by the Emergency Distribution system that can be reenergized with a LOCA signal present.

7.14 Given a valid LOCA signal on DIV I and DIV II identify all 4KV & 480V equipment that auto operates.

7.15 Given a valid LOCA signal for either DIV I or DIV II only (I&C surveillance test mishap) identify all 4KV & 480V equipment that will auto operate.

8.0 LESSON OUTLINE:

8.1 Theory

8.1.1 Purpose

.1 The purpose of the emergency electrical distribution system is to supply the electrical power requirements of all nuclear safety related equipment.

.2 Safety related equipment is the equipment that is required to safely shutdown the Rx during an accident (LOCA) condition.

8.1.2 Design Basis — Fig. 1

.1 The emergency distribution system consists of 3 independent electric divisions. (Therefore single fault can't disable 2 divisions).

.2 All plant safety related equipment is ultimately powered from the 4KV emergency buses.

.3 Each 4KV emergency bus is capable of being supplied by the NSST, RSST or its associated EDG.

.4 Entire emergency distribution system is seismic, Cat. I. are all located in one switchgear room. (Total of 3 rooms).

.5 The 3 switchgear rooms are physically isolated from each other so that a single fault can't disable 2 divisions.

.6 Each 4KV bus can be supplied by one of 3 power sources.

a) Normal Station Service Transformer (NSST)

b) Reserve Station Service Transformer (RSST)

c) Its associated Emergency Diesel Generator (EDG)

.7 The normal power supply to each 4KV bus and therefore all equipment in that division is the NSST.

.8 Auto transfer schemes are provided to the RSST & then the EDG if NSS power is lost to the 4KV emergency bus.

.9 Each 480V bus can only be supplied by its associated 4KV emergency bus. (No crosstie breakers are provided).

.10 Each 480V bus supplies all of the various 480V MCC's associated with that division.

.11 The 480V MCC's supply various small motor loads (i.e. pumps & valves) that either support the operation of the associated 4KV equipment or perform a safety function of their own. In addition, they also supply the 125V DC Battery charger & 120V AC instrument panels associated with each division.

.12 The 120V AC instrument panels supply the AC instrumentation power to the systems associated with that division.

.13 The 125V DC Battery Charger supplies the 125V DC bus during normal operation & also supplies a small float charge on the associated 125V DC battery.

.14 The 125V DC bus supplies 125V DC distribution panels. Buses A & B also supply 125V DC MCC's.

.15 The 125V DC MCC's supply power to MOV's & auxiliaries for the HPCI & RCIC systems.

.16 The 125V DC distribution panels supply power to the associated division ECCS logic circuits, associated division EDG start auxiliaries, associated division 4KV bus & 480V bus control power as well as associated division instrumentation.

8.3 Major Equipment Description:

8.3.1 4KV Emergency Buses

a) All circuit breakers on the bus are equipped with 125V DC control power. (1 circuit breaker supplies control power to all bus breakers on one bus).

b) Circuit breaker operation is as follows: Fig. 3

1) 125V DC supplies power to a charging motor that is located inside each circuit breaker mechanism.

2) Charging motor is used to compress (charge) ACB closing springs.

3) Closing springs remain compressed until either the closing coil is energized (from control room control switch or local control switch on cubicle) or local close pushbutton is pressed.

4) When close signal is received the closing springs discharge as they close the circuit breaker contacts.

5) During the close cycle the ACB opening springs are compressed to provide motive force for opening the breaker contacts during an open sequence.

6) The compressed opening springs are held in a latched position.

7) The opening springs can be unlatched by energizing the ACB trip coil (from control room control switch or local control switch on cubicle) or pushing the local trip pushbutton.

8) ACB Operational Characteristics:

a) ACB requires control power for remote operation (closing or opening).

b) Therefore if control power is lost the breaker will remain in the position it was prior to the loss of power.

c) Loss of control power disables ACB fault protection so that on a fault condition the circuit breaker remains closed.

a) Control Power Indications

1) all 4KV circuit breakers are equipped with the following control room indicating lights.

GREEN - WHITE - RED

2) GREEN light significance:

a) indicates that ACB is OPEN and control power is available.

3) RED light significance:

a) indicates that ACB is closed and control power is available.

b) also indicates that there is continuity through the trip coil. Therefore auto trip functions will operate.

4) WHITE light

a) Indicates breaker disagreement. Control switch is auto after start and ACB is open.

b) Light is out during normal operation but on an ACB trip it will light either dim or bright.

1. dim light
   indicates ACB has tripped due to a system problem (i.e. high level, low pressure etc.). Trip can be reset by taking control switch to STOP.

2. bright light

   indicates breaker has tripped to an electrical fault & has been locked out. Lockout must be reset locally at ACB cubicle. (Lockout should not be reset until fault has been repaired).

8.3.2 480V Emergency Switchgear Buses

a) Supplied by 4KV/480V transformer from associated 4KV emergency bus.

b) breaker operation is the same as that discussed for the 4KV breakers.

c) 1 - 125V DC breaker on an associated 125V DC distribution panel supplies control power to all 480V bus breakers on each of the 480V buses.

8.3.3 480V MCC's

a) Fed from associated 480V buses
   i.e. Bus 111 supplies MCC's 1110 - 1119 etc.

b) First three numbers of MCC designate its electrical DIVISION.

c) As plant electrical requirements have grown, the number of MCC's associated with each division has also grown. Therefore, alpha-numeric designations have been incorporated.

d) The following convention has been incorporated:

   1) Letters at beginning of alphabet designate a non-safety related MCC that is supplied with emergency power.
      e.g. MCC 111A; MCC 112B.

2) These non-safety related MCC's are disconected from their emergency power sources due to either a LOCA signal or EDG supplying the associated emergency bus with a LOCA signal present (load shed).

3) Panels in the emergency switchgear rooms allow non-safety related loads to be reenergized by manually overriding their load shed signals:

NOTE: loads are reenergized by taking their override switch to the override position. (White light illuminates to indicate the load shed signal has been overridden). MCC breaker must then be reset.

e) Letters at the end of the alphabet designate safety related MCC's.

e.g. MCC 111X, 112Y, etc.

f) MCC Operational Characteristics

1) Each remotely controlled AC MCC load uses 120V AC control power.

2) This 120V AC control power is tapped off via a stepdown transformer from the 480V power to the load. (Each cubicle contains a control power transformer).

3) Each cubicle is equipped with a circuit breaker that is closed during normal operation (provides isolation for maintenance purposes).

4) Remotely operated loads are equipped with magnetic motor contactors that are used to open & close the circuit during normal operations. Thermal overloads, that open the circuit, due to overcurrent conditions are also supplied.

5) Loss of control power (120V AC) to an operating MCC load will cause the load to be deenergized due to the opening of the magnetic contractor.

g) MCC Control Power Indications

1) Remotely controlled MCC loads are equipped with 2 general indicating light schemes:

a) GREEN - RED

GREEN - indicates that a valve is closed or a motor contactor (pumps, fan, heaters, etc) is open.

RED - indicates that a valve is open or a motor contactor (pumps, fans, heaters, etc) is closed.

GREEN AND RED BOTH LIT - indicates that a valve is in a mid-position.

b) GREEN-BLUE-RED

GREEN - same as for green-red scheme

RED - same as for green-red scheme

BLUE

- monitors the condition of the thermal overload on certain MOV's
- the blue light is normally lit indicating that the thermal overload is reset.
- blue light "not lit" in conjunction with either a green or red light indicates that the thermal overload is tripped.
- green, blue & red lights all "not lit" indicates that a loss of control power has occurred. (Possible fuse failure).
- all valves that are automatically positioned by LOCA signals have their thermal overloads bypassed during a LOCA condition.
- in addition, the thermal overloads can be bypassed by the operator holding the control switch or pushbutton to the position of desired travel.

8.3.4 125V DC Buses — Fig. 2

a) Power can be supplied to the bus from 2 sources:

1) associated 125V DC battery (hardwired to bus)

2) associated 125V DC battery charger

b) During normal operation the battery charger supplies all loads and maintains a float charge on the battery.

c) Each of the 125V DC systems is ungrounded, except for ground detection circuit, so that a single ground won't disable the system.

d) If a ground occurs it must be isolated & repaired to assure that a second ground won't cause system damage.

e) Major loads supplied by the 125V DC buses include:

1) ECCS system logic circuits (energize to operate)

2) HPCI

3) RCIC

4) Series MOV's associated with NS 4 primary containment isolations.

5) Control power for 4KV emergency buses (allows breaker operation to restore power to emergency buses on a loss of off-site power).

6) EDG auxiliaries needed for starting.

8.3.5 <u>125V DC Battery Chargers</u> <u>Fig. 2</u>

a) Supply DC loads during normal operation.

b) Power to charger is supplied via an associated emergency division MCC.

c) The battery charger is equipped with an output current limiter so that on a high load condition both the charger & the battery will supply the DC loads.

8.3.6 <u>125V DC Distribution Panels</u> <u>Fig. 2</u>

a) Supply power to ECCS system logics (energize to operate)

b) DIV I & DIV II power is used for this purpose.

c) Supply required EDG start auxiliaries & power to power restoration schemes for associated emergency division.

8.3.7 <u>12ØV AC Instrument Panels</u>

a) Supplied by step down transformers from associated division MCC's.

b) Supply power for remote indication & controller operation for associated safety related systems.

e.g. 1R35*PNLR1 (R2) (R3) supply instrument power for "A" Core Spray, "A" Rx Bldg. Service Water, "A" RBSVS, "A" H_2 Recombiners, etc.
1R35*PNL B1 (B2) (B3) supply instrument power for "B" Core Spray, "B" RHR "B" RBSVS, "B" Fuel Pool Cooling, etc.

8.4 <u>System Operation</u>

8.4.1 <u>Normal Operation</u> Figure 9

During normal operation the NSS supply breakers are closed on all 3 4KV emergency buses supplying power to all safety related plant equipment.

8.4.2 <u>Abnormal Operation</u>

a) Fast Transfer (NO LOCA) Figure 10

1) <u>Initiated by the NSS supply breaker to an emergency bus opening</u> for any reason except backup protective relaying schemes associated with the NSST.

2) When NSS supply breaker opens the RSS supply breaker receives an auto close signal.

3) If fast transfer is successful all motors loads that were being supplied by the bus will remain running.

4) If fast transfer is <u>not</u> completed in 10 cycles the RSS supply breaker will be blocked from closing & slow transfer will try to restore bus power.

<u>NOTE</u>: There is <u>no</u> provision for fast transfer from the RSS to the NSS on the emergency buses; therefore the NSST is the preferable supply to the emergency bus.

b) Slow Transfer (NO LOCA) . Fig. 11

1) Initiated by sustained undervoltage on the emergency buses. Initiation signals are:

   a) 80% voltage for 2 seconds

   b) 90% voltage for 8 seconds

2) If either of the above conditions is sensed the following occurs:

   a) NSS supply breaker receives trip signal.

   b) All motor loads supplied by the bus are tripped, except CRD pump.

      NOTE: 4KV feeder breaker to the associated 480V bus also stays closed.

   c) RSS supply breaker receives an auto CLOSE signal (NSS supply breaker must be open or the RSS supply breaker will not auto close).

   d) Associated EDG receives a start signal.

   e) If slow transfer is successful the RSS supply breaker will be feeding the emergency bus and the EDG will be running with its output breaker open.

   f) The only auto other auto action associated with the slow transfer scheme is the auto start of the Rx Bldg. service water pump associated with the EDG. The Rx Bldg. service water pump starts a few seconds after the EDG is close to rated RPM in order to provide cooling for the diesel engine.

c) Unsuccessful Slow Transfer (NO LOCA) Fig. 12

1) If bus voltage is not restored within 5 seconds of slow transfer being initiated.

   The following occurs:

   a) NSS & RSS supply breakers are locked out. (Lockout relay on MCB-Ø1 for each bus).

   b) EDG supply breaker auto closes onto the emergency bus (will not auto close if NSS or RSS supply breaker fails to open).

d) LOCA signal present

1) The existence of a LOCA signal will initiate the Bus Loading Program associated with each emergency bus & cause the running CRD pump to auto trip. (CRD pump can be manually started via operator action after a 60 second time delay).

2) All 4KV safety related loads then receive auto start signals via the bus Loading Programs.

3) The Bus loading programs are as follows:

   1) at time = Ø a LOCA signal is received.

   2) 2 seconds - RHR pump starts (all 3 buses)

   3) 7 seconds - Core Spray pump starts (or second RHR pump on DIV III bus)

   4) 12 seconds - Rx Bldg. Service Water Pumps start & RBSVS & Crac chillers receive start signal.

NOTE: The Rx Bldg. Service Water Pumps discharge valves must be closed as a start permissive.

4) The Bus Loading programs are not initiated until bus voltage has been restored, therefore on a concurrent loss of off-site power there will be a time delay while the EDG's restore bus voltage before the bus loading programs will start.

5) LOCA & concurrent loss of NSST will cause bus loading to begin after either fast or slow transfer to the RSST is successful.

e) Loss of offsite power occurring after a LOCA signal has been received (NSS supplying buses).

1) Fast transfer will be initiated if NSS supply breaker opens.

2) If fast transfer is successful safety related loads keep running.

3) If fast transfer is not successful:

   a) Slow transfer will be initiated on sustained undervoltage.

b) Safety related loads trip

c) RSS supply breaker receives close signal.

d) If bus voltage is restored the safety related loads will sequence back on via the bus loading programs.

4) If slow transfer is not successful:

a) NSS & RSS supply breakers will be locked out & the EDG's will close onto the buses.

b) When EDG's close onto the buses the safety related loads will sequence back on via the Bus Loading Programs.

NOTE: If the EDG is supplying the bus when a sustained undervoltage is sensed load shedding will not occur.

8.5 System interlocks

8.5.1 The NSS & RSS supply breakers to the emergency buses are each equipped with 2 sets of trip coils.

8.5.2 One trip coil is energized by faults on the NSST (RSS) side of the NSS (RSS) supply breakers.

a) Operation of this trip coil will cause the NSS (RSS) supply breaker to the emergency bus to open and appropriate power restoration scheme will be implemented.

b) These trip circuits are powered from non-safety related 125V DC power and continuity through the trip coil is monitored via red indicating lights on the MXP panel.

8.5.3 The second trip coil for each of the NSS & RSS supply breakers is energized by faults on the emergency bus.

a) If a bus fault occurs all 3 power supplies to the emergency bus NSS, RSS & EDG will be locked out and the entire emergency division will be disabled.

b) These trip coils are monitored via the red indicating light associated with the breaker control switch on MCB-Ø1.

NOTE: In addition to indicating that a circuit breaker is closed, the red indicating light also monitors trip coil continuity. (The trip coils are energized to operate). Therefore if a red light is out it may indicate that the trip coil is opened. All auto trips would be disabled and the breaker would have to be considered inoperable, (even if it was closed and supplying load).

8.5.4 <u>4160/480V Transformer Protection</u> <u>Fig. 4</u>

a) The step down transformers that supply the 480V emergency buses are equipped with 2 protective relaying schemes.

1) Primary Protection

- causes auto trip of the 4KV supply breaker & 480V supply breaker to the 480V emergency bus.

<u>NOTE</u>: If this protection operates the 4KV can be running but <u>all</u> lower voltage auxiliaries will be inoperable (except 125V DC that will be supplied by the batteries).

2) Backup Protection

- causes auto trip & lock out of <u>all</u> 4KV supply breakers (NSS, RSS & EDG) to the associated 4KV emergency bus.

8.6 <u>System Interrelations</u>

8.6.1 The emergency distribution system requires the operation of each of its composite systems in order to support the operation of the entire distribution network.

8.6.2 In addition 4KV power via the NSST, RSST or EDG is required.

8.7 <u>Tech Specs</u>

8.7.1 The following LCO's apply to the emergency distribution system. <u>The following AC electrical power sources shall be OPERABLE</u>:

a) <u>NSST supply to emergency buses</u>
b) <u>RSST supply to emergency buses</u>
c) <u>3 separate and independent EDG's</u> each with:

1) separate day tank containing <u>275</u> gallons of fuel
2) separate fuel storage system containing a minimum of <u>40,600</u> gallons of fuel
3) separate fuel transfer pump

Applicable in Conditions 1, 2 & 3.

<u>Action</u>

Within <u>one</u> hour, if any of above sources are inoperable, must demonstrate operability of remaining A.C. sources by performing applicable surveillances.

Other <u>one</u> hour actions required for more limiting cases than above - consult Tech Specs.

NOTE: 1 EDG & 1 offsite power source can be inop in condition 4 or 5.

In Conditions 4 and 5,

If A.C. electrical power sources are less conservative than specified must suspend Core Alterations, handling of irradiated fuel in secondary containment operations with a potential for draining vessel and crane operations over spent fuel pool.

E.7.2 The following AC distribution system electrical divisions shall be OPERABLE and energized:

a) DIVISION I consisting of:

1). Bus 1Ø1

2) Bus 111

3) MCC's 111Ø through 1119, 111W, 111Y and 111Z

4) MCC 111X (normally aligned with DIV I but automatically transferable to DIV III).

5) 120V AC distribution panels R1, R2 & R3

b) DIVISION II consisting of:

1) Bus 1Ø2

2) Bus 112

3) MCC's 1120 through 1129, 112W & 112X

4) 12ØV AC distribution panels B1, B2 & B3

c) DIVISION III consisting of:

1) Bus 1Ø3

2) Bus 113

3) MCC's 1131, 1133 & 1134

4) 12ØV AC distribution panels Ø1 & Ø2 applicable conditions applicable conditions 1, 2 & 3

In conditions 4 & 5 2 out of 3 divisions are required.

.3 <u>The following DC distribution system electrical divisions shall be OPERABLE and energized</u>:

a) DIVISION I consisting of:

1) 125V battery A1

2) 125V charger A1

3) 125V Bus A1

b) DIVISION II consisting of:

1) 125V battery B1

2) 125V charger B1

3) 125V bus B1

c) DIVISION III consisting of:

1) 125V battery C1

2) 125V charger C1

3) 125V Bus C1

Applicable Conditions 1, 2 & 3

In Condition 4, 5 2 out of 3 of the DC divisions must be OPERABLE.

With <u>two</u> of the above required AC or DC divisions not energized, suspend core alterations, handling of irradiated fuel in the secondary containment and operations with a potential of draining the reactor vessel.

.4 <u>Two independent LPCI/recirculation valve swing bus power supply assemblies shall be OPERABLE. Each assembly shall be comprised of</u>:

a) 2 OPERABLE MG Sets

b) An OPERABLE power monitor and automatic transfer instrumentation

c) An OPERABLE valve bus.

Applicable Conditions 1, 2 & 3

In Condition 4 or 5 only 1 MG set need be OPERABLE.

.5 All primary containment penetration protective overcurrent devices shall be OPERABLE.

.6 The thermal overload protection of MSIV-LCS valves shall be bypassed continuously by an OPERABLE bypass device.

.7 Two RPS power monitoring assemblies for each inservice RPS MG set or alternate power supply shall be OPERABLE.

8.7 Summary

The emergency distribution system supplies power to all plant safety related equipment. It consists of 3 independent electrical divisions.

DIV I (Red)

DIV II (Blue).

DIV III (Orange)

The only plant loads that can be supplied with power from 2 divisions are MCC's 111X & 112Y (LPCI injection valves) but separation criteria Fig. 5 is maintained by using MG sets to supply these MCC's. The LPCI MG Set 480V distribution system is illustrated schematically in Figure 5. Normal Control room configuration is illustrated in Figure 5a.

The 4KV loads supplied by these divisions are:

DIV I	DIV II	DIV III	Fig. 6,7,8
A Core Spray	B Core Spray	C RHR Pump	
A RHR	B RHR	D RHR Pump	
A Rx Bldg. Service Water	B Rx Bldg. Service Water	C Rx Bldg. Service Water Pump	
A CRD	B CRD	D Rx Bldg. Service Water Pump	
3A RBSVS & Crac Chiller	3B RBSVS & Crac Chiller	4A & 4B RBSVS & Crac Chiller	
480V Bus 111	480 Bus 112	480V Bus 113	

The following safety related systems are powered by the 480V systems:

DIV I	DIV II
"A" RBCLCW	"B" RBCLCW
"A" RBSVS	"B" RBSVS
"A" Fuel Pool Cooling	"B" Fuel Pool Cooling
"A" MSIV Leakage Control	"B" MSIV Leakage Control

MALFUNCTIONS

Normal Operation

- o All control switch semaphors and breaker indicating lights should be in agreement.
- o NSST should be supplying power
- o NSST amps to 4KV bus should be less than 1200.
- o 4KV Feeder amps should be less than 180.
- o DC Bus Ammeter should show a slight positive amp reading caused by battery charger supplying 125V DC loads and small battery float charge.
- o Both 125V DC Battery Ground Detector lights should be dimly lit. (Probably have to cup hard around lens to determine that the light is on).
- o 4KV & 480V Bus power available lights are both on indicating that the buses are energized.

FAST TRANSFER — Fig. #2

- o All control switch semaphors and breaker indicating lights should be in agreement EXCEPT for NSS supply breaker
- o NSST no longer supplying power
- o Should show RSST amps to 4KV bus
- o EDG does not start on a successful fast transfer
- o All motor loads supplied by 4KV bus remain as they were prior to the transfer i.e. If running they remain running. If not running they remain off.

SLOW TRANSFER (successful) — Fig. #3

- o The control switch semaphors and breaker indicating lights for the NSS and RSS supply breakers will not be in agreement.
- o The EDG has auto started but the EDG output breaker has not closed because the RSS supply breaker is in the close position.
- o NSST no longer supplying power
- o Should show RSST amps to the 4KV bus
- o All motor loads on 4KV bus auto trip (except CRD pump)

- Slow transfer may result in Rx scram and Rx isolation due to RPS power supply frequency/voltage transient.

- DC loads may increase due to transfer of UPS to battery power & DC powered isolation valves.

SLOW TRANSFER (unsuccessful) [Loss of offsite power if all 3 Emergency Bus are affected] Fig. 4/Fig. 6

- The control switch semaphors and breaker indicating lights for the NSS and EDG supply breakers will not be in agreement.

  NOTE: If the NSST had been out of service for repairs then it could be the RSS & EDG supply breakers that are not in agreement.

- Lockout relay tripped due to voltage not being restored to the 4KV bus after the slow transfer scheme was initiated.

- Load supplied by EDG will vary depending upon whether or not a LOCA signal is present:

NO LOCA SIGNAL	LOCA SIGNAL
RBSW pump starts	CRD Pump Trips (Bus 101 or 102 only)
CRD pump continues to run (Bus 101 or 102 only)	Bus loading program sends start permissives to remainder of 4KV bus loads.
480V loads continue to be supplied	

4KV Bus Fault or 4KV/480V XFRMR Backup Protection Fig. 5

- Control room indications for either of the above malfunctions would be similar. Distinguishing actual fault will require field checking the lockout relays in the Emergency Switchgear Room.

- EDG has auto started due to sustained undervoltage on the 4KV bus.

- EDG output breaker has a trip signal present but no "double brilliant" white light since control switch is in auto after trip.

- 4KV feeder breaker & 480V supply breaker to the 480V Bus remain closed however both the 4KV Bus & the 480V bus are deenergized. (All voltmeters & ammeters indicators are at zero).

- Indication of EDG SW outlet valve position is lost since this is an AC powered solenoid.

- 125V DC Battery is supplying DC loads.

4KV/480V XFRMR PRIMARY PROTECTION — Fig. 7

- The control switch semaphors and breaker indicating lights for the 4KV feeder breaker & the 480V supply breaker to the 480V Bus will be in disagreement.
- 4KV motor loads will continue to run if they were running prior to the malfunction. However, all AC powered auxiliaries that support these 4KV loads will be deenergized. i.e. MOV's control room instrumentation.
- DC loads are supplied by the 125V DC batteries since the battery charger is deenergized.

125V DC SUPPLY BREAKER TRIP — Fig. 8

- The trip of a 125V DC Supply Breaker could result in any of the following:

  a) RCIC INOP (DIV I)

  b) HPCI INOP (DIV II)

  c) ECCS INITIATION LOGIC INOP

  d) EDG START AUXILIARIES INOP

  e) BUS Loading Program INOP

  NOTE: The malfunction depicted by Figure 8 involves the trip of a circuit breaker that supplies the 125V DC distribution panels.

- Indicating lights for all 4KV & 480V Bus loads are extinguished.
- Lack of 125V DC prevents auto operation & remote operation of the 4KV & 480V Bus loads.

  NOTE: 4KV Breakers will not trip on electrical fault protection.

  480V Bus breakers will auto trip due to overcurrent fault protection.

- AC distribution system remains energized and the AC loads that were running will continue to run.

125V DC DISTRIBUTION PANEL CB TRIP — Fig. 9

NOTE: Malfunction depicts a trip of the current breaker (CB) that supplies control power to all of the 4KV bus breakers.

- Same discussion applies for the 125V DC Supply Breaker trip with the exception that only the 4KV circuit breakers are affected.

125V DC DISTRIBUTION PANEL CB TRIP Fig. 10

NOTE: Malfunction depicts a trip of the circuit breaker (CB) that supplies control power to the 480V bus breakers.

o Same discussion applies as for the 125V DC Supply Breaker trip with the exception that only the 480V Bus circuit breakers are affected.

125V DC SYSTEM GROUND Fig. 11

NOTE: 125 VDC Systems are ungrounded so that a single fault will not disable any of the 125V DC equipment. However, the existence of grounds on both the (+) leg and the (-) leg could cause extensive damage to the system. To prevent this, grounds should be isolated and repaired as soon as they are detected.

o The bright light on the ground detector would be on the ungrounded leg.

o If the ground is of the intermittent type both lights may return to a dimly lit status without operator action.

o Grounded leg can be verified and severity of ground can be determined by checking ground detectors at back of 125V DC Bus in the Emergency Switchgear Room.

0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP TRIP	0220 [illegible] XFMR PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW PLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 SYS DEGRADED	0369 DIESEL 1 SYS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 SYS INOP	0356 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR M1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 SYS DEGRADED	0337 DIESEL 3 SYS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL

0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP P TRIP	0220 XFMR PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0087 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 SYS DEGRADED	0369 DIESEL 1 SYS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 SYS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR H1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLT BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 SYS DEGRADED	0337 DIESEL 3 SYS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLT BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL

0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS X BACKU. TRIP	0220 XFMR PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 STS DEGRADED	0369 DIESEL 1 STS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0346 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 STS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR N1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 STS DEGRADED	0337 DIESEL 3 STS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL

0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	[illegible] [illegible]MR [illegible]PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KF NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 SYS DEGRADED	0369 DIESEL 1 SYS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 SYS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR H1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 SYS DEGRADED	0337 DIESEL 3 SYS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL

0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	0220 [illegible]FMR [illegible] PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KF NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

0371 DIESEL 1 LUBE OIL PRESS LO	0373 . ESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 SYS DEGRADED	0369 DIESEL 1 SYS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0253 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 SYS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR N1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 SYS DEGRADED	0337 DIESEL 3 SYS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0102 BUS 103 PROGRAM LCTL

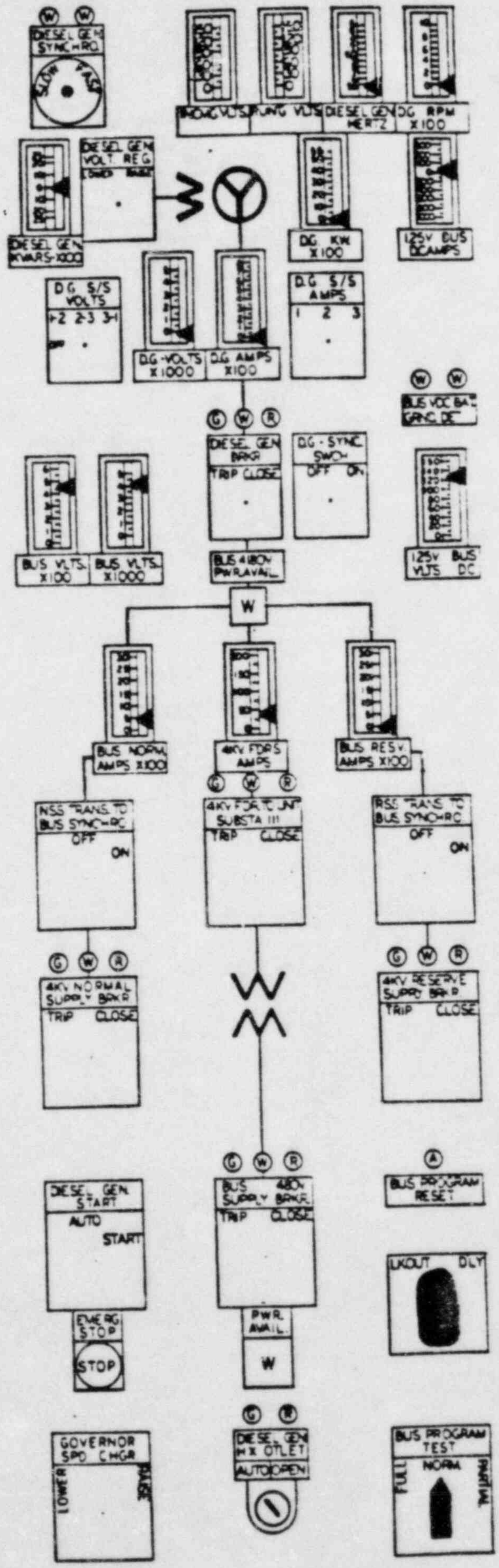
0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	[illegible] [illegible] XFMR [illegible] PROT TRIP	0085 4KV NSS BUS UV	0263 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 SYS DEGRADED	0369 DIESEL 1 SYS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

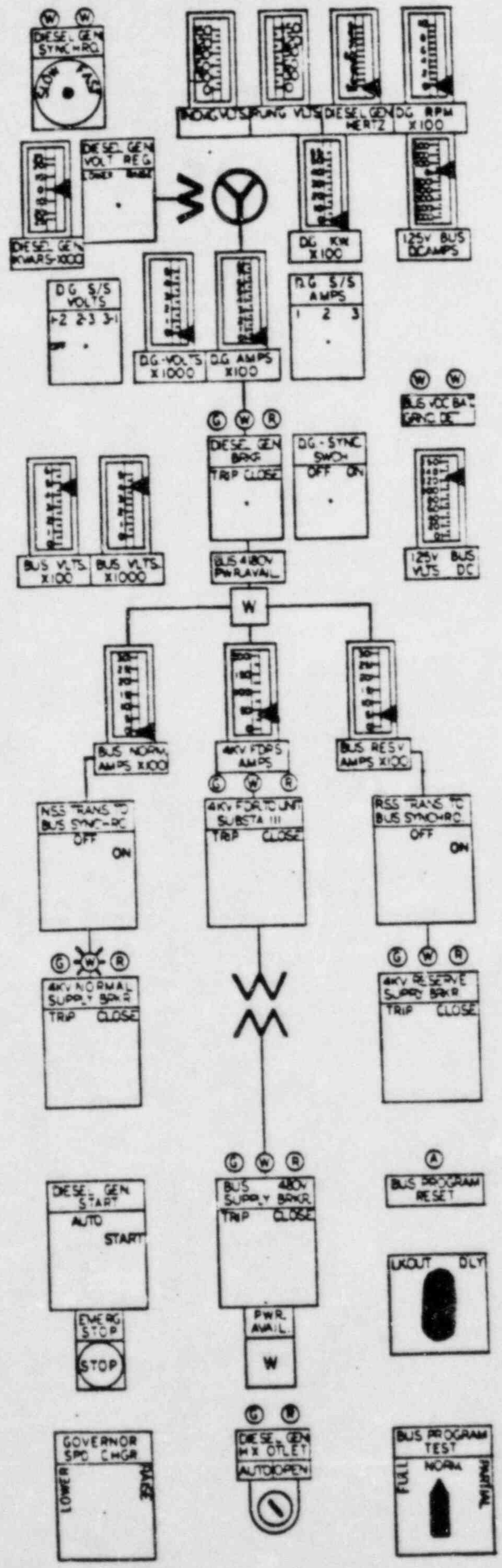
0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 SYS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR N1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 SYS DEGRADED	0337 DIESEL 3 SYS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL

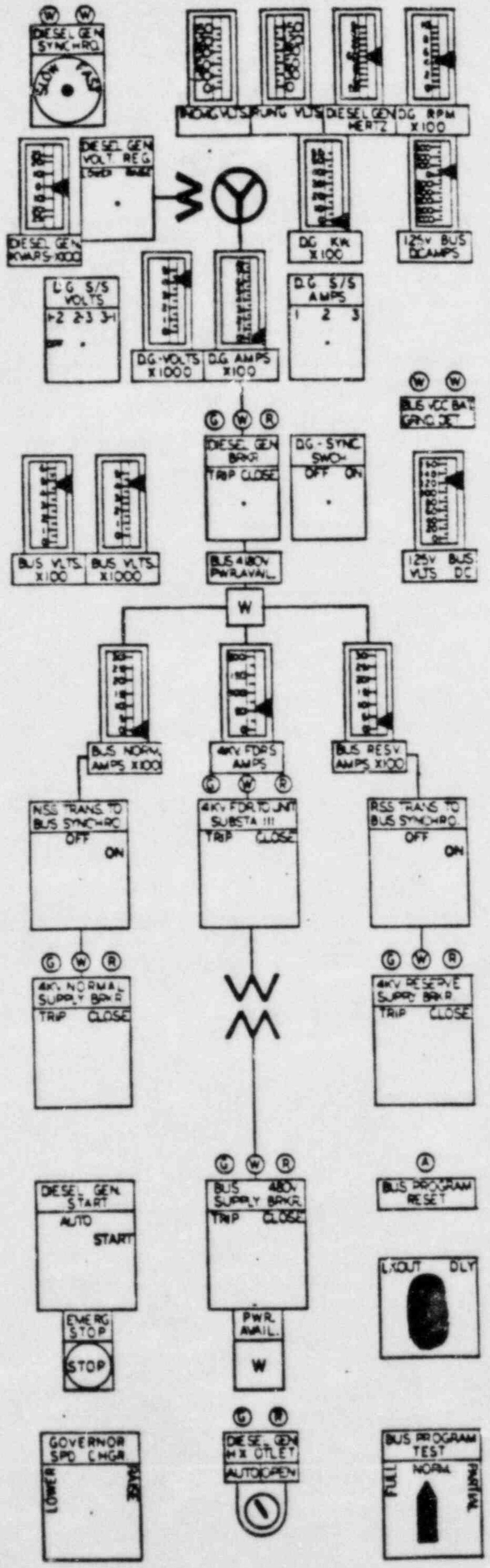
#1


DIESEL GEN SYNCHRO.
SLOW
FAST
PROG VLTS
RUNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT REG
DIESEL GEN KVARS X100
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2
2-3
3-1
DG-VOLTS X1000
DG AMPS X100
DG S/S AMPS
1
2
3
BUS VDC BAT GRND DET
DIESEL GEN BRKR
TRIP
CLOSE
DG-SYNC SWCH
OFF
ON
BUS VLTS. X100
BUS VLTS. X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV. AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF
ON
4KV FDR TO UNIT SUBSTA 111
TRIP
CLOSE
RSS TRANS TO BUS SYNCHRO
OFF
ON
4KV NORMAL SUPPLY BRKR
TRIP
CLOSE
4KV RESERVE SUPPLY BRKR
TRIP
CLOSE
BUS PROGRAM RESET
DIESEL GEN START
AUTO
START
BUS 480V SUPPLY BRKR
TRIP
CLOSE
LKOUT
DLY
EMERG STOP
STOP
PWR AVAIL
W
GOVERNOR SPD CHGR
LOWER
RAISE
DIESEL GEN HX OTLET
AUTO
OPEN
BUS PROGRAM TEST
FULL
NORM
PARTIAL

#2

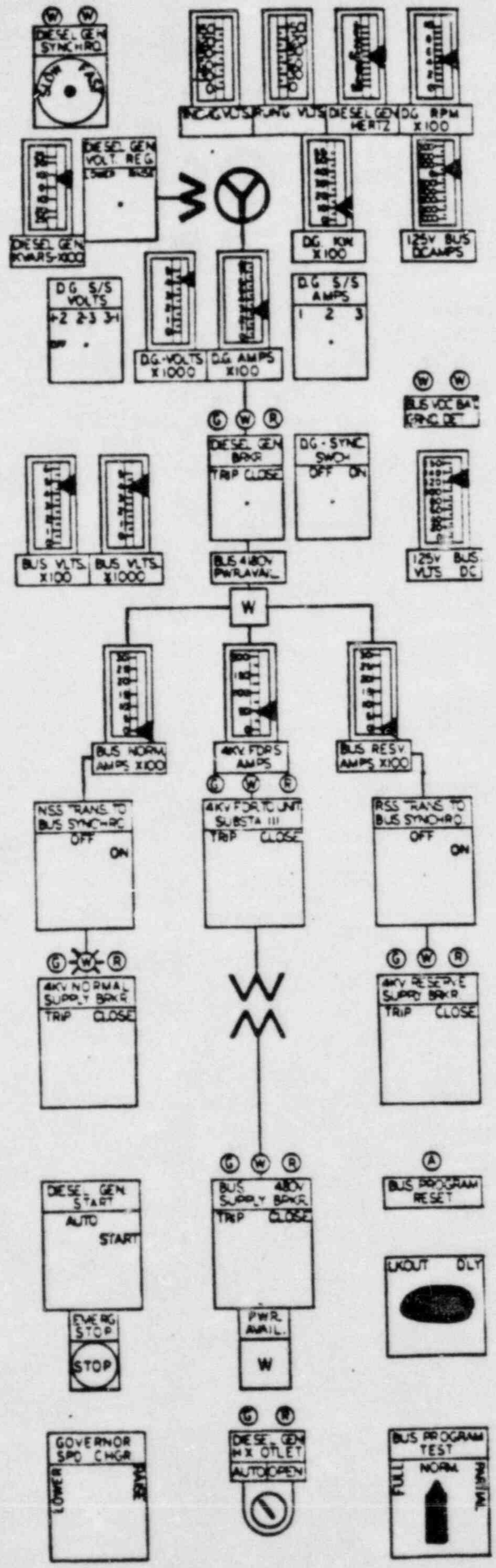

DIESEL GEN SYNCHRO.
SLOW
FAST
BKG VOLTS
RUNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT REG
DIESEL GEN KVARS X1000
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
D.G. VOLTS X1000
D.G. AMPS X100
D.G S/S AMPS
1 2 3
DIESEL GEN BRKR
TRIP CLOSE
DG-SYNC SWCH
OFF ON
BUS VLTS. X100
BUS VLTS. X1000
BUS 480V PWR AVAIL.
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
G W R
NSS TRANS TO BUS SYNC-RO
OFF
ON
4KV FDR TO UNIT SUBSTA III
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF
ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO
START
BUS 480V SUPPLY BRKR
TRIP CLOSE
A
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR. AVAIL.
W
GOVERNOR SPD CHGR
LOWER
RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

#3

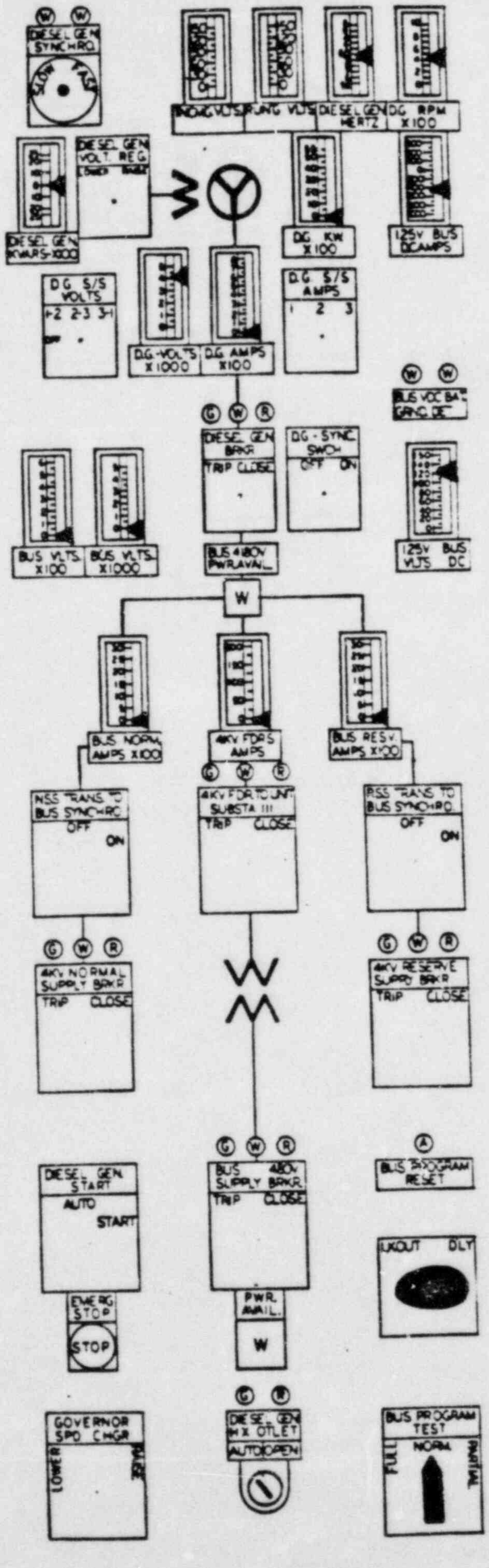


DIESEL GEN SYNCHRO.
SLOW
FAST
INCMG VLTS
RUNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT REG
LOWER
RAISE
DIESEL GEN KVARS X1000
DG KW X100
125V BUS DC AMPS
L-G S/S VOLTS
1-2 2-3 3-1
D.G. VOLTS X1000
D.G. AMPS X100
DG S/S AMPS
1 2 3
BUS VCC BAT GRND DET
DIESEL GEN BRKR
TRIP CLOSE
DG-SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF
ON
4KV FDR TO UNIT SUBSTA 111
TRIP
CLOSE
RSS TRANS TO BUS SYNCHRO
OFF
ON
4KV NORMAL SUPPLY BRKR
TRIP
CLOSE
4KV RESERVE SUPPLY BRKR
TRIP
CLOSE
BUS PROGRAM RESET
DIESEL GEN START
AUTO
START
BUS 480V SUPPLY BRKR
TRIP
CLOSE
LKOUT
DLY
EMERG STOP
STOP
PWR AVAIL
W
GOVERNOR SPD CHGR
LOWER
RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL
NORM
PARTIAL

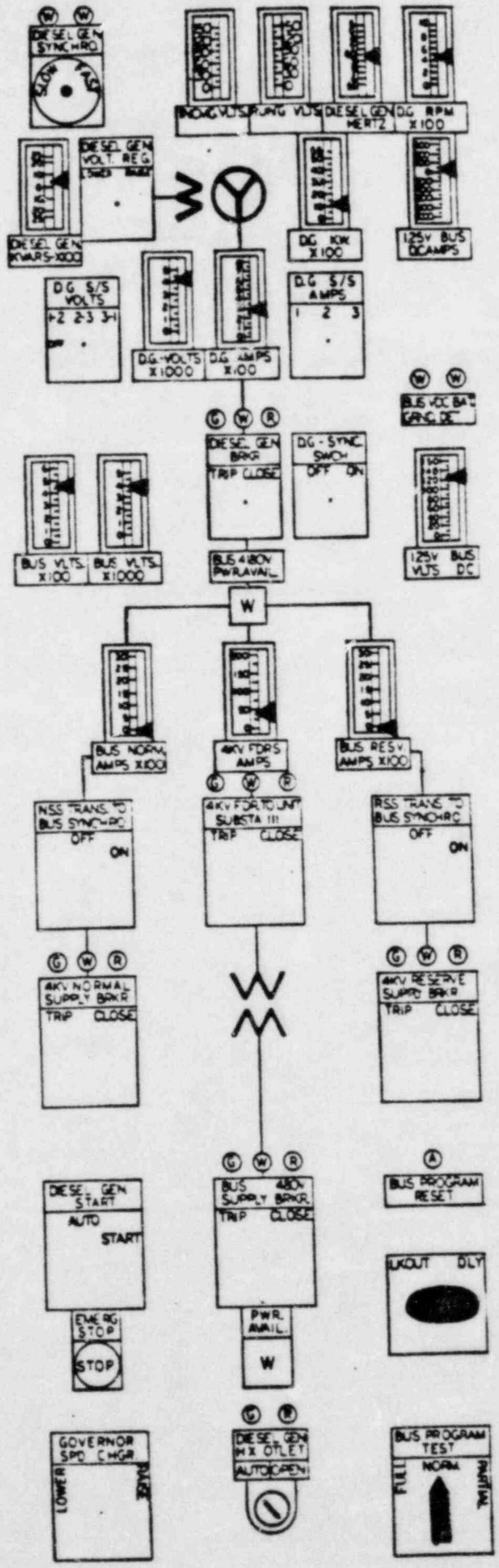
#4


DIESEL GEN SYNCHRO
SLOW
FAST
INC. VLTS
RUNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT. REG.
DIESEL GEN KVARS-X100
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
OFF
DG-VOLTS X1000
DG AMPS X100
DG S/S AMPS
1 2 3
DIESEL GEN BRKR
TRIP CLOSE
DG-SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF
ON
4KV FDR TO UNIT SUBSTA III
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF
ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO
START
BUS 480V SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
W
GOVERNOR SPD CHGR
LOWER
RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL
NORM
PARTIAL

#5


DIESEL GEN SYNCHRO
SLOW FAST
INC'G VLTS
RUNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT. REG
LOWER RAISE
DIESEL GEN KVARS-X100
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
OFF
D.G. VOLTS X1000
D.G. AMPS X100
D.G. S/S AMPS
1 2 3
BUS VDC BAT GRND DET
DIESEL GEN BRKR
TRIP CLOSE
DG - SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV. AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF
ON
4KV FDR TO UNIT SUBSTA 111
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF
ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO
START
BUS 480V SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
W
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

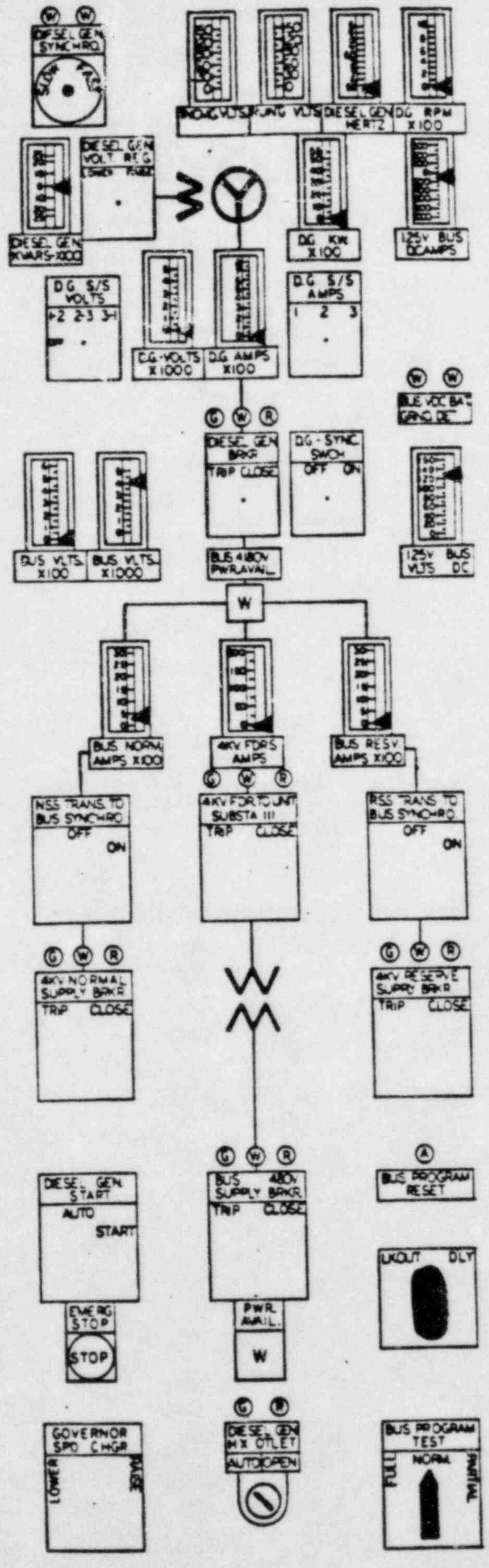
#6.



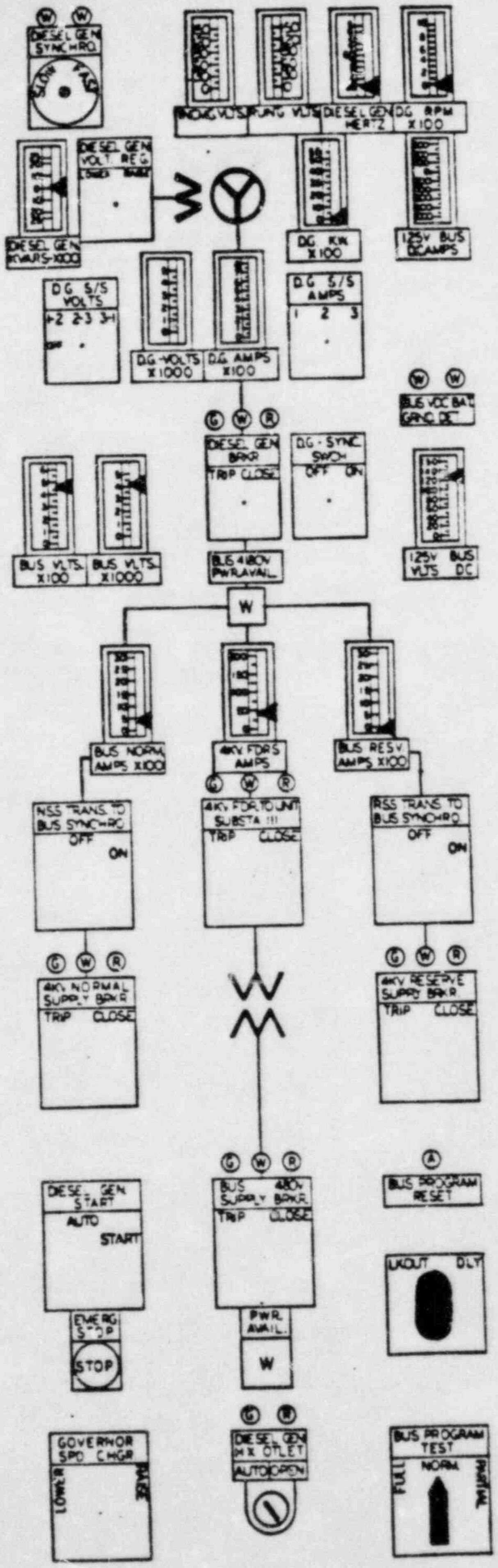
DIESEL GEN SYNCHRO
SLOW FAST
INC'G VLTS
RUNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT. REG
DIESEL GEN KVARS-X100
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
DG-VOLTS X1000
DG AMPS X100
DG S/S AMPS
1 2 3
BUS VDC BAT CHG DC
DIESEL GEN BRKR
TRIP CLOSE
DG-SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF ON
4KV FDR TO UNIT SUBSTA 111
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
DIESEL GEN START
AUTO START
BUS 480V SUPPLY BRKR
TRIP CLOSE
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
W
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

NSST
o/s

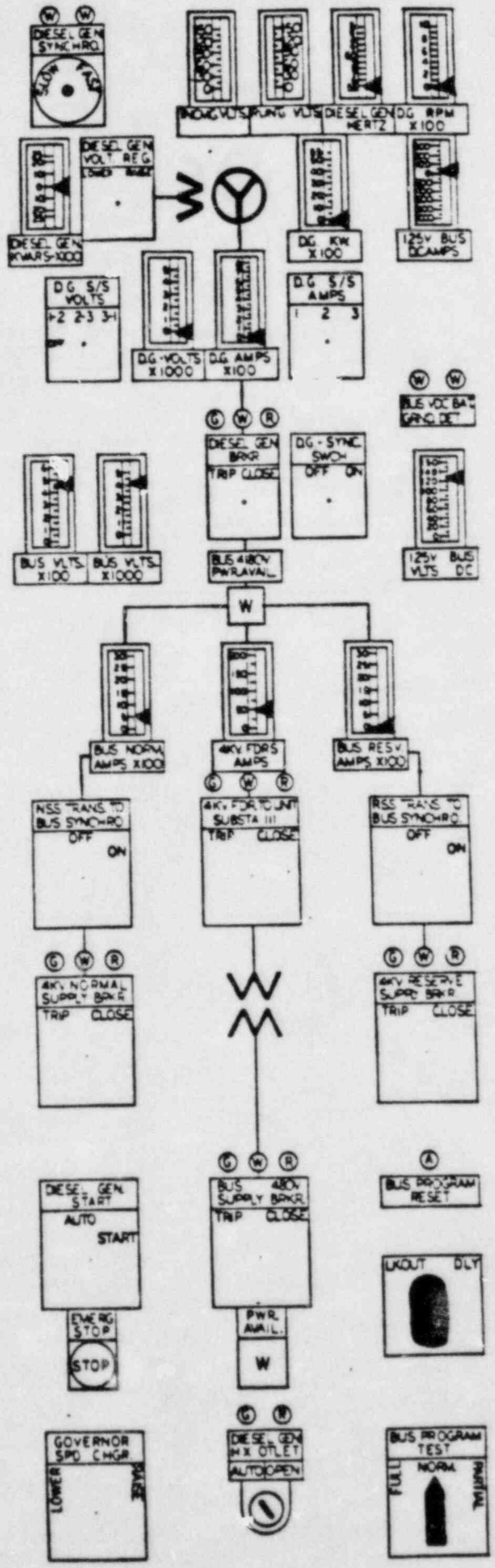
#7


DIESEL GEN SYNCHRO
SLOW FAST
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT REG
LOWER RAISE
DIESEL GEN KVARS X100
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
DG VOLTS X1000
DG AMPS X100
DG S/S AMPS
1 2 3
DIESEL GEN BRKR
TRIP CLOSE
DG SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF
ON
4KV FDR TO UNIT SUBSTA
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF
ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO
START
BUS 480V SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
W
GOVERNOR SPD CHGR
LOWER
RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL
NORM
PARTIAL

#8.

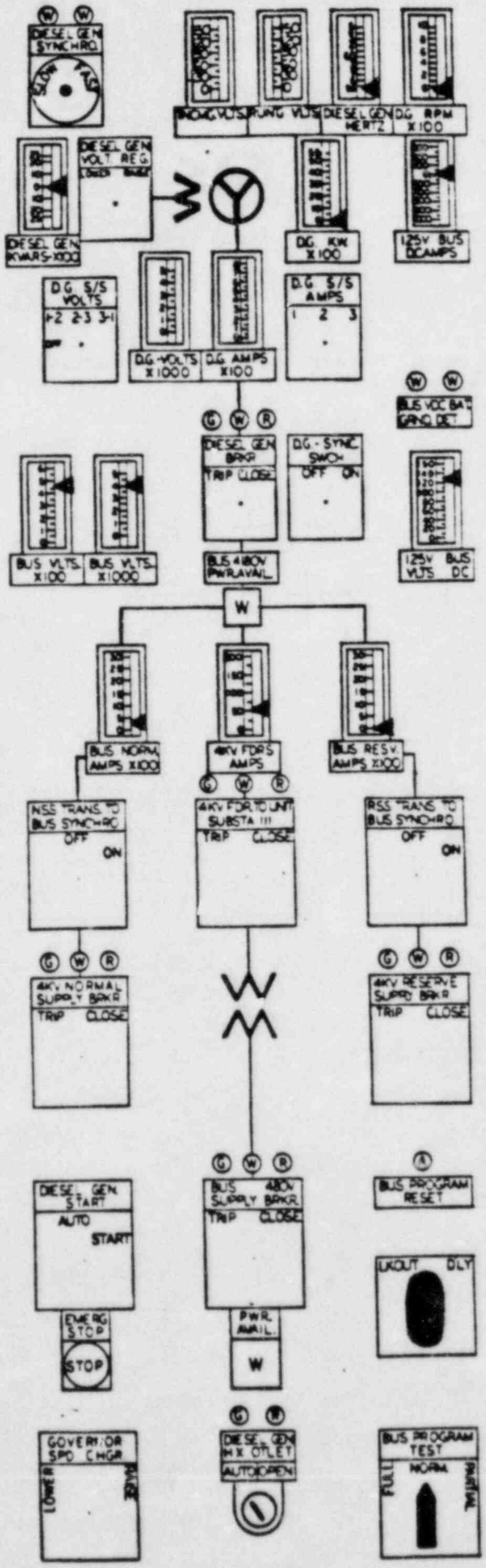

DIESEL GEN SYNCHRO
SLOW
FAST
DIESEL GEN VOLT. REG.
DIESEL GEN KVARS-X100
DG KW X100
125V BUS DC AMPS
DIESEL GEN HERTZ
DG RPM X100
DG S/S VOLTS
1-2 2-3 3-1
DG S/S AMPS
1 2 3
DG VOLTS X1000
DG AMPS X100
DIESEL GEN BRKR
TRIP CLOSE
DG - SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF
ON
4KV FDR TO UNIT SUBSTA
TRIP CLOSE
4KV NORMAL SUPPLY BRKR
4KV RESERVE SUPPLY BRKR
DIESEL GEN START
AUTO
START
BUS 480V SUPPLY BRKR
BUS PROGRAM RESET
EMERG STOP
STOP
PWR AVAIL
GOVERNOR SPD CHGR
LOWER
RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL
NORM
PARTIAL

#9



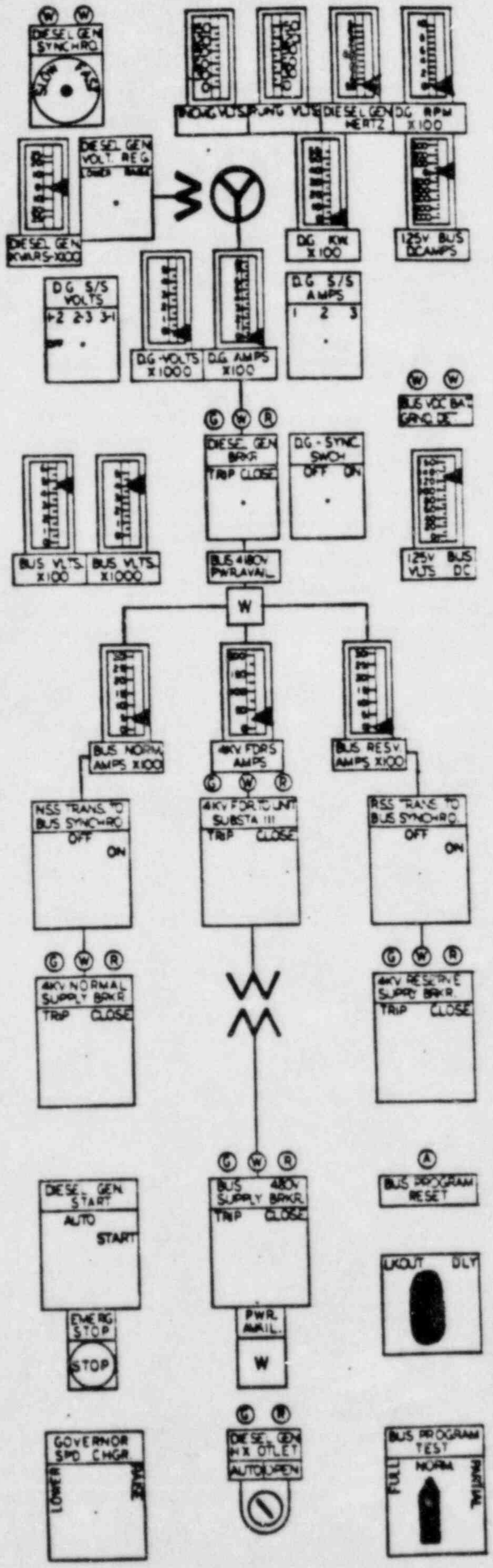
DIESEL GEN SYNCHRO
SLOW FAST
INCMG VLTS
RUNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT REG
LOWER RAISE
DIESEL GEN KVARS X100
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
D.G. VOLTS X1000
D.G. AMPS X100
D.G S/S AMPS
1 2 3
BUS VDC BAT GRND DET
DIESEL GEN BRKR
TRIP CLOSE
DG - SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF ON
4KV FDR TO UNIT SUBSTA 111
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO START
BUS 480V SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
W
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

#10



DIESEL GEN SYNCHRO
SLOW FAST
RNG VLTS
DIESEL GEN HERTZ
D.G. RPM X100
DIESEL GEN VOLT REG
DIESEL GEN KVARS X100
D.G. KW X100
125V BUS DC AMPS
D.G. S/S VOLTS
D.G. VOLTS X1000
D.G. AMPS X100
D.G. S/S AMPS
1 2 3
DIESEL GEN BRKR
TRIP CLOSE
D.G. SYNC SWCH
OFF ON
BUS VLTS. X100
BUS VLTS. X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM. AMPS X100
4KV FDRS AMPS
BUS RESV. AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF ON
RSS TRANS TO BUS SYNCHRO
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
DIESEL GEN START
AUTO START
BUS 480V SUPPLY BRKR
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

#11



DIESEL GEN SYNCHRO
SLOW FAST
INC'G VLTS
RUN'G VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT. REG
LOWER RAISE
DIESEL GEN KVARS-X100
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
DG-VOLTS X1000
DG AMPS X100
DG S/S AMPS
1 2 3
BUS VDC BAT GRND DET
DIESEL GEN BRKR
TRIP CLOSE
DG-SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF ON
4KV FDR TO UNIT SUBSTA 111
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO START
BUS 480V SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
W
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

MALFUNCTIONS

Normal Operation

- o All control switch semaphors and breaker indicating lights should be in agreement.
- o NSST should be supplying power
- o NSST amps to 4KV bus should be less than 1200.
- o 4KV Feeder amps should be less than 180.
- o DC Bus Ammeter should show a slight positive amp reading caused by battery charger supplying 125V DC loads and small battery float charge.
- o Both 125V DC Battery Ground Detector lights should be dimly lit. (Probably have to cup hard around lens to determine that the light is on).
- o 4KV & 480V Bus power available lights are both on indicating that the buses are energized.

FAST TRANSFER Fig. #2

- o All control switch semaphors and breaker indicating lights should be in agreement EXCEPT for NSS supply breaker
- o NSST no longer supplying power
- o Should show RSST amps to 4KV bus
- o EDG does not start on a successful fast transfer
- o All motor loads supplied by 4KV bus remain as they were prior to the transfer i.e. If running they remain running. If not running they remain off.

SLOW TRANSFER (successful) Fig. #3

- o The control switch semaphors and breaker indicating lights for the NSS and RSS supply breakers will not be in agreement.
- o The EDG has auto started but the EDG output breaker has not closed because the RSS supply breaker is in the close position.
- o NSST no longer supplying power
- o Should show RSST amps to the 4KV bus
- o All motor loads on 4KV bus auto trip (except CRD pump)

- Slow transfer may result in Rx scram and Rx isolation due to RPS power supply frequency/voltage transient.

- DC loads may increase due to transfer of UPS to battery power & DC powered isolation valves.

SLOW TRANSFER (unsuccessful) [Loss of offsite power if all 3 Emergency Bus are affected] Fig. 4/Fig. 6

- The control switch semaphors and breaker indicating lights for the NSS and EDG supply breakers will not be in agreement.

  NOTE: If the NSST had been out of service for repairs then it could be the RSS & EDG supply breakers that are not in agreement.

- Lockout relay tripped due to voltage not being restored to the 4KV bus after the slow transfer scheme was initiated.

- Load supplied by EDG will vary depending upon whether or not a LOCA signal is present:

NO LOCA SIGNAL	LOCA SIGNAL
RBSW pump starts	CRD Pump Trips (Bus 101 or 102 only)
CRD pump continues to run (Bus 101 or 102 only)	Bus loading program sends start permissives to remainder of 4KV bus loads.
480V loads continue to be supplied	

4KV Bus Fault or 4KV/480V XFRMR Backup Protection Fig. 5

- Control room indications for either of the above malfunctions would be similar. Distinguishing actual fault will require field checking the lockout relays in the Emergency Switchgear Room.

- EDG has auto started due to sustained undervoltage on the 4KV bus.

- EDG output breaker has a trip signal present but no "double brilliant" white light since control switch is in auto after trip.

- 4KV feeder breaker & 480V supply breaker to the 480V Bus remain closed however both the 4KV Bus & the 480V bus are deenergized. (All voltmeters & ammeters indicators are at zero).

- Indication of EDG SW outlet valve position is lost since this is an AC powered solenoid.

- 125V DC Battery is supplying DC loads.

4KV/480V XFRMR PRIMARY PROTECTION . Fig. 7

o The control switch semaphors and breaker indicating lights for the 4KV feeder breaker & the '80V supply breaker to the 480V Bus will be in disagreement.

o 4KV motor loads will continue to run if they were running prior to the malfunction. However, all AC powered auxiliaries that support these 4KV loads will be deenergized. i.e. MOV's control room instrumentation.

o DC loads are supplied by the 125V DC batteries since the battery charger is deenergized.

125V DC SUPPLY BREAKER TRIP Fig. 8

o The trip of a 125V DC Supply Breaker could result in any of the following:

a) RCIC INOP (DIV I)

b) HPCI INOP (DIV II)

c) ECCS INITIATION LOGIC INOP

d) EDG START AUXILIARIES INOP

e) BUS Loading Program INOP

NOTE: The malfunction depicted by Figure 8 involves the trip of a circuit breaker that supplies the 125V DC distribution panels.

o Indicating lights for all 4KV & 480V Bus loads are extinguished.

o Lack of 125V DC prevents auto operation & remote operation of the 4KV & 480V Bus loads.

NOTE: 4KV Breakers will not trip on electrical fault protection.

480V Bus breakers will auto trip due to overcurrent fault protection.

o AC distribution system remains energized and the AC loads that were running will continue to run.

125V DC DISTRIBUTION PANEL CB TRIP Fig. 9

NOTE: Malfunction depicts a trip of the current breaker (CB) that supplies control power to all of the 4KV bus breakers.

o Same discussion applies for the 125V DC Supply Breaker trip with the exception that only the 4KV circuit breakers are affected.

125V DC DISTRIBUTION PANEL CB TRIP Fig. 10

NOTE: Malfunction depicts a trip of the circuit breaker (CB) that supplies control power to the 480V bus breakers.

o Same discussion applies as for the 125V DC Supply Breaker trip with the exception that only the 480V Bus circuit breakers are affected.

125V DC SYSTEM GROUND Fig. 11

NOTE: 125 VDC Systems are ungrounded so that a single fault will not disable any of the 125V DC equipment. However, the existence of grounds on both the (+) leg and the (-) leg could cause extensive damage to the system. To prevent this, grounds should be isolated and repaired as soon as they are detected.

o The bright light on the ground detector would be on the ungrounded leg.

o If the ground is of the intermittent type both lights may return to a dimly lit status without operator action.

o Grounded leg can be verified and severity of ground can be determined by checking ground detectors at back of 125V DC Bus in the Emergency Switchgear Room.

EMERGENCY ELECTRICAL MALFUNCTIONS

1. Normal Operation
2. Fast Transfer
3. Slow Transfer (Sucessful)
4. Slow Transfer(Unsucessful)
5. 4 KV Bus Fault, 4 KV /480 V Transformer Backup Protection
6. Loss of Offsite Power
7. 4 KV/ 480 V Transformer Primary Protection
8. 125 VDC Supply Breaker Trip
9. 125 VDC Dist Pnl. Bkr CB Trip
10. 125 VDC Ground amd CB Trip
11. 125 VDC Ground

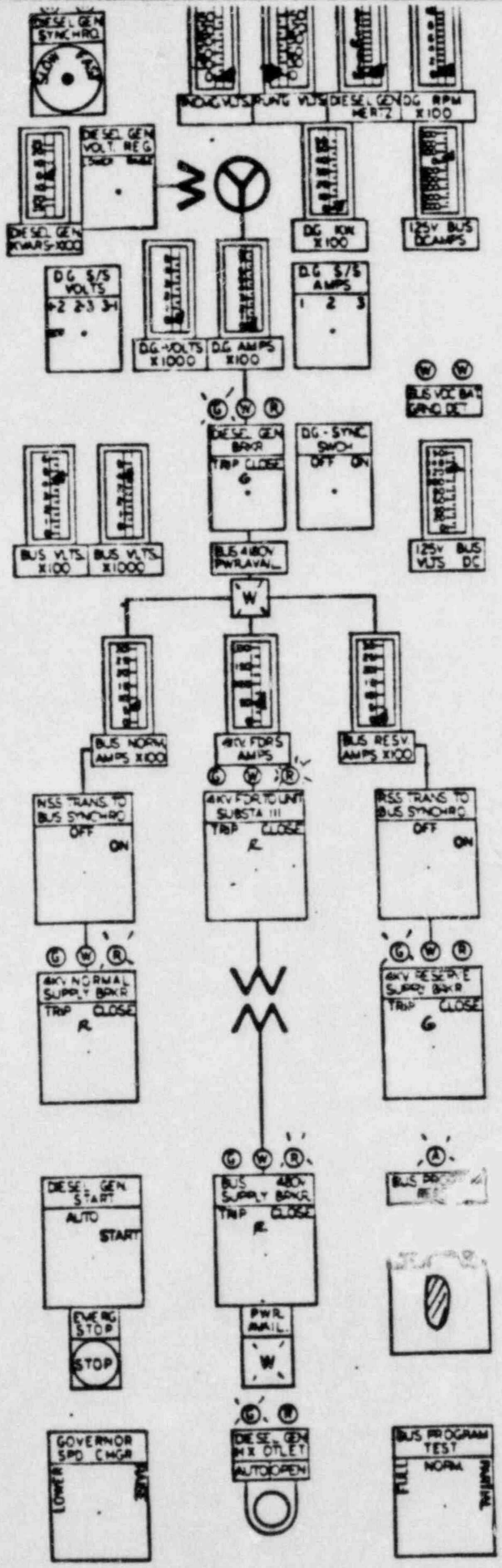
1

0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	0220 RSS XFMR PRI PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 STS DEGRADED	0369 DIESEL 1 STS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0100 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 STS DEGRADED	0375 DIESEL 2 STS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR H1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY [illegible] FDR AU[illegible] TRIP	0101 BUS 102 PROGRAM LCTL

03[illegible] DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 STS DEGRADED	0337 DIESEL 3 STS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0171 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL


DIESEL GEN SYNCHRO.
SLOW FAST
BUS VLTS
RUNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT. REG
DIESEL GEN KVARS X1000
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
DG VOLTS X1000
DG AMPS X100
DG S/S AMPS
1 2 3
BUS VDC BAT GRND DET
DIESEL GEN BRKR
TRIP CLOSE
DG SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF ON
4KV FDR TO UNIT SUBSTA III
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO START
BUS 480V SUPPLY BRKR
TRIP CLOSE
EMERG STOP
STOP
PWR AVAIL
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

1

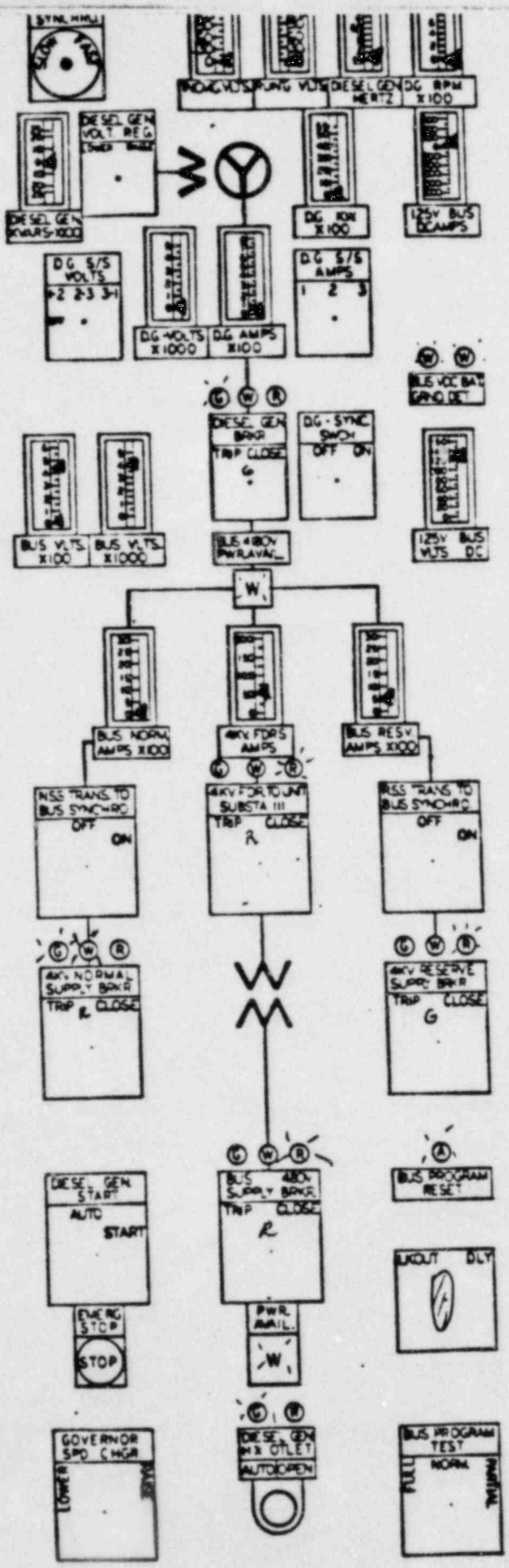
2

0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	0720 RSS XFMR PRI PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI-HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI-HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 SYS DEGRADED	0369 DIESEL 1 SYS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0144 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 SYS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR B1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHGR C1 TROUBLE
03[illegible]1 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 SYS DEGRADED	0337 DIESEL 3 SYS INOP	0359 125 V BATT C GND
02[illegible]5 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL


DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT REG
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
DG VOLTS X1000
DG AMPS X100
DG S/S AMPS
BUS VDC BAT GRND DET
DIESEL GEN BRKR
TRIP CLOSE
DG SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV FDR TO UNIT SUBSTA III
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
DIESEL GEN START
AUTO START
BUS 480V SUPPLY BRKR
TRIP CLOSE
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

#2

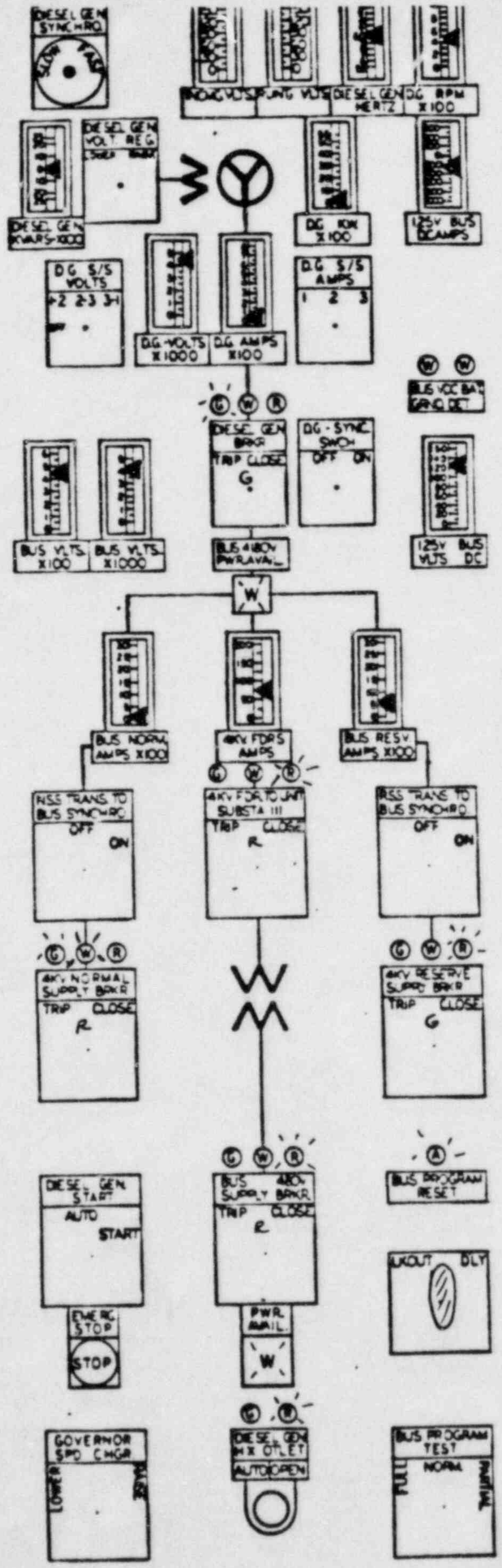
#3/4

0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	0220 RSS XFMR PRI PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWTD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTN N. HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE F	0197 24V BATT CHGR A2-2 TROUBLE F	0198 24V BATT CHGR B2-1 TROUBLE F	0159 24V BATT CHGR B2-2 TROUBLE F	0177 RW PLT PNL TROUBLE	0460 RR SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTN N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

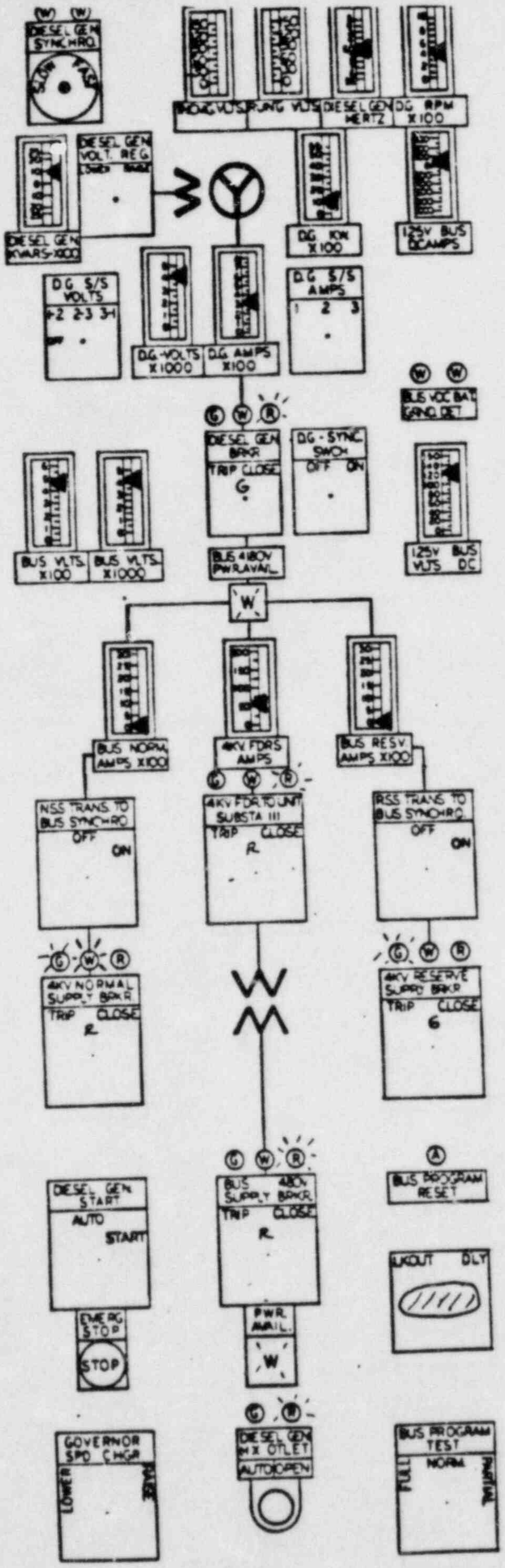
0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE F
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 STS DEGRADED F	0369 DIESEL 1 STS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REC POWER FAIL	0286 VITAL BUS INV TROUBLE F	0287 VITAL BUS INV BATT OPERATION F	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV F
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE F
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 STS DEGRADED F	0375 DIESEL 2 STS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REC POWER FAIL	0473 SEC-COMM INV TROUBLE F	0474 SEC-COMM INV BATT/ ALT AC OPERATION F	0475 125 V CHGR H1 TROUBLE F	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV F
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHGR C1 TROUBLE F
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 STS DEGRADED F	0337 DIESEL 3 STS INOP	0359 125 V BATT C GND
0295 EM.R GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE F	0290 COMPUTER INV BATT OPERATION F	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
01 1 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103 F
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL


DIESEL GEN SYNCHRO
SLOW FAST
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT REG
DIESEL GEN KVARS X1000
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
D.G. VOLTS X1000
D.G. AMPS X100
DG S/S AMPS
1 2 3
BUS VDC BAT GRND DET
DIESEL GEN BRKR
TRIP CLOSE
DG-SYNC SW
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV FDR TO UNIT SUBSTA 111
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO START
BUS 480V SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OFLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

#3


DIESEL GEN SYNCHRO
SLOW FAST
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT. REG
DIESEL GEN KVARS-X100
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
DG VOLTS X1000
DG AMPS X100
DG S/S AMPS
1 2 3
BUS VDC BAT GRND DET
DIESEL GEN BRKR
TRIP CLOSE
DG - SYNC SWCH
OFF ON
BUS VLTS. X100
BUS VLTS. X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF ON
4KV FDR TO UNIT SUBSTA III
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
BUS 480V SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
DIESEL GEN START
AUTO START
LKOUT DLY
PWR AVAIL.
EMERG STOP
STOP
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

4

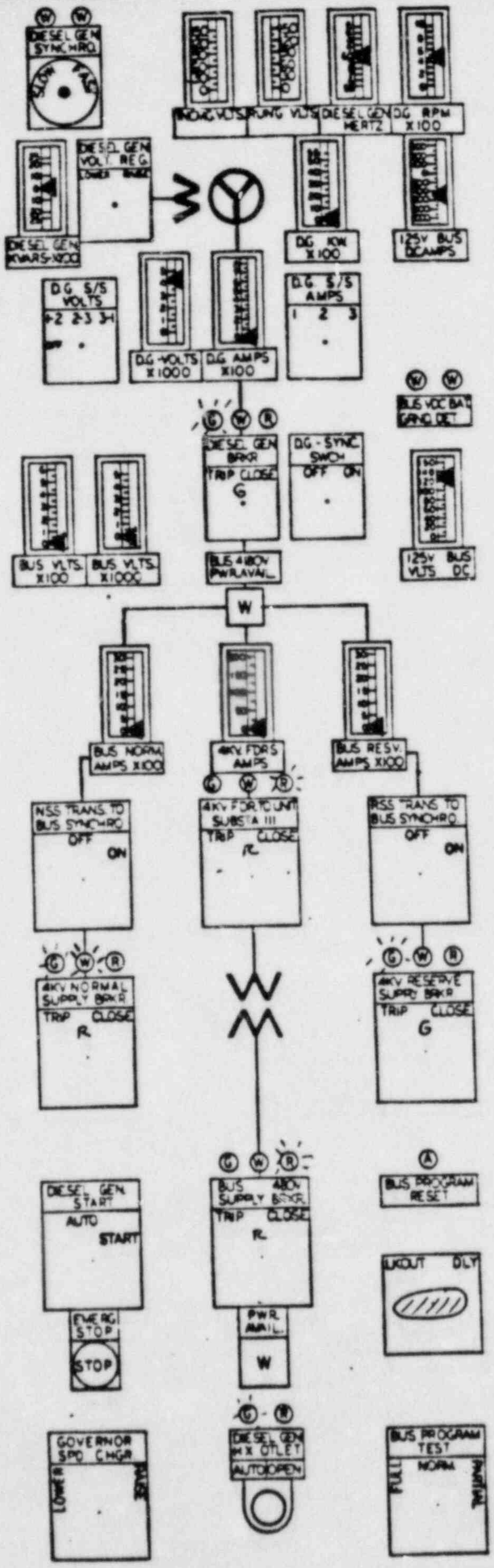
0218 MSS XFMR PRI PROT TRIP	0219 MSS XFMR BACKUP PROT TRIP	0226 MSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	0220 RSS XFMR PRI PROT TRIP	0045 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLT UV CKT LCTL	0461 REMOTE TRIP-SWTD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV NSS SPLT BKR AUTO TRIP	0081 4KV NSS SPLT BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLT-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLT BKR OC TRIP	0162 480V NSS SPLT BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLT-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLT BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLT UV CKT LCTL	0364 BUS 11C-12C SPLT-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLT-TIE BKR PARALLELED

#5

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 SYS DEGRADED	0369 DIESEL 1 SYS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLT BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLT BKR LCTL	0249 BUS 101 SPLT OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLT XFMR GND TRIP	0170 BUS 111 SPLT BKR OC TRIP	0257 BUS 111 SPLT BKR LCTL	0105 BUS 101 SPLT OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 SYS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR H1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLT BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLT BKR LCTL	0250 BUS 102 SPLT OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLT XFMR GND TRIP	0255 BUS 112 SPLT BKR OC TRIP	0258 BUS 112 SPLT BKR LCTL	0089 BUS 102 SPLT OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 125 V BATT CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 SYS DEGRADED	0337 DIESEL 3 SYS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLT BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLT BKR LCTL	0251 BUS 103 SPLT OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLT XFMR GND TRIP	0256 BUS 113 SPLT BKR OC TRIP	0259 BUS 113 SPLT BKR LCTL	0093 BUS 103 SPLT OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL


DIESEL GEN SYNCHRO.
SLOW FAST
INC'G VLTS
RUNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT. REG.
DIESEL GEN KVARS-X100
DG KW X100
125V BUS DC AMPS
D.G. S/S VOLTS
1-2 2-3 3-1
D.G. VOLTS X1000
D.G. AMPS X100
D.G. S/S AMPS
1 2 3
BUS VDC BAT GRND DET
DIESEL GEN BRKR
TRIP CLOSE
G
D.G. - SYNC SWCH
OFF ON
BUS VLTS. X100
BUS VLTS. X1000
125V BUS VLTS DC
BUS 480V PWR AVAIL
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV. AMPS X100
NSS TRANS. TO BUS SYNCHRO
OFF ON
4KV FDR TO UNIT SUBSTA III
TRIP CLOSE
R
RSS TRANS. TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
R
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
G
A
BUS PROGRAM RESET
DIESEL GEN. START
AUTO START
BUS 480V SUPPLY BRKR
TRIP CLOSE
R
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
W
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN H X OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

#5

#6

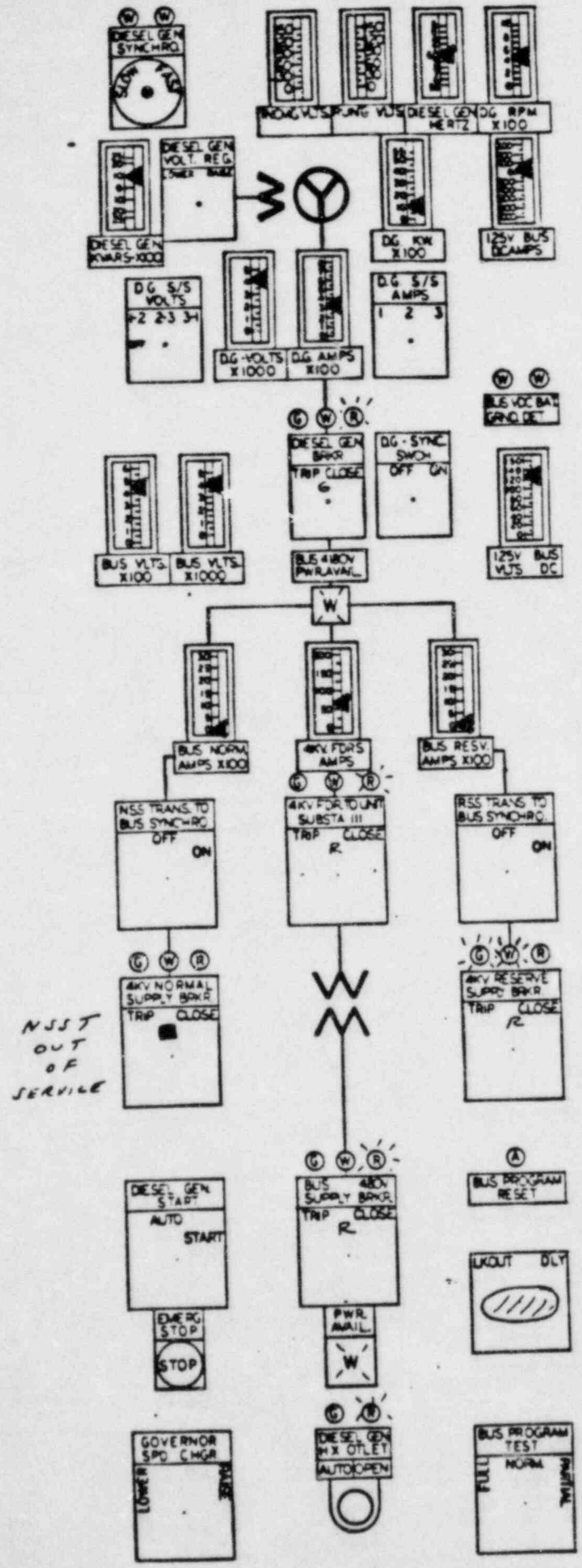
0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	0220 RSS XFMR PRI PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE F	0197 24V BATT CHGR A2-2 TROUBLE F	0198 24V BATT CHGR B2-1 TROUBLE F	0199 24V BATT CHGR B2-2 TROUBLE F	0177 RW PLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

1

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE F
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 STS DEGRADED F	0369 DIESEL 1 STS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE F	0287 VITAL BUS INV BATT OPERATION F	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV F
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0100 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE F
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 STS DEGRADED F	0375 DIESEL 2 STS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE F	0474 SEC-COMM INV BATT/ ALT AC OPERATION F	0475 125 V CHGR M1 TROUBLE F	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV F
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0101 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 125 V BATT CHGR C1 TROUBLE F
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 STS DEGRADED F	0337 DIESEL 3 STS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE F	0290 COMPUTER INV BATT OPERATION F	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103 F
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL


DIESEL GEN SYNCHRO.
SLOW FAST
INC'G VLTS
RUNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT. REG.
LOWER RAISE
DIESEL GEN KVARS-X1000
DG. KW X100
125V BUS DC AMPS
D.G. S/S VOLTS
1-2 2-3 3-1
DG-VOLTS X1000
D.G AMPS X100
D.G. S/S AMPS
1 2 3
BUS VDC BAT GRND DET
DIESEL GEN BRKR
TRIP CLOSE
DG - SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 4160V PWR AVAIL
125V BUS VLTS DC
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV. AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF ON
4KV FDR TO UNIT SUBSTA III
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO.
OFF ON
4KV NORMAL SUPPLY BKR
TRIP CLOSE
4KV RESERVE SUPPLY BKR.
TRIP CLOSE
DIESEL GEN. START
AUTO START
BUS 480V SUPPLY BKR.
TRIP CLOSE
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL
G
R
NSST OUT OF SERVICE

6

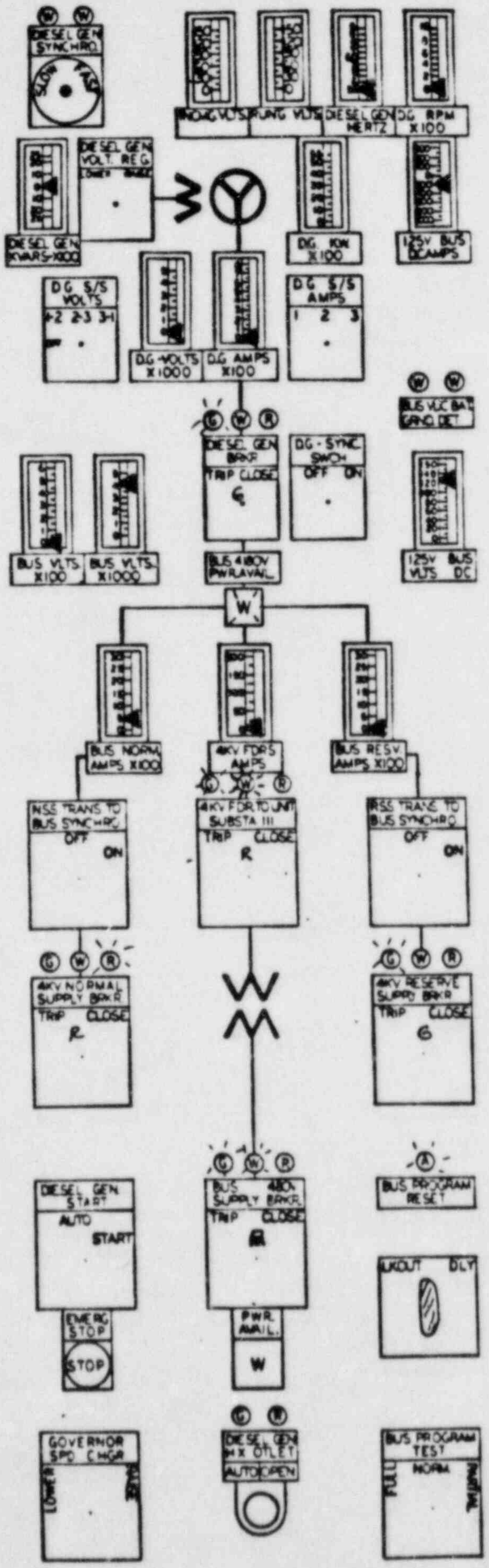
#7

0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	[illegible]0 RSS XFMR PRI PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CPT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V RSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHCR A2-1 TROUBLE	0197 24V BATT CHCR A2-2 TROUBLE	0198 24V BATT CHCR B2-1 TROUBLE	0199 24V BATT CHCR B2-2 TROUBLE	0177 RW PLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHCR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 SYS DEGRADED	0369 DIESEL 1 SYS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0144 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 1 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHCR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 SYS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHCR B1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHCR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 SYS DEGRADED	0337 DIESEL 3 SYS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL


DIESEL GEN SYNCHRO
SLOW FAST
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT. REG
DIESEL GEN KVARS-X100
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
DG VOLTS X1000
DG AMPS X100
DG S/S AMPS
1 2 3
BUS VLC BAL GRND DET
DIESEL GEN BRKR
TRIP CLOSE
DG - SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF ON
4KV FDR TO UNIT SUBSTA 111
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO START
BUS 480V SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
W
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

7

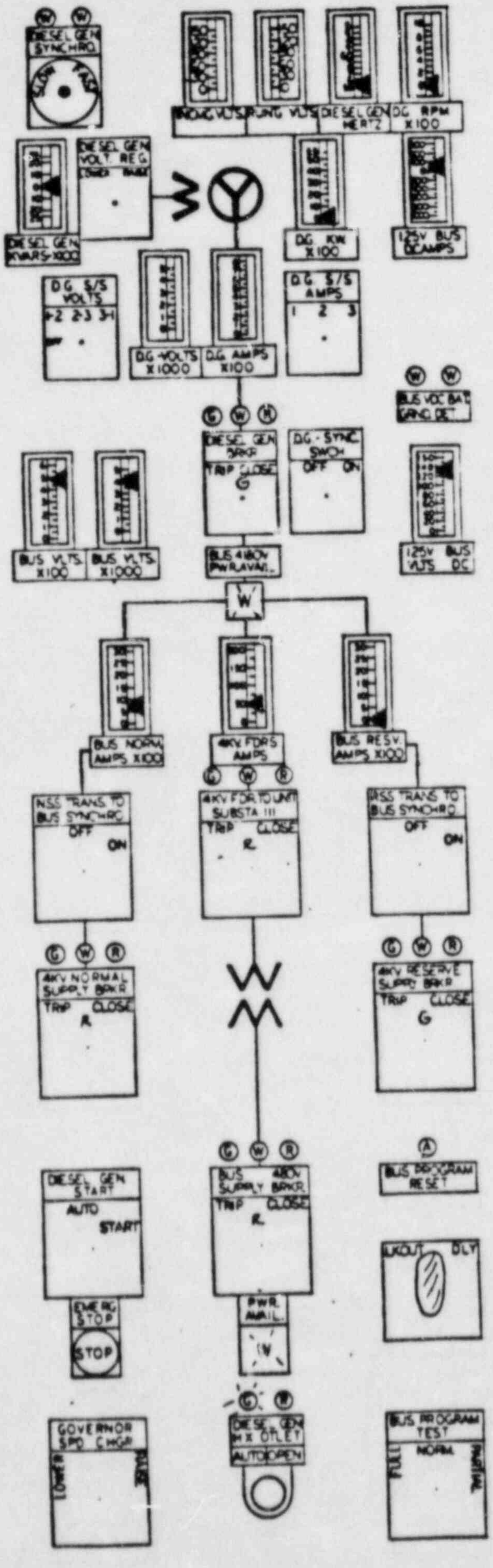
8

0218 NSS XFMR P21 PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	[illegible] RSS XFMR PRI PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY U CKT LCTL	0461 REMOTE TRIP-SWTD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0110 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BK XFMR GND	0163 480V NSS TIE BKR OC TRIP	0111 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 SYS DEGRADED	0369 DIESEL 1 SYS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 SYS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR H1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	03[illegible] DIESEL 3 SYS DEGRADED	0337 DIESEL 3 SYS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL


DIESEL GEN SYNCHRO
SLOW FAST
INCMG VLTS
RUNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT. REG
DIESEL GEN KVARS X100
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
DG VOLTS X1000
DG AMPS X100
DG S/S AMPS
1 2 3
DIESEL GEN BRKR
TRIP CLOSE
DG - SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV. AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF ON
4KV FDR TO UNIT SUBSTA 111
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO START
BUS 480V SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

8

0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	0220 RSS XFMR PRI PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWTD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

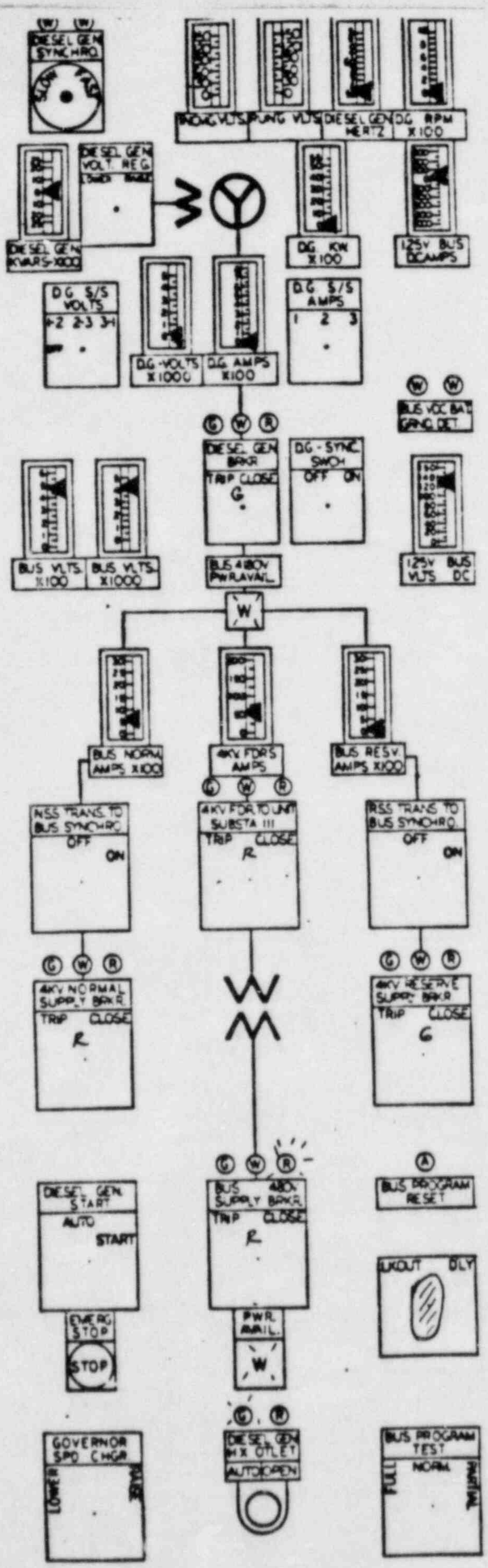
9

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 STS DEGRADED	0369 DIESEL 1 STS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 STS DEGRADED	0375 DIESEL 2 STS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR H1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 STS DEGRADED	0337 DIESEL 3 STS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL

9


DIESEL GEN SYNCHRO.
SLOW
FAST
BKRG VLTS
RUNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT REG
DIESEL GEN KVARS X100
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
DG VOLTS X1000
DG AMPS X100
DG S/S AMPS
1 2 3
BUS VDC BAT GRND DET
DIESEL GEN BRKR
TRIP CLOSE
DG - SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF
ON
4KV FDR TO UNIT SUBSTA III
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF
ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO
START
BUS 480V SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
GOVERNOR SPD CHGR
LOWER
RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL
NORM
PARTIAL

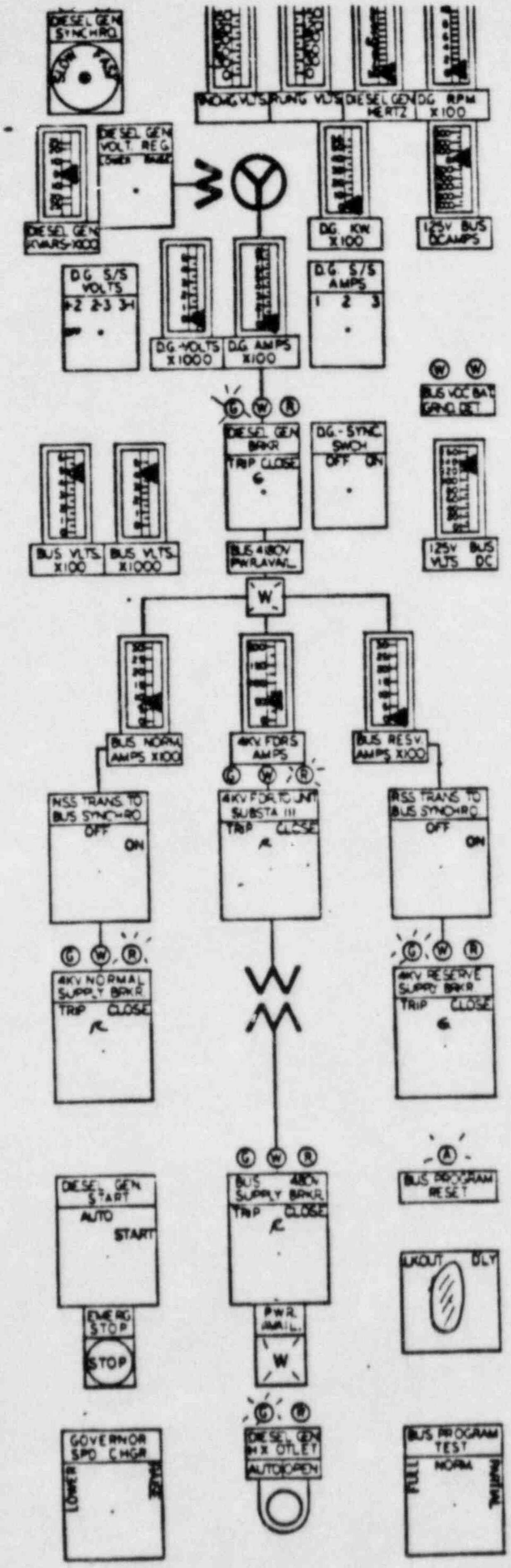
0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 R[illegible] B [illegible] T[illegible]	0220 RSS XFMR PRI PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

#10

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 STS DEGRADED	0369 DIESEL 1 STS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 STS DEGRADED	0375 DIESEL 2 STS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR H1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BA[illegible] CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 [illegible]IESEL 3 [illegible]YS [illegible]EGRADED	0337 DIESEL 3 STS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BU[illegible] C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL


DIESEL GEN SYNCHRO
SLOW FAST
DIESEL GEN VOLT. REG.
LOWER RAISE
DIESEL GEN KVARS X100
DG KW X100
125V BUS DC AMPS
DG HERTZ
DG RPM X100
D.G. S/S VOLTS
1-2 2-3 3-1
DG VOLTS X1000
DG AMPS X100
D.G. S/S AMPS
1 2 3
BUS VDC BAT GRND. DET.
DIESEL GEN BRKR
TRIP CLOSE
DG - SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF ON
4KV FDR TO UNIT SUBSTA III
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
DIESEL GEN START
AUTO START
BUS 480V SUPPLY BRKR
TRIP CLOSE
LKOUT DLY
EMERG STOP
STOP
PWR. AVAIL.
W
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

#10

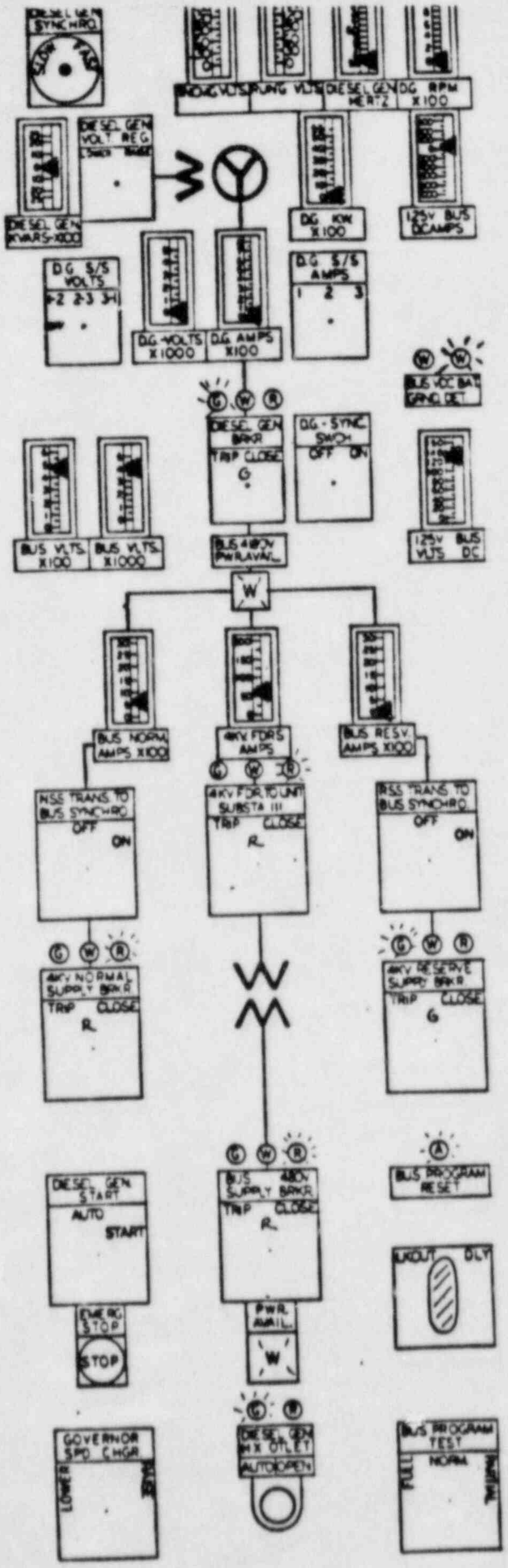
NSS XFMR PRI PROT TRIP	NSS XFMR BACKUP PROT TRIP	NSS XFMR TROUBLE	RSS XFMR TROUBLE	RSS XFMR BAC— ROT TR	RSS XFMR PRI PROT TRIP	4KV NSS BUS UV	4KV BKR NSS & RSS PARALLED	4KV NSS SPLY UV CKT LCTL	REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		022 NSSY/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	C456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

#11

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 SYS DEGRADED	0369 DIESEL 1 SYS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPL BKR LCTL	0248 BUS 101 SPLY OR FDR LCTL	006 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	030 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 SYS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR H1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 SYS DEGRADED	0337 DIESEL 3 SYS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL


DIESEL GEN SYNCHRO
SLOW FAST
DIESEL GEN KVARS-X100
DIESEL GEN VOLT REG
INC VLTS
RUNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
DG VOLTS X1000
DG AMPS X100
DG S/S AMPS
1 2 3
BUS 125V DC BAT GRND DET
DIESEL GEN BRKR
TRIP CLOSE
DG - SYNC SWCH
OFF ON
BUS VLTS. X100
BUS VLTS. X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV. AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF ON
4KV FDR TO UNIT SUBSTA III
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO
START
EMERG STOP
STOP
BUS 480V SUPPLY BRKR
TRIP CLOSE
PWR AVAIL
BUS PROGRAM RESET
LKOUT DLY
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORM PARTIAL

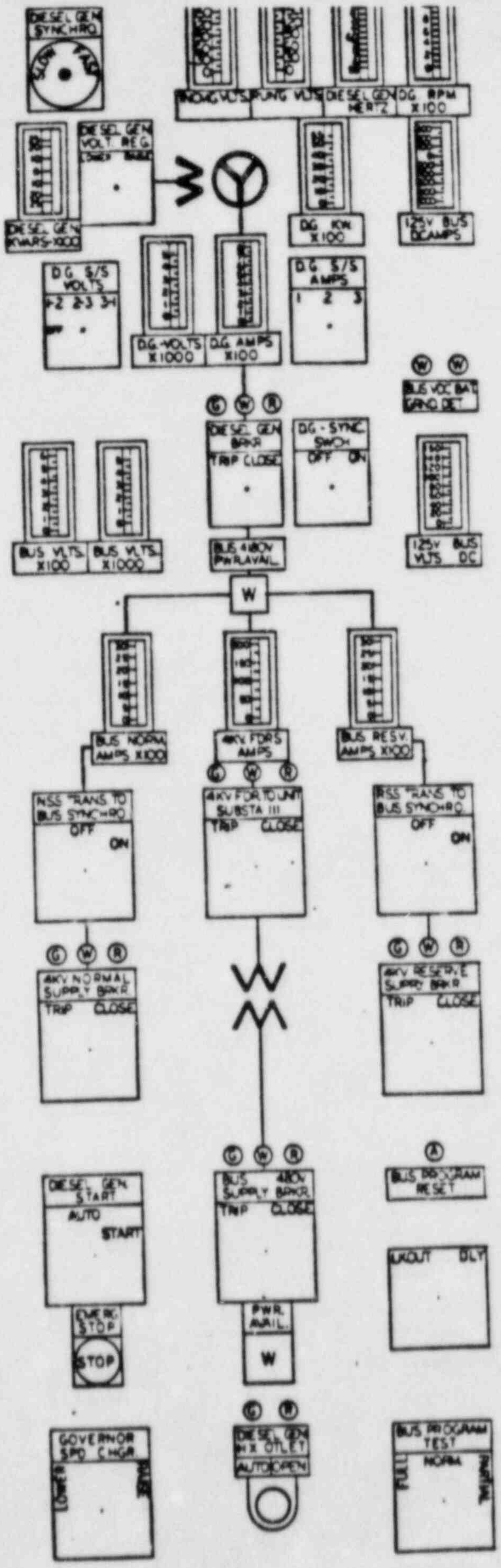
#11

NSS XFMR PRI PROT TRIP	NSS XFMR BAC.UP PROT TR'P	NSS XFMR TROUBLE	RSS XFMR TROUBLE	RSS XFMR BA[illegible] TR.	RSS XFMR PRI PROT TRIP	4KV NSS BUS UV	4KV BKR NSS & RSS PARALLED	4KV NSS SPLY UV CKT LCTL	REDC./E TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI-HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	04-6 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI-HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW PLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

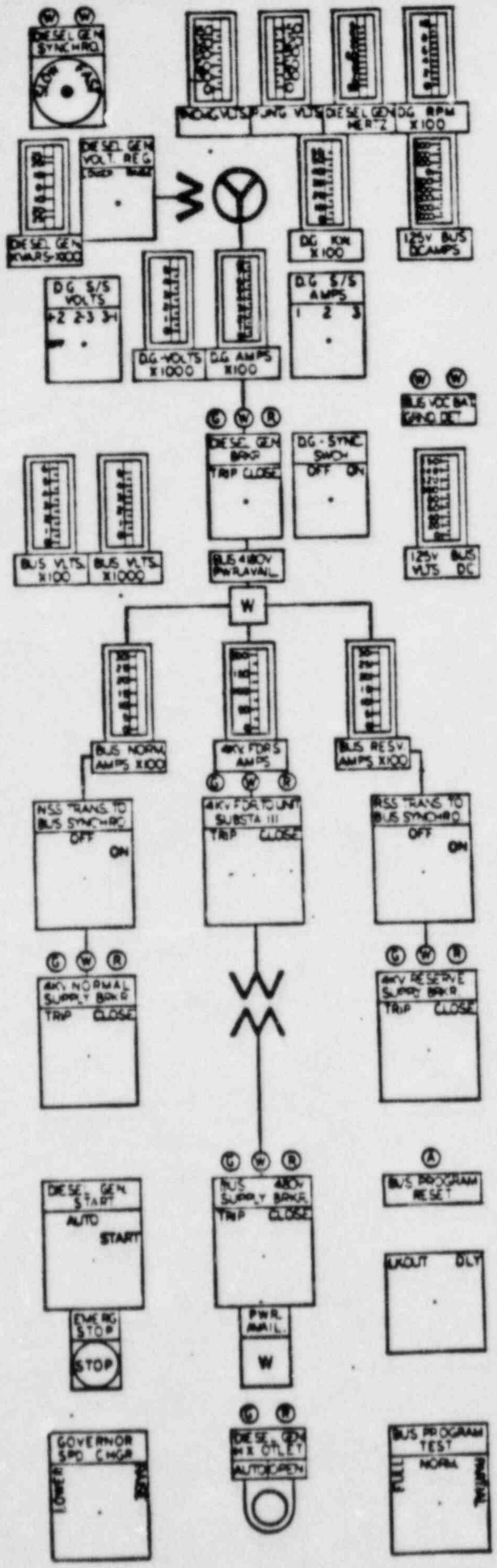
0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 SYS DEGRADED	0369 DIESEL 1 SYS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 SYS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REC POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR H1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BATT CHG/ C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 SYS DEGRADED	0337 DIESEL 3 SYS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 303 PROGRAM LCTL



DIESEL GEN SYNCHRO
SLOW FAST
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT REG
DIESEL GEN KVARS-X1000
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
DG S/S AMPS
DG-VOLTS X1000
DG AMPS X100
DIESEL GEN BRKR
TRIP CLOSE
DG-SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
4KV FDR TO UNIT SUBSTA III
RSS TRANS TO BUS SYNCHRO
4KV NORMAL SUPPLY BRKR
4KV RESERVE SUPPLY BRKR
DIESEL GEN START
AUTO START
BUS 480V SUPPLY BRKR
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
GOVERNOR SPD CHGR
LOWER RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL NORMAL PARTIAL


DIESEL GEN SYNCHRO.
SLOW
FAST
INC'G VLTS
RNG VLTS
DIESEL GEN HERTZ
DG RPM X100
DIESEL GEN VOLT. REG
DIESEL GEN KVARS-X1000
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
1-2 2-3 3-1
DG VOLTS X1000
DG AMPS X100
DG S/S AMPS
1 2 3
BUS VDC BAT GRND DET
DIESEL GEN BRKR
TRIP CLOSE
DG-SYNC SWCH
OFF ON
BUS VLTS. X100
BUS VLTS. X1000
BUS 480V PWR AVAIL
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
NSS TRANS TO BUS SYNCHRO
OFF
ON
4KV FDR TO UNIT SUBSTA III
TRIP CLOSE
RSS TRANS TO BUS SYNCHRO
OFF
ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO
START
BUS 480V SUPPLY BRKR
TRIP CLOSE
BUS PROGRAM RESET
LKOUT DLY
EMERG STOP
STOP
PWR AVAIL
W
GOVERNOR SPD CHGR
LOWER
RAISE
DIESEL GEN HX OTLET
AUTO OPEN
BUS PROGRAM TEST
FULL
NORM
PARTIAL

NSS XFMR PRI PROT TRIP	NSS XFMR BACKUP PROT TRIP	NSS XFMR TROUBLE	RSS XFMR TROUBLE	RSS XFMR BAC[illegible] PROT T	RSS XFMR PRI PROT TRIP	4KV NSS BUS UV	4KV BKR NSS & RSS PARALLED	4KV NSS SPLY UV CKT LCTL	REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI- HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	045 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	[illegible]63 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL 'AMPLE CND.T HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTN N2 HDR A PRESS HI/ LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0 97 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 HW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OX/GEN HI	0254 CNDS OXYGEN LO	0323 INSTN N2 HDR B PRESS HI/ LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 STS DEGRADED	0369 DIESEL 1 STS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	0062 BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	02[illegible] BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 STS DEGRADED	0375 DIESEL 2 STS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR B1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	0089 BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0202 124 V BA CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 STS DEGRADED	0337 DIESEL 3 STS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V DV C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL

STUDENT HANDOUT
REACTOR BUILDING STANDBY VENTILATION SYSTEM
FOR SHIFT (SRO) ADVISOR TRAINING PROGRAM

Prepared By: L. T. Pugg 5/10/84
Training Specialist / Date

Rev. Ø Date: 5/10/84

Approved By: [illegible] 5/10/84
Training Supervisor / Date

1.0 LESSON PLAN: Reactor Building Standby Ventilation System (RBSVS)

2.0 LECTURE DURATION: 2 hrs.

3.0 MATERIALS REQUIRED FOR STUDENTS:

3.1 RBSVS Lesson Plan

4.0 MATERIALS REQUIRED BY INSTRUCTOR:

4.1 Related Graphics

5.0 REFERENCE MATERIAL:

5.1 RBSVS System Description - 1020.405

5.2 RBNVS System Description - 1020.418

5.3 FSAR

5.4 Technical Specifications

6.0 SCOPE OF LECTURE:

To teach the student the duct arrangement, major components, instrumentation system operation and system interrelations of the Reactor Building Standby Ventilation System.

7.0 OBJECTIVES - Containment Ventilation Systems

7.1 State the purpose of the containment ventilation systems as given in the student handout.

7.2 Given diagrams of the systems trace out the flowpath for:

1. Normal Operation

2. Primary containment purge and/or venting

3. Operation with an RBSVS initiation signal present

7.3 Given a diagram of the containment ventilation systems and system parameters available in the control room identify the following system malfunctions:

1. Drywell cooling coil leak

2. Improper operation of RBNVS Pressure control dampers

3. Clogged RBSVS Filter Train

4. Inproper operation of the RBSVS exhaust flow control dampers.

5. Inproper operation of a RBSVS Filter Train preheater.

6. Containment ventilation Rad isolation (Future)

7.4 Without the use of procedures (control room walkthrough or classroom if panel layout is supplied).

1. Verify automatic initiation of the RBSVS.

2. State how to manually initiate the RBSVS as per SP 23.4Ø5.Ø1 if failure to automatically operate is identified.

3. State the requirements as contained in SP 23.4Ø5.Ø1 for shutting down the system after it has started due to a valid initiation signal.

7.5 Given values for the following parameters, determine if RBSVS should auto initiate.

1. Radiation in the refueling level return duct

2. Drywell pressure

3. Reactor Water Level

4. Reactor Building Differential Pressure

5. Reactor Building supply air conditioning unit coil air temperature.

6. Reactor Building inlet or outlet valve positions

7. Status of power to the normal station 480V Busses.

7.6 Given control room indications and/or annunciators associated with the RBNVS or RBSVS system, identify conditions that require use of the following (Abnormal, Emergency) procedures.

1.	29.002.03	ABNORMAL RAD RELEASE -STATION VENTILATION
2.	29.009.01	FUEL HANDLING ACCIDENT
3.	29.013.01	LOSS OF PRIMARY CONTAINMENT INTEGRITY
4.	29.013.02	LOSS OF SECONDARY CONTAINMENT INTEGRITY

8.0 LESSON OUTLINE:

8.1 Theory

8.1.1 Purpose of the System is to maintain a negative pressure in the Secondary Containment during accident conditions, and prevents the egress of unfiltered contaminants.

8.1.2 Design Basis

.1 The RBSVS is designed to maintain the secondary containment at - .5 in water gauge during a 30 mph wind at the secondary containment wall.

.2 The RBSVS filtered exhaust is designed to meet the release requirements of 10CFR100 during an accident condition.

.3 Pressure buildup due to heat gains within the secondary containment is precluded by unit coolers situated throughout the building. Coolers are also in the recirculation path to the refueling level.

.4 Design consistent with single failure criteria.

8.1.3 Theory of Operation Fig. 1 & 2

The RBSVS maintains the secondary containment at sub-atmospheric pressure during accident and abnormal conditions to minimize the uncontrolled release of radioactive contaminants to the atmospheres. The RBSVS coolers assist the reactor building differential pressure by subcooling the building atmosphere. The exhaust portion of the system maintains the differential pressure by removing the expected infiltration produced by the differential pressure. The normal ventilation system is isolated from the atmosphere and used to recirculate the building atmosphere for mixing and dilution purposes.

8.2 Physical Description

8.2.1 General System Description

The exhaust system of the RBNVS is utilized to recirculate the Reactor Building atmosphere. The flow path is from the building lower levels to the refueling level. The air returns to the lower level via equipment openings on the refueling level. The RBSVS logic consists of two identical subsystems which energize in a one out of one logic to actuate their respective system components. Temperature control valves open supplying RBSVS/CRAC chilled water to the recirculation unit coolers during accident conditions. The air that enters the secondary containment due to the differential atmospheric pressure is exhausted via a sidestream filter train to the atmosphere.

8.2.2 System Initiations:

.1 High radiation in refueling level exhaust (35 mr/hr)

.2 High drywell pressure (1.69 psig)

.3 Low reactor vessel level (-38")

.4 Loss of power to normal 480V busses (sensed off 4160V AC buses & anticipates loss of RBNVS)

.5 Low Reactor Building differential pressure (.3 in. water gauge)

.6 Reactor Building supply and exhaust isolation valve failure (Rx Building supply or exhaust AOV closed)

.7 Manual initiation on VC2

8.2.3 Major Equipment Description

.1 Reactor Building exhaust fans (FN 3A, B, C) Three, 100% capacity, parallel, vane axial fans 45,000 CFM each.

Power Supply - FN 3A - 480V AC DIV I Emergency Bus

FN 3B - 480V AC DIV II Emergency Bus

FN 3C - 480V AC DIV III Emergency Bus

.2 Exhaust booster fans (FN 79A, B)

Two, 100% capacity, parallel, centrifugal fans 1,585 CFM each

Power Supply - FN 79A - 480V DIV I MCC

FN 79B - 480V DIV II MCC

.3 Filter Trains (FLT 1A, B)

Two, 100% capacity, parallel filter train. Each filter consists of: Fig. 3

a) The electric preheater is designed to reduce the relative humidity from 100% to 70% during the postulated DBA. Three banks of heaters maintain the relative humidity 70%. High temperature trip is 190° with a 225° backup.

Power Supply - 1A HTR DIV I MCC

1B HTR DIV II MCC

b) Prefilter is designed to remove the larger particles and prevent excessive loading of the HEPA filter.

c) HEPA filter removes fine discrete particulate matter which could interfere with the charcoal adsorber efficiency.

d) The adsorber is activated coconut shell charcoal. It removes gaseous iodine. It functions efficiently at 70% relative humidity. In the event of a fire a water spray is provided by the deluge and sprinkler system.

e) HEPA filter removes carbon fines exhausted from the adsorber and has an efficiency in excess of 99%.

.4 Recirculation Cooling Coils (CLC-5A/B):

a) Two, 100% capacity cooling coils in series

b) RBSVS/CRAC chillwater system A and B supplies cooling coils.

.5 Unit Coolers:

a) Two, 100% capacity subsystems. Each unit cooler consists of a filter, cooler and fan.

b) Unit coolers provide cooling to the following areas:

1)	UC-2A/B and UC-3A/B	RHR/Core Spray Areas
2)	UC-20A/B	MCC Rooms, RB-112'
3)	UC-4A/B and UC-5A/B	Refueling Level Area
4)	UC-21A/B and UC-22A	MG Set Rooms

c) Power supplies for the above unit coolers are:
"A" coolers - Div. I 480V AC Emergency Bus
"B" coolers - Div. II 480V AC Emergency Bus

d) The TCV's controlling chill water to the unit coolers operate to maintain exit air temperature during normal and RBSVS operating conditions.

.6 Dampers and Valves

a) Modulating dampers (MOD 34A, B) are used to regulate the exhaust air flow at 1,160 CFM.

b) 120V AC power for valve and damper motors and solenoids comes from the associated emergency distribution panels.

.7 Ventilation Control Panel 2 (VC2)

Controls and indications for RBNVS, RBSVS and primary containment purge system.

8.3 Principles of Operation

8.3.1 Operating Modes

Normal - Fig. 1
RBSVS - Fig. 2

	NORMAL	RBSVS
R.B. Exhaust Fans (FN 3A,B,C)	2 running	1 running
R.B. Supply Fans (FN 2A, B)	1 running	Stopped
R.B. Intake Valves (AOV 35A, B)	Open	Closed
R.B. Exhaust Valves (AOV 37A,B)	Open	Closed
Refueling Level Exhaust (AOD 40A,B)	Open	Closed
Contaminated Area Exhaust (AOD 41A,B)	Open	Closed
Pri. Cont. Purge Valves (AOV38A,B,C,D)	Open During Purge	Closed
Pri. Cont. Purge Valves (AOV39A,B,C,D)	Open During Purge	Closed
Mixing Plenum Inlet (MOD 31A, B)	Closed	Open
Exhaust Booster Fans (FN 79A, B)	Stopped	1 Running train
Filter Train Inlet (MOD48A,B)	Closed	1 open
Flow Control Dampers (MOD 34A, B)	Closed	Both Modulating
Unit Coolers	Some Oper.	Operating

.1 Automatic Action on RBSVS Initiation

a) Isolate Primary and Secondary Containment

(Shuts AOV 38A, B, C, D and AOV 39A, B, C, D)

(Shuts AOV 35A, B and AOV 37A, B)

(Shuts AOV 78A, B and AOV 79A, B)

b) Stops R.B. supply fans (FN 2A, B) and ACU 13

c) Switches R.B. exhaust system into recirc. mode

(Shuts AOD 40A, B, AOD 41A, B)

(Opens MOD 31A, B and MOD 34A, B)

d) Two R.B. exhaust fans (FN 3A, B or C) will remain operating or will restart when power is restored.

e) Two RBSVS exhaust booster fans start (FN 79A, B)

f) Two RBSVS filter trains actuate (open MOD 48A, B)

g) Fans on RBSVS unit coolers start (both sets)

h) TCV's on coolers go full open.

i) RBSVS/CRAC chill water subsys. isolated from each other. Chill water pumps start. Condensing pumps start. Water chillers 3A, B and 4A, B start. The RBSVS initiation consists of two subsystems (A, B), each subsystem will actuate the primary containment isolation valves and those components with the logic designation. (A logic starts A components). Because each component has 100% capacity the redundant component can be secured 30 minutes after RBSVS initiation. During RBNVS operation 2 exhaust fans are running. Manual override controls are on control room panel VC2. The lineup and controls are:

1 - R.B. Exhaust Fan

1 - R.B. Exhaust Booster Fan

1 - RBSVS Filter on and 1 in the Cooling Mode

1 - Set of Unit Coolers

1 - RBSVS/CRAC Chill Water Subsystem

When an RBSVS filter is shutdown to its cooling mode its inlet damper is shut. The filter is cooled by 250 CFM backflow through the orifice at the filter inlet. Decay heat is produced by radioactive nuclides which accumulate on the filters and adsorber. (Fig. 6)

.2 Shutdown

Only after the RBSVS initiation signal has cleared can the operator manually reset the RBSVS initiation on VC2. When the RBSVS initiation is reset, RBNVS resumes normal operation automatically.

.3 Technical Specifications
3.6.5.3 Two independent Reactor Building Standby Ventilation Systems (RBSVS) shall be OPERABLE.

8.3.2 Hazards and Precautions - Refer to Containment Ventilations Supplement

8.3.3 Instrumentation and Controls

.1 Main Control Room Panel (VC2)

a) R.B. Normal Exhaust Flow Ind.

b) RBSVS Exhaust Flow Ind.

c) RBSVS Exhaust Flow Rec.

d) Filter Moisture Ind.

e) Filter Diff. Press. Ind.

f) R.B. Diff. Press. Ind.

g) R.B. Diff. Press. Rec.

h) RBSVS Recirc Air Temp Rec.

.2 Controls (VC2)

a) RBSVS Manual Initiation and Reset Switches

b) R.B. Exhaust Train Flow Controller

c) R.B. Exhaust Fans (FN 3A, B, C)

d) R.B. Differential Pressure Controller

e) RBSVS Exhaust Booster Fans (FN 79A, B)

f) RBSVS Unit Cooler Fans

g) System Dampers and Valves

h) Filter Preheaters

.3 Local Controls - Fans 3A, B, C (local emergency switchgear)

8.3.4 System Interlocks

.1 Fans in the RBSVS are interlocked with their discharge dampers. As the fans go on and off the dampers will open and close. The fan will trip if the damper fails to open.

.2 Fans are interlocked with each other such that if the running fan fails the standby fan will start.

.3 The filter preheater will not operate with no flow through the filter.

8.3.5 Specific System Interrelations

.1 The RBSVS is nuclear safety related and requires support from the emer. busses and RBSVS/CRAC chill water systems.

.2 Air operated valves are dependent upon the instrument air system. These valves fail to their RBSVS position on loss of air.

.3 RBSVS initiation overrides RBNVS and primary containment purge operation.

.4 The RBSVS/CRAC chill water system consists of two identical subsystems. Each subsystem is made up of two water chillers, condensing and chilled water pump for each chiller, surge tank, unit coolers and cooling coils.
During normal operation one chiller is running and the subsystem crossconnect bypass valves are open. RBSVS initiation separates the subsystems, starts all the water chillers and associated pumps. All A/C units, unit coolers, and cooling coils will be supplied.

8.4 Summary

The RBSVS is designed to maintain a negative pressure inside the secondary containment during abnormal and accident conditions to prevent the uncontrolled release of radioactive contaminants.

RBSVS DATA

1. Maintains Reactor Building Pressure at @ - .5" Water Gauge with 30 MPH wind and 1,160 CFM infiltration by discharging 1160 CFM through the filter trains and cooling inside secondary containment.

2. Recirc Flow 43,415 CFM

   Exhaust Flow 1,160 CFM

   Cooling Flow to Stby Filter 150 CFM

   Vent Flow to On-Line Filter 275 CFM

3. Exhaust Fans 45,000 CFM

   Exhaust Booster Fans 1,585 CFM

FN3A	Bus 111	FN79A	MCC 1114
3B	112	79B	1124
3C	113		

4. Filter Train

   Preheaters - 3 banks

   Prefilter - 85% removal eff.

   HEPA - 99.97% removal eff.

   Charcoal - 95% methyl iodine removal

5. FN-Ø79A (B) 1585 SCFM
   -275 Thru inlet orifice (returned to sec cont area)
   -150 Flows backward thru inactive B & D
   1160 SCFM discharge out separate exhaust duct

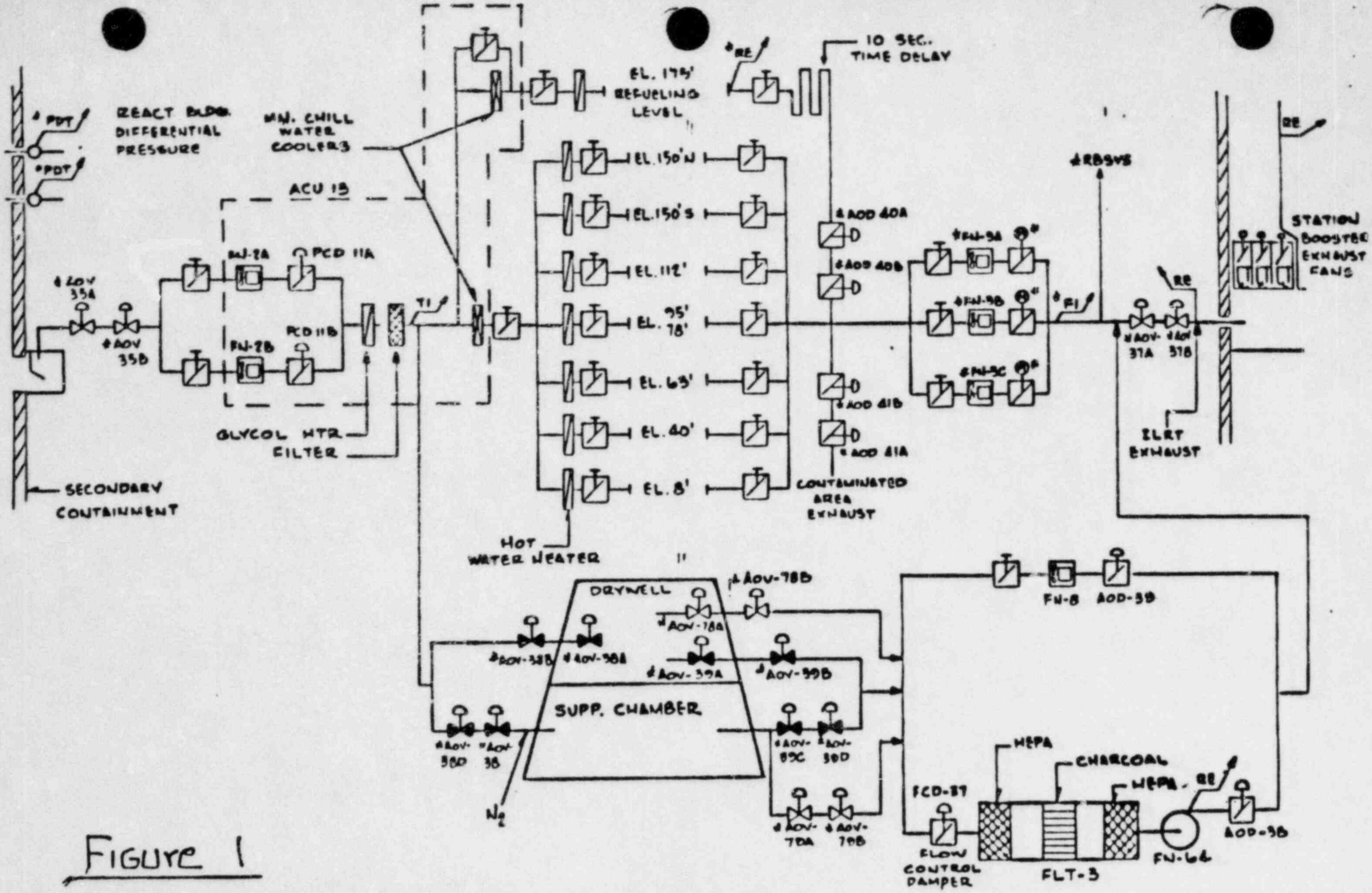


Figure 1

* SAFETY RELATED COMPONENTS

REACT. BLDG. NORMAL VENTILATION & PRIMARY CONT. PURGE SYSTEM

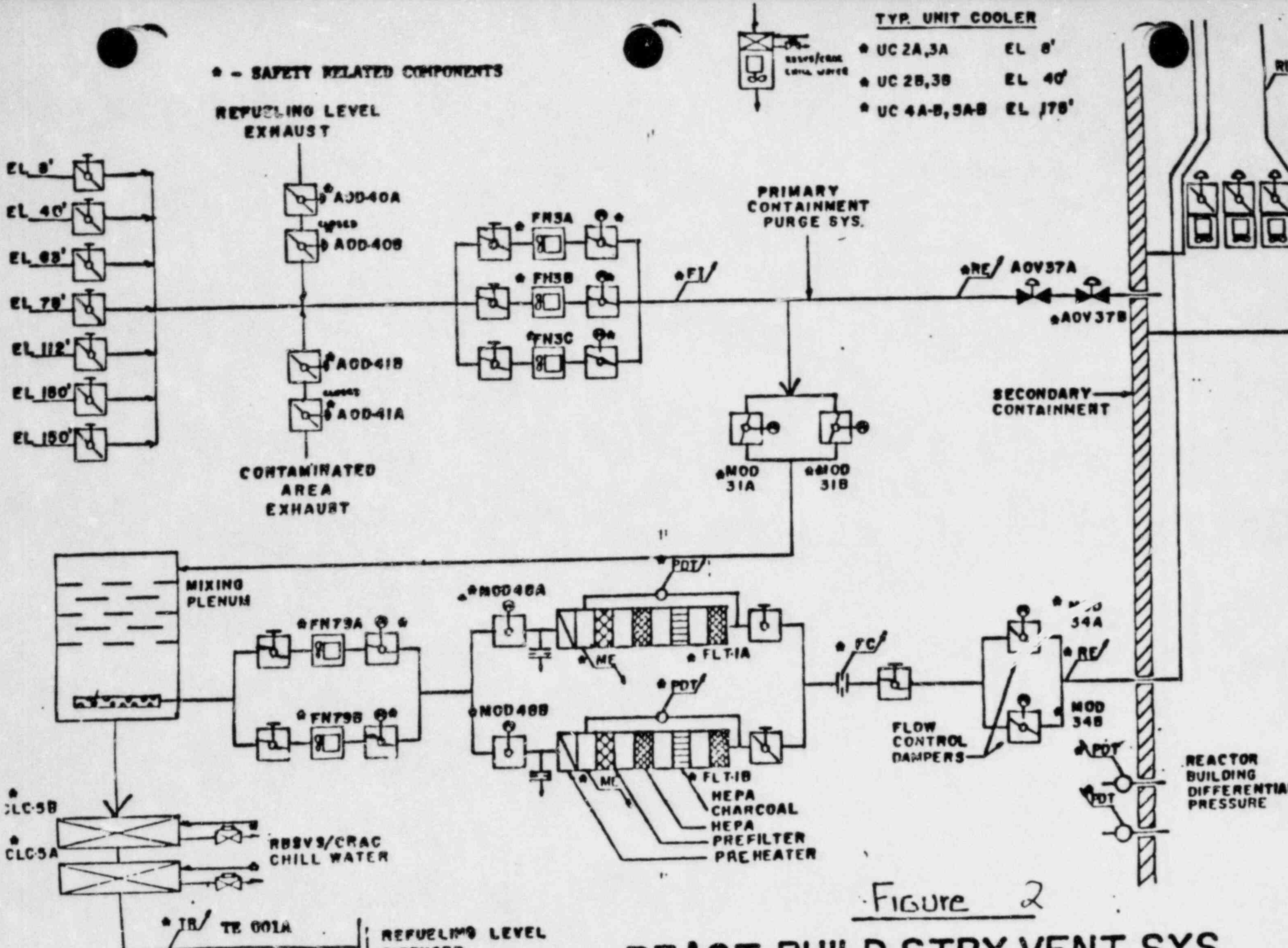


Figure 2

REACT. BUILD. STBY. VENT. SYS.

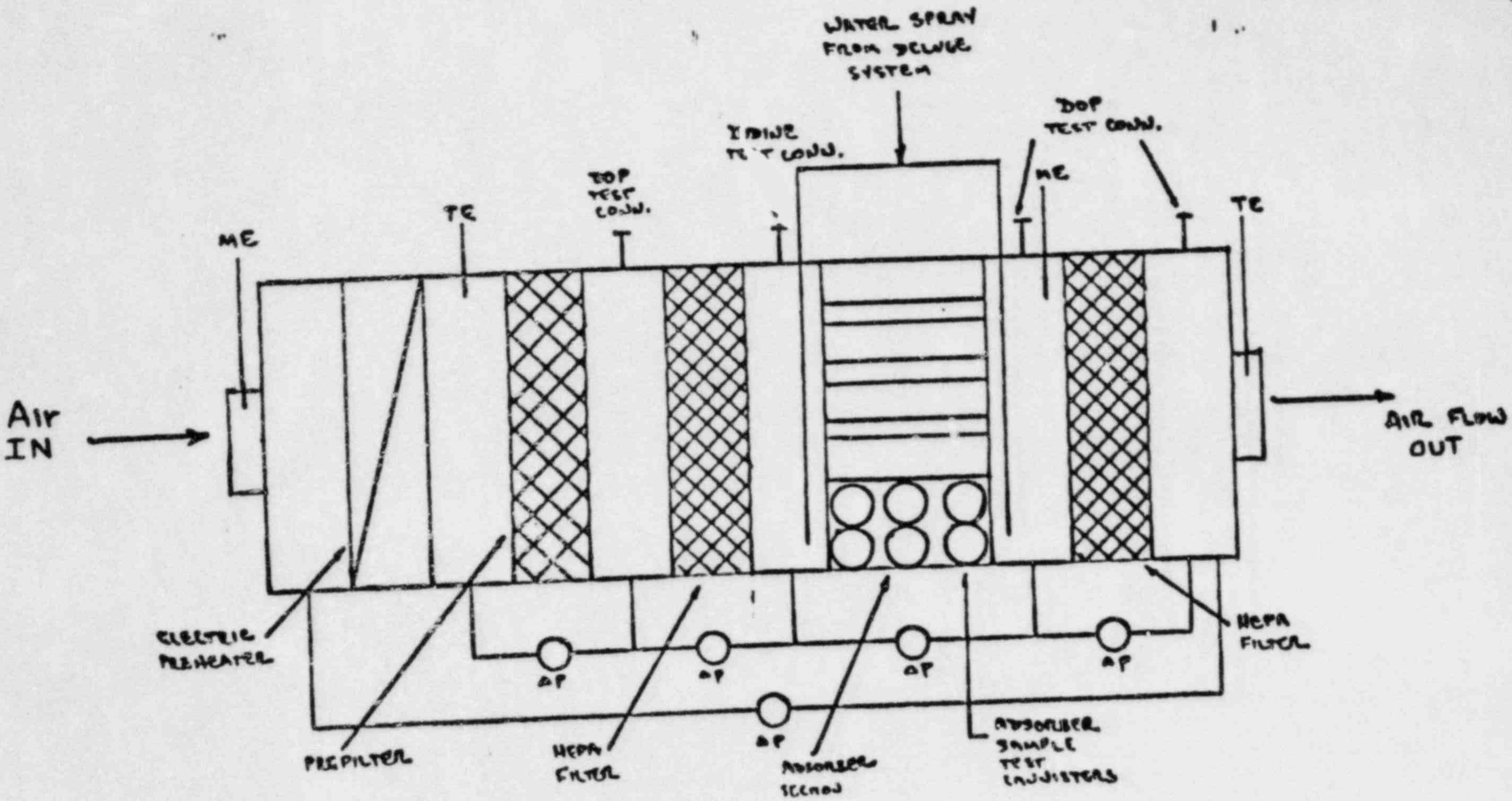


Figure 3

RBSVS Filter Train

CONTAINMENT VENTILATION SUPPLEMENT

(RBNVS, DW COOLING, RBSVS)

Date:________ Prepared by:______________________________

Training Specialist / Date

Handout # SHS 405,413,418

Rev # Ø Approved by: Marcelen P Buckingham 5/23/84

Operations Training Specialist / Date

I. This supplement is to be handed out along with the Student Handouts for RBNVS, DW COOLING and RBSVS.

II ANNUNCIATORS

ANNUNCIATOR	ARP	VALIDATION
RB SPLY FANS AUTO TRIP	3049	Green and white light on VC Panel
RB SPLY FLT DIFF P HI	3050	Dispatch an EO to local PDI
RB SPLY AIR TEMP LO	3051	Panel VC & TI indicates less than 40°
RB EXH FANS AUTO TRIP	3053	Green and white light on VC Panel
RB EXH FANS DEGRADED	3054	Fan lights out on VC panel or breaker in Test
CNTMT PURGE SYS A VALVES LCTL	3076	AOV lights out on VC panel for Cnmt Purge VLVS
CNTMT PURGE SYS B VALVES LCTL	3077	AOV lights out on VC panel for Cnmt Purge Vlvs
RB EXH AIR TEMP HI	3078	Computer indicates a local high area temp
RB DIFF P HI	3079	RBNVS Press Controller indicates - 2.0 or greater
RB DIFF P LO	3080	RBNVS Press Controller indicates - 0.4 or less
CNTMT PURGE FILTER DIFF P HI	3082	Dispatch on EO to EL 96 for local PDI
RB VENT EXH FLOW LO	3086	Panel VC FI less than normal
RB SPLY FAN OC TRIP	3087	Dispatch an EO to breaker compartment
RB EXH FAN DMPR DEGRADED	3088	RB Exh DAMPER Lights out on VC panel
RB SUPPLY FN MTR TEMP HI	3089	?
RBNVS EXH DMPR TROUBLE	3099	Green or No lights for Refuel or Cont Area Exh damper
RB VENT ISOL VV A LCTL	3100	Loss of Power to RB Vent A IN/EXH AOV
RB VENT ISOL VV B LCTL	3101	Loss of Power to RB Vent B IN/EXH AOV
RB MCC ROOM A TEMP HI-LO	3106	Computer point readout (RB 112')
RB MCC B TEMP HI-LO	3107	Computer point readout (RB 112 East)
RB MCC ROOM A VENT INOP	3108	Various - refer to computer readout
RB MCC ROOM B VENT INOP	3109	Various - refer to computer readout
DRYWELL UC-17A 17B DRN FLOW HI	3055,3056	NONE
DRYWELL UC FANS TROUBLE	3059	UC Fan off or Damper closed when it should be running
DRYWELL UC DIFF P LO	3095	VC Panel PDI reading
DRYWELL CNTMT AREA TEMP HI	3096	Temp on recorder reading high - Set Points various
RB MG ROOMS TEMP HI/LO	1173	VARIOUS - Refer to computer readout
MG RM 111 VENT INOP	1174	VARIOUS - Refer to computer readout
MG RM 112 VENT INOP	1175	VARIOUS - Refer to computer readout
MG RM 113A VENT INOP	1176	VARIOUS - Refer to computer readout
MG RM 113B VENT INOP	1177	VARIOUS - Refer to computer readout
RBSVS UC SYS A(B) INOP	3015,3016	VARIOUS - Look for a Loss of Power on an RBSVS component
RBSVS FLTTR TRN A(B) DEGRADED	3072	VARIOUS - Look for Loss of Control power, heater off or RB ΔP problems
RBSVS UC SYS A(B) DEGRADED	3074	VARIOUS - Refer to computer readout
RBSVS FLTR TRANS FLOW HI-LO	3081	Panel VC-2 FIC - indicates abnormal
RBSVS SYS A(B) INITIATION	3084,3085	RBSVS Initiation Red Light Illumination
RBSVS SYS A(B) INIT CONT LOSS	3093,3094	VARIOUS - Refer to computer readout
RBSVS PLNM INL DMPR A(B) OPEN	3097,3098	Loss of Power or wrong position of damper

III SYSTEM PROCEDURES

System Precautions, cautions and/or Limitations

1. Ensure that no other testing is in progress that affects the RBNVS or the Control Room Air Conditioning System.

   o SAWS Forms or SP's must be reviewed by the WS or WE before being performed.

2. Coordinate operation of the RBSVS and CRAC with operation of the RBSVS and CRAC chilled water system, Reference 11.11.

   o Viewing Panel VC-1 and 2 should show all "A" or all "B" equipment in service.

3. Ensure that the preheater control cubicle is not deenergized during the performance of measuring preheater currents. Deenergizing the preheater control cubicle will result in a loss of fire protection to the associated RBSVS filter train.

   o Red light for heaters do NOT come on during filter operation.

4. Failure of the RBSVS will allow reactor building pressure to rise to atmospheric and possibly allow an unmonitored release of radioactive containmants to the atmosphere.

   o VC panel indicates RB ΔP -.25" WG or less.

5. To avoid possible damage to the air-conditioning filter(s), allow only one Reactor Building supply fan (FN-ØØ2A or -ØØ2B) to run (start) when shifting Reactor Building supply fans or when restoring to RBNVS operations from RBSVS operation.

   o One RBNVS supply for running when the other is about to be started.

6. Do not run RBSVS or CRAC if organic fumes (I.E. painting, etc.) are present in the Reactor or COntrol Buildings.

   o Notification of bad smells from personnel.

7. Manual dampers have been set by air balancing and should not be operated for any but emergency reasons.

   o EO or control room indication reports unusual temperatures in area.

8. Ensure that both the drywell and suppression pool areas have been previously purged and radiation limits are within allowable limits prior to opening the primary containments purge valves.

   o Containment sample results meet the tech spec limits for purging without going through the containment filter.

9. Prior to operational testing of the RBSVS Filter Trains, the associated Filter Train preheater control switch should be checked in the auto position.

   o Filter train in operation and red lights for the 3 banks of heaters not ON.

10. The RBSVS system is nuclear safety-related. Corresponding redundant components (A and B) should never be rendered inoperable at the same time. The RBSVS shall not be inoperable when irradiated fuel is being handled in the Reactor Building.

   o Redundant components out of position and/or de-energized.

11. If the Primary Containment atmosphere radiation levels are high, the air shall be filtered prior to discharge. The stack release rate should be monitored for any change in release rate.

   o Containment atmosphere sample indicates greater than the amount required for release without filtering.

12. A filter train or RBSVS unit cooler(s) which has been placed in manual override during accident condition operation must be manually restarted if the need arises for it to operate.

   o VC panel white light illuminated.

IV MALFUNCTIONS

1. RBSVS Initiation - Refer to figures 1A through 1E and 1G.

2. DW Cooling Coil Leak - Refer to figure 2H

3. RBSVS PCD improper operation - Refer to figures 3C and 3G.

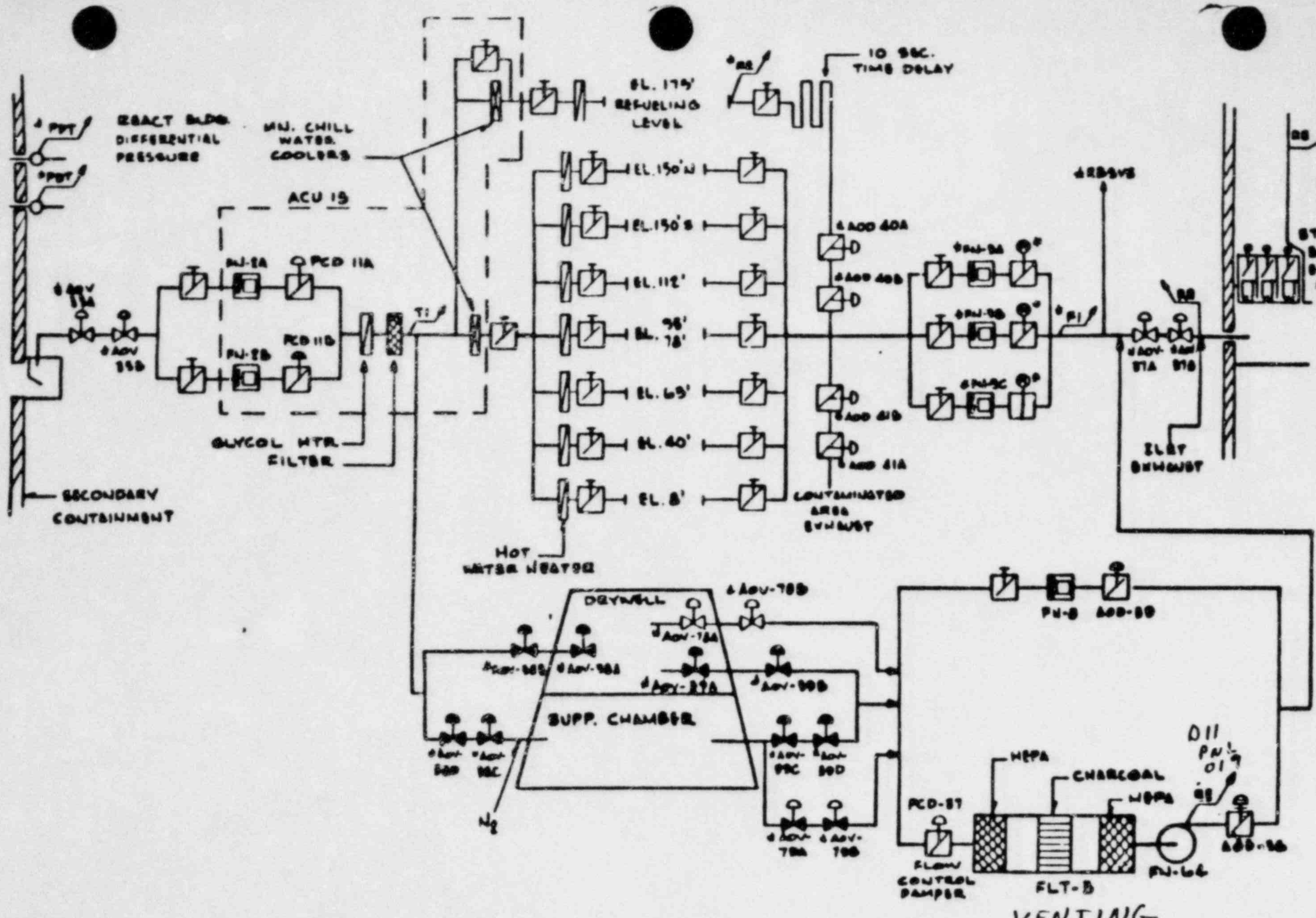
4. RBSVS clogged Filter train - Refer to figures 4E and G.

5. RBSVS Exhaust FCD's improper operation - Refer to figures 5E and G.

6. RBSVS Heater improper operation - Refer to figures 6E and G.

7. Containment Ventilation Rad Hi and all other future RBSVS initiations - Refer to figure 6D.

8. Emergency Procedure Entrance - Refer to figures 8A, 8G, and 8H.



* SAFETY RELATED COMPONENTS

REACT. BLDG. NORMAL VENTILATION & PRIMARY CONT. PURGE SYSTEM

Fig A

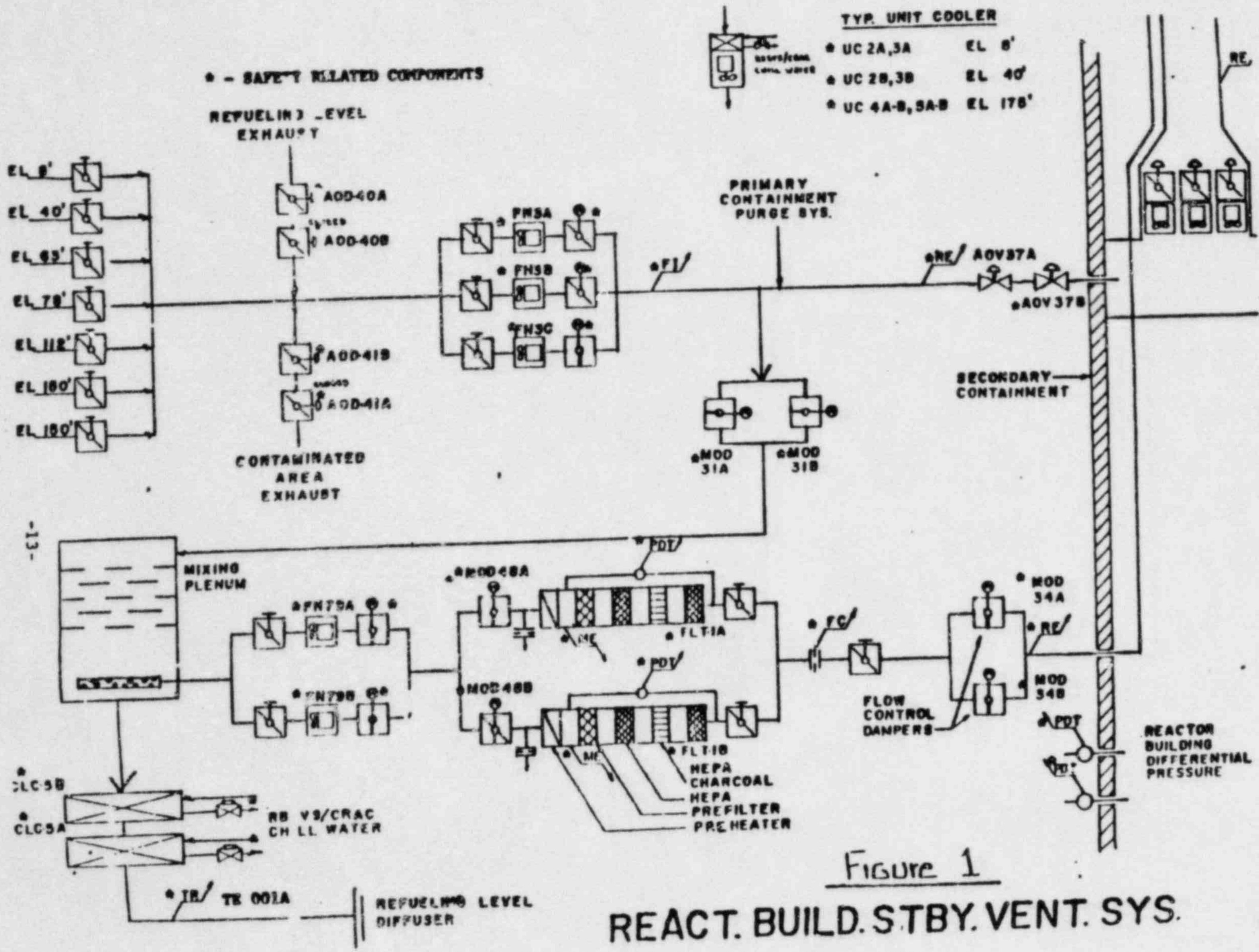
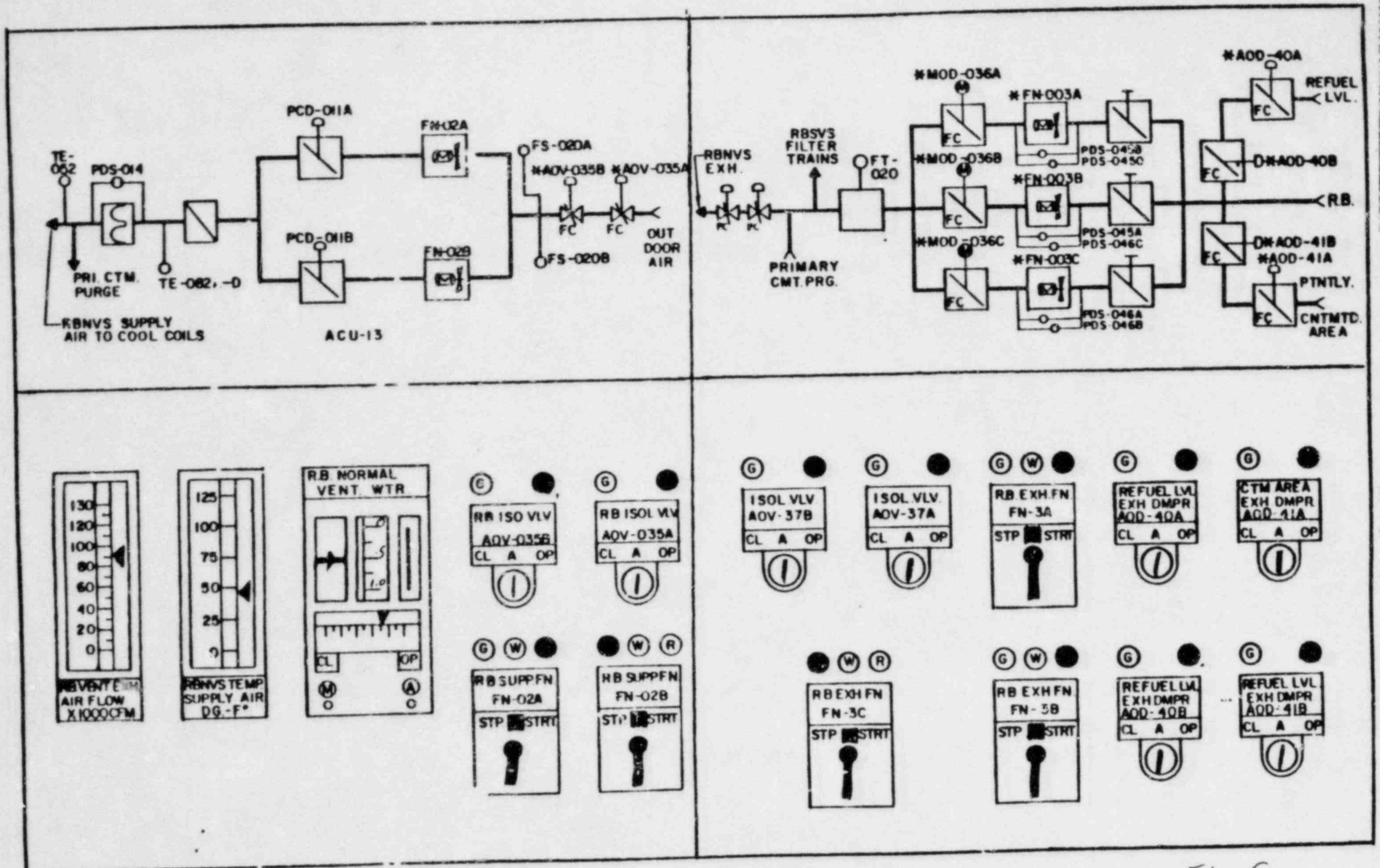


Figure 1

REACT. BUILD. STBY. VENT. SYS.

Fig B



TE-062
PDS-014
PRI. CTM. PURGE
TE-082, -D
RBNVS SUPPLY AIR TO COOL COILS
PCD-011A
PCD-011B
FN-02A
FN-02B
ACU-13
FS-020A
FS-020B
*AOV-035B
*AOV-035A
FC
OUT DOOR AIR
RBNVS EXH.
RBSVS FILTER TRAINS
PRIMARY CMT. PRG.
FT-020
*MOD-036A
*MOD-036B
*MOD-036C
*FN-003A
*FN-003B
*FN-003C
PDS-045B
PDS-045C
PDS-045A
PDS-046C
PDS-046A
PDS-046B
*AOD-40A
*AOD-40B
*AOD-41B
*AOD-41A
REFUEL LVL.
R.B.
PTNTLY. CNTMTD. AREA
RBVENT EXH AIR FLOW X1000CFM
RBNVS TEMP SUPPLY AIR DG.-F°
R.B. NORMAL VENT. WTR
RB ISO VLV AOV-035B
RB ISOL VLV AOV-035A
CL A OP
RB SUPP FN FN-02A
RB SUPP FN FN-02B
STP STRT
ISOL VLV AOV-37B
ISOL VLV AOV-37A
RB EXH FN FN-3A
RB EXH FN FN-3C
RB EXH FN FN-3B
REFUEL LVL EXH DMPR AOD-40A
CTM AREA EXH DMPR AOD-41A
REFUEL LVL EXH DMPR AOD-40B
REFUEL LVL EXH DMPR AOD-41B

Fig C

3082 CNTMT PURGE FLT D[illegible] HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	3013 RBSVS SYS A CHLR MTR OVLD	3014 RBSVS SYS B CHLR MTR OVLD	3090 PASF SYS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
3[illegible] CNTMT PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS SYS A CHILL WTR INOP	3020 RBSVS SYS B CHILL WTR INOP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	309[illegible] RBSVS CHLR DEMIN PURGE FLOW HI	309[illegible] DRYWELL UNIT CLR DIFF P HI
3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3052 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	309[illegible] RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI
1	2	3	4	5	6	7	8	9	10

PNL - VC2

Normal venting

Fig D

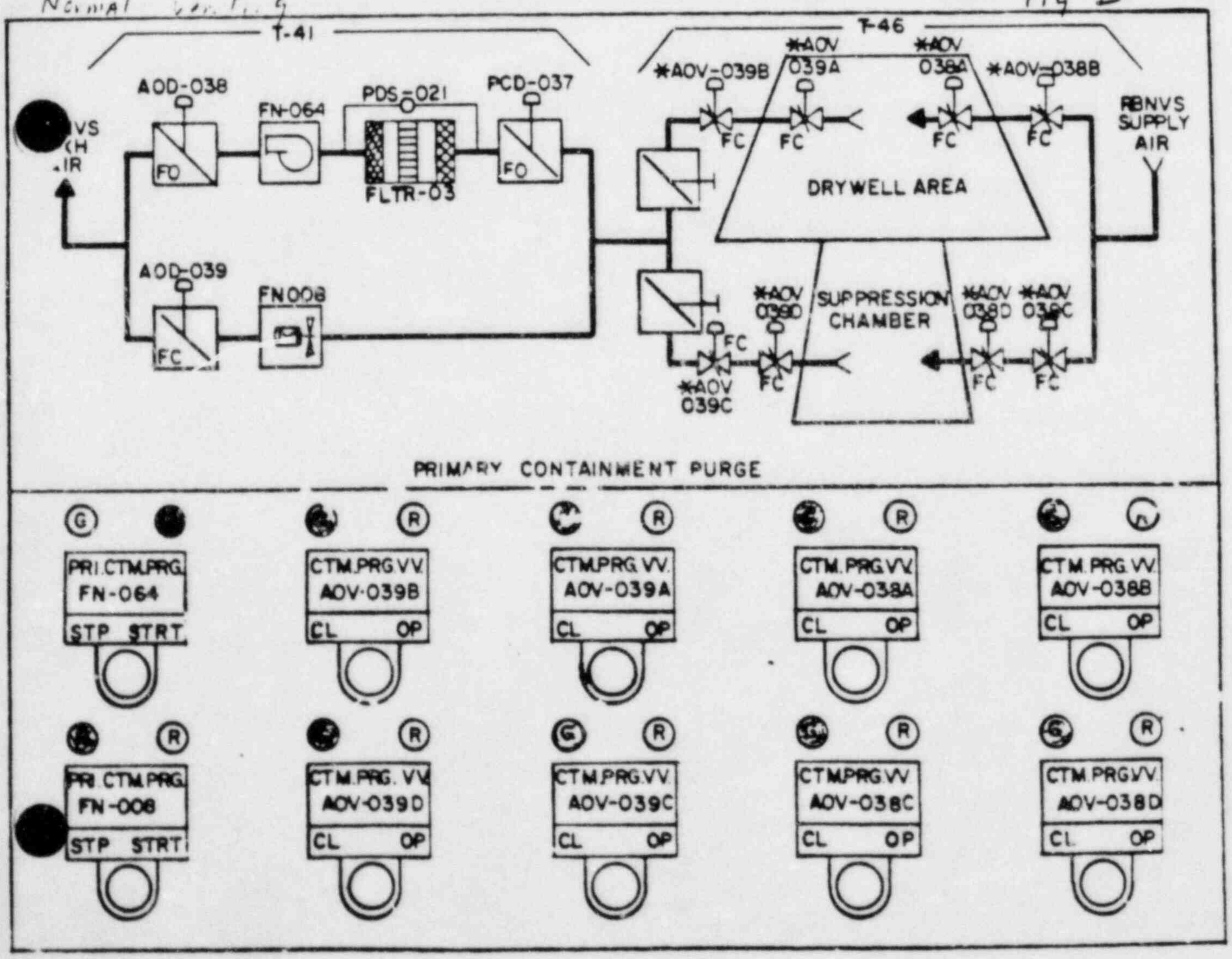
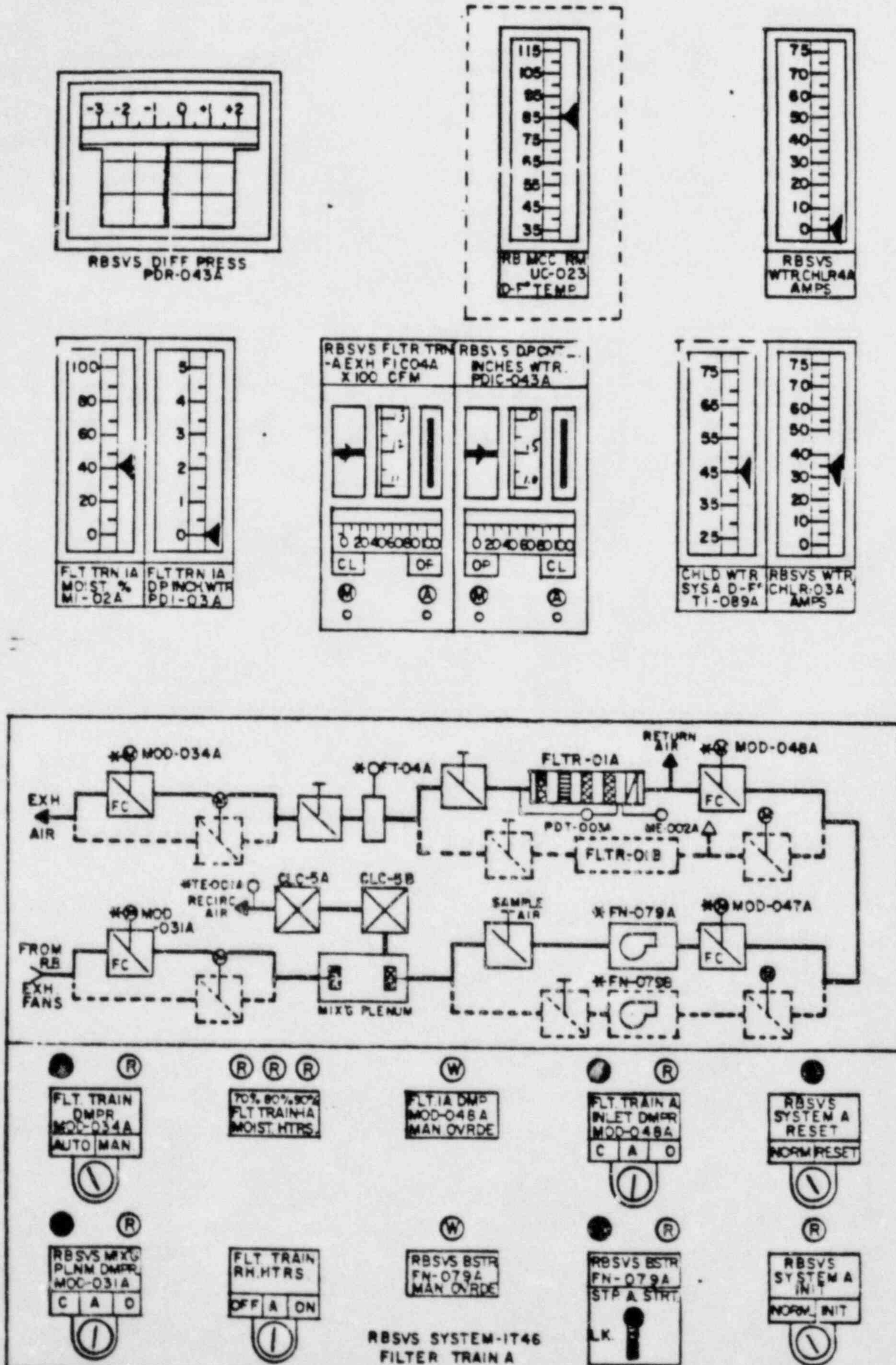


Fig E


RBSVS DIFF PRESS
PDR-043A
RB MCC RM
UC-023
D-F° TEMP
RBSVS
WTR CHLR 4A
AMPS
FLT TRN 1A
MOIST. %
MI-02A
FLT TRN 1A
DP INCH WTR
PDI-03A
RBSVS FLTR TRN -A EXH FIC04A
X 100 CFM
RBSVS DP CNT
INCHES WTR.
PDIC-043A
CHLD WTR
SYS A D-F°
TI-089A
RBSVS WTR
CHLR-03A
AMPS
MOD-034A
EXH
AIR
FT-04A
FLTR-01A
RETURN
AIR
MOD-048A
PDT-003A
ME-002A
FLTR-01B
TE-001A
RECIRC
AIR
CLC-5A
CLC-5B
MOD
-031A
FROM
RB
EXH
FANS
MIX'G PLENUM
SAMPLE
AIR
FN-079A
MOD-047A
FN-079B
FLT. TRAIN
DMPR
MOD-034A
AUTO
MAN
70% 80% 90%
FLT TRAIN 1A
MOIST. HTRS.
FLT. 1A DMP
MOD-048A
MAN OVRDE
FLT. TRAIN A
INLET DMPR
MOD-048A
RBSVS
SYSTEM A
RESET
NORM
RESET
RBSVS MIX'G
PLNM DMPR
MOD-031A
FLT. TRAIN
RH. HTRS
OFF
ON
RBSVS BSTR
FN-079A
MAN OVRDE
RBSVS BSTR
FN-079A
STP A STRT
LK.
RBSVS
SYSTEM A
INIT
NORM
INIT
RBSVS SYSTEM-1T46
FILTER TRAIN A

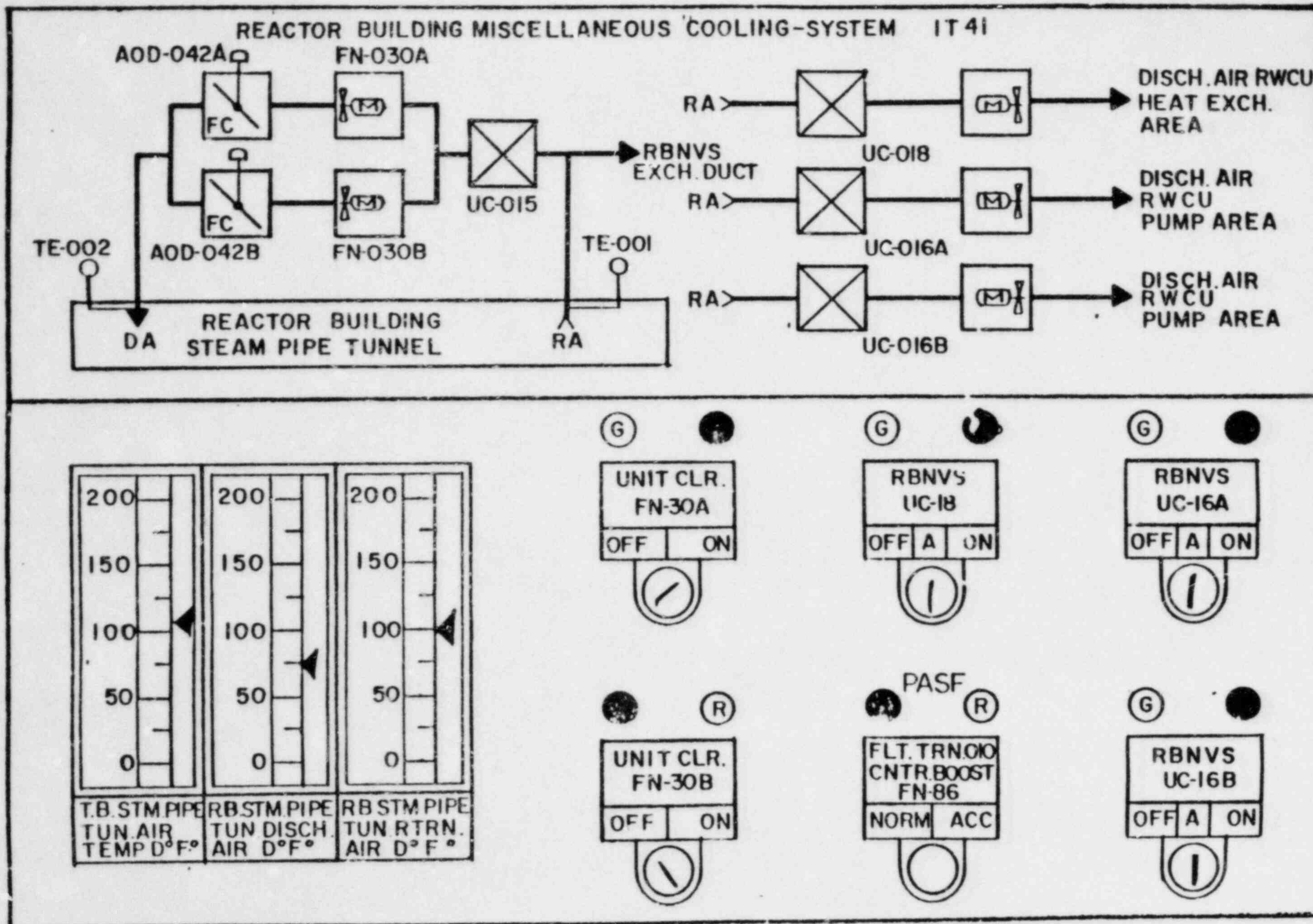

REACTOR BUILDING MISCELLANEOUS COOLING-SYSTEM IT41
AOD-042A
FN-030A
FC
RBNVS EXCH. DUCT
UC-015
AOD-042B
FN-030B
TE-002
TE-001
REACTOR BUILDING STEAM PIPE TUNNEL
DA
RA
UC-018
UC-016A
UC-016B
DISCH. AIR RWCU HEAT EXCH. AREA
DISCH. AIR RWCU PUMP AREA
DISCH. AIR RWCU PUMP AREA
T.B. STM PIPE TUN. AIR TEMP D°F°
RB STM PIPE TUN DISCH. AIR D°F°
RB STM PIPE TUN. RTRN. AIR D°F°
UNIT CLR. FN-30A
OFF ON
RBNVS UC-18
OFF A ON
RBNVS UC-16A
OFF A ON
UNIT CLR. FN-30B
OFF ON
PASF
FLT. TRN.010 CNTR. BOOST FN-86
NORM ACC
RBNVS UC-16B
OFF A ON

FIG.- 3

Fig - F.

7A

	1	2	3	4	5	6	7	8	9	10
A	3057 VC2 ANN GND DETECTED	3081 RBSVS FLT TRN FLOW HI/LO	3072 RBSVS FLT TRN A DEGRADED	3073 RBSVS FLT TRN B DEGRADED	3083 PASF ACU/FILTER TROUBLE	3079 RB DIFF P HI	3053 RB EXH FANS AUTO TRIP	[illegible] RB EXH FANS DEGRADED	3086 RB VENT EXH FLOW LO	3088 RB EXH FANS DMPRS DEGRADED
B	3074 RBSVS SYS A UNIT CLR DEGRADED	3075 RBSVS SYS B UNIT CLR DEGRADED	3084 RBSVS SYS A INIT	3085 RBSVS SYS B INIT	3089 RB SPLY FAN MTR TEMP HI	3080 RB DIFF P LO	3078 RB EXH AIR TEMP HI	3049 RB SPLY FANS AUTO TRIP	3050 RB SPLY FLT DIFF P HI	3051 RB SPLY AIR TEMP LO
C	3015 RBSVS SYS A UNIT CLR INOP	3016 RBSVS SYS B UNIT CLR INOP	3093 RBSVS SYS A INIT LCTL	3094 RBSVS SYS B INIT LCTL	3097 RBSVS IN PLENUM DMPR A OPEN	3098 RBSVS IN PLENUM DMPR B OPEN	3087 RB SPLY FAN OC TRIP	3100 RB VENT ISOL VV A LCTL	3101 RB VENT ISOL VV B LCTL	3099 RBHVS EXH DMPRS TROUBLE

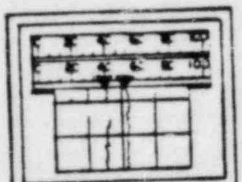
PNL-601

1009 REFUELING FLOOR RAD HI		1010 Rx BLDG RAD HI		1178 REFUEL LEVEL DIV I VENT RAD HI	1179 REFUEL LEVEL DIV II VENT RAD HI		1180 REFUEL LEVEL VENT EXH RAD ALERT		1173 RB MG ROOMS TEMP HI/LO

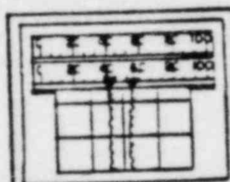
PNL - VC2

Fig G.

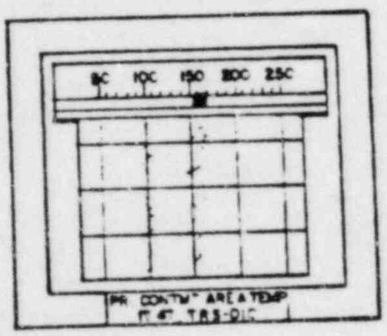
1	2	3	4	5	6	7	8	9	10
3082 PURGE HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	3013 RBSVS SYS A CHLR MTR OVLD	3014 RBSVS SYS B CHLR MTR OVLD	3090 PASF SYS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
3076 CNTMT PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS SYS A CHILL WTR INOP	3020 RBSVS SYS B CHILL WTR INOP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	3091 RBSVS CHLR DEMIN PURGE FLOW HI	3095 DRYWELL UNIT CLR DIFF P HI
3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3052 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	3092 RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI



DW UC17A, ME-015A MOISTURE RECORDER



DW UC017B, ME-015B MOISTURE RECORDER



DRYWELL UNIT COOLERS - SYSTEM IT05

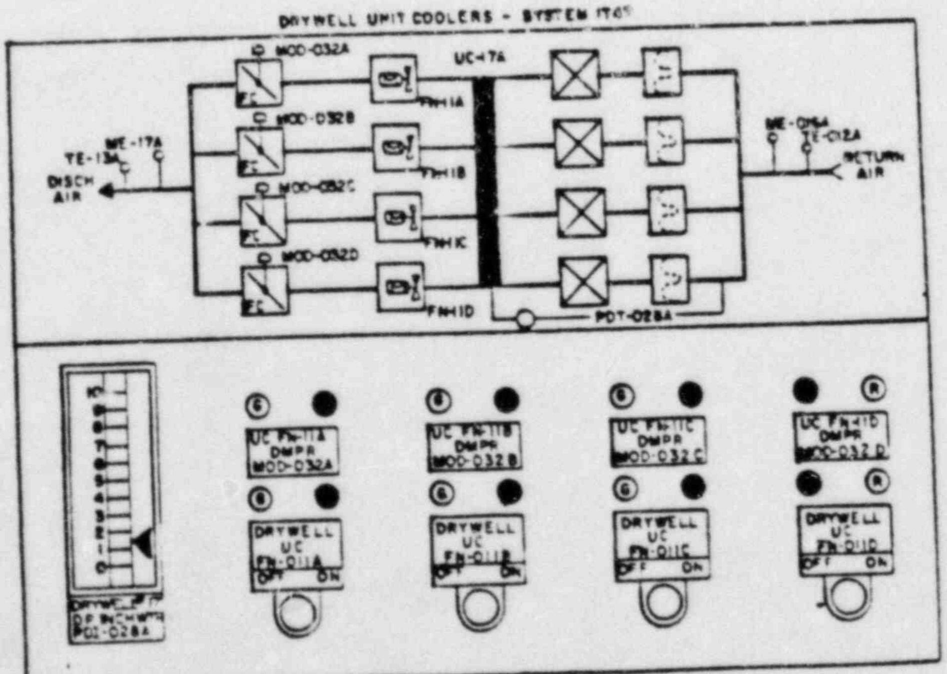
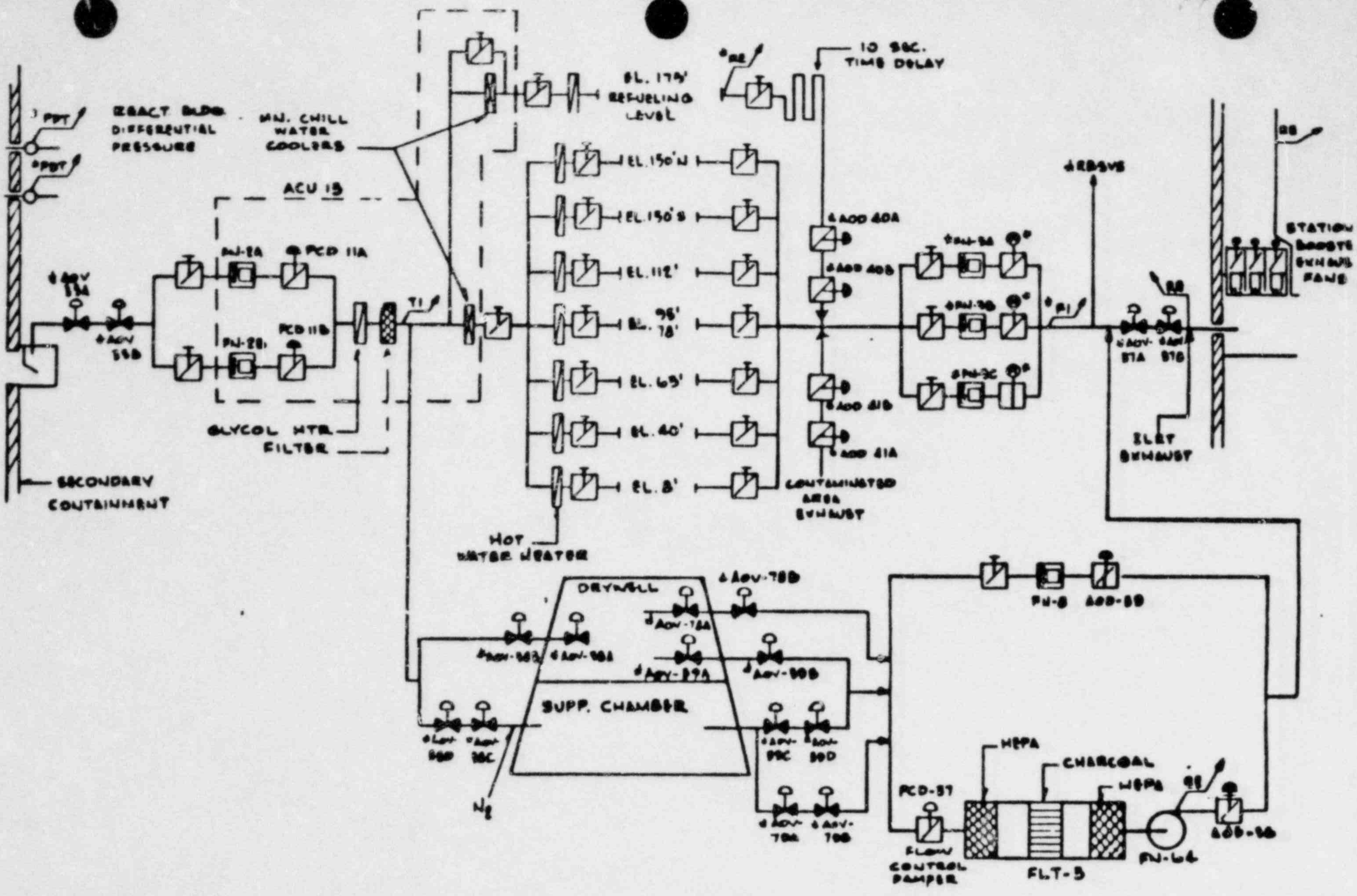


Fig H



* SAFETY RELATED COMPONENTS

REACT. BLDG. NORMAL VENTILATION &
PRIMARY CONT. PURGE SYSTEM

Fig 1A

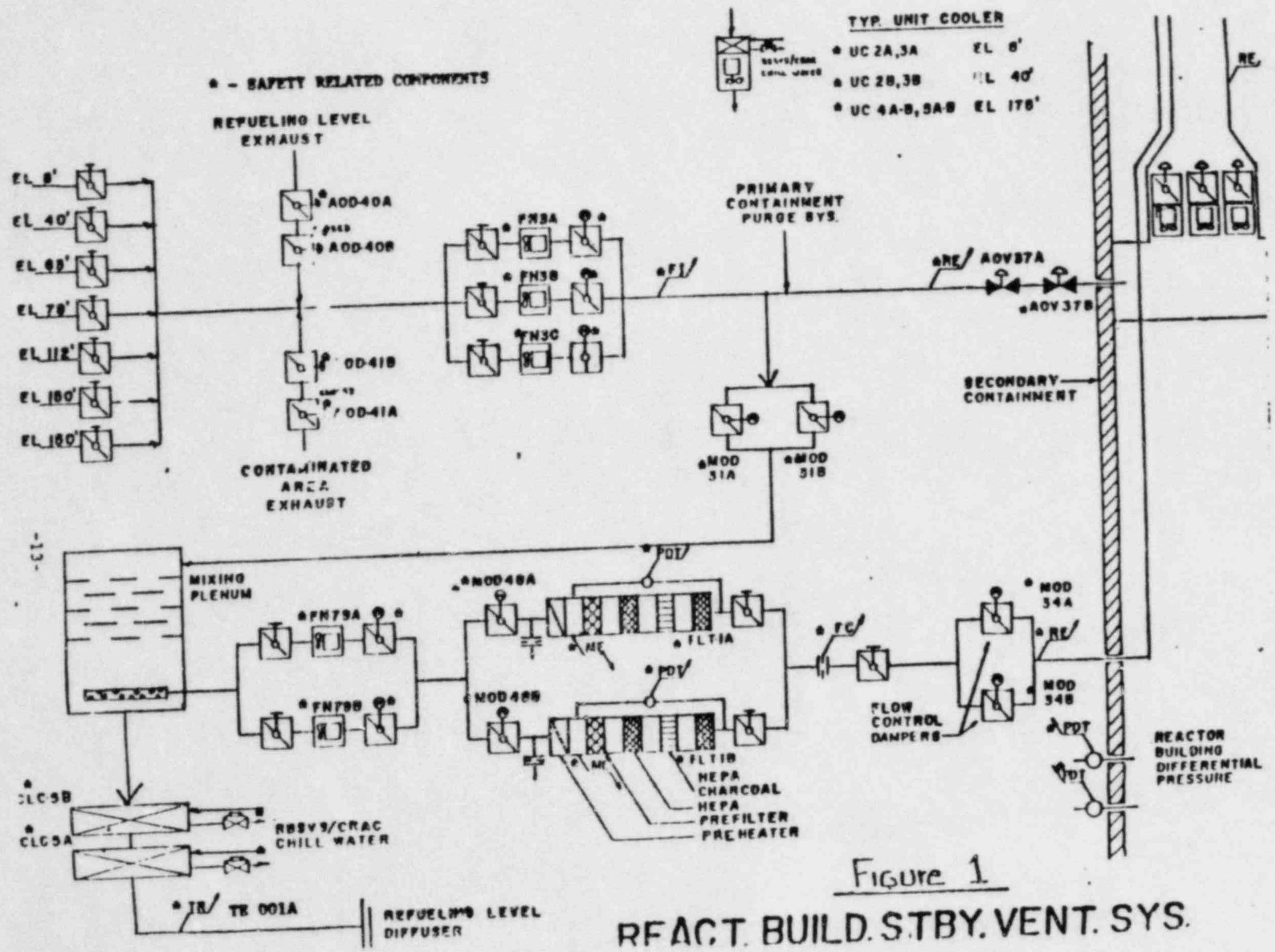
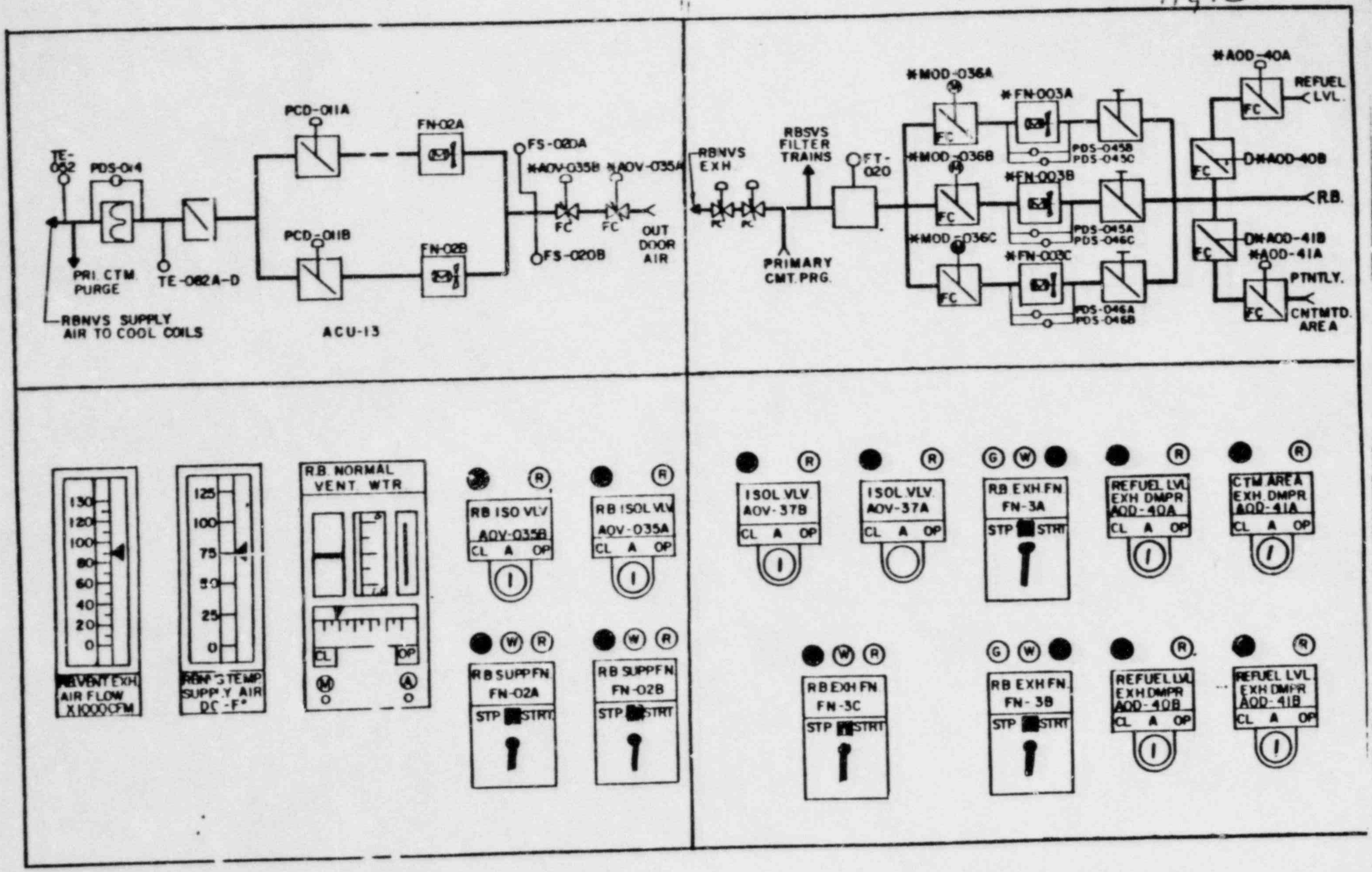


Figure 1

REACT. BUILD. STBY. VENT. SYS.

Fig 1B

Fig 1C

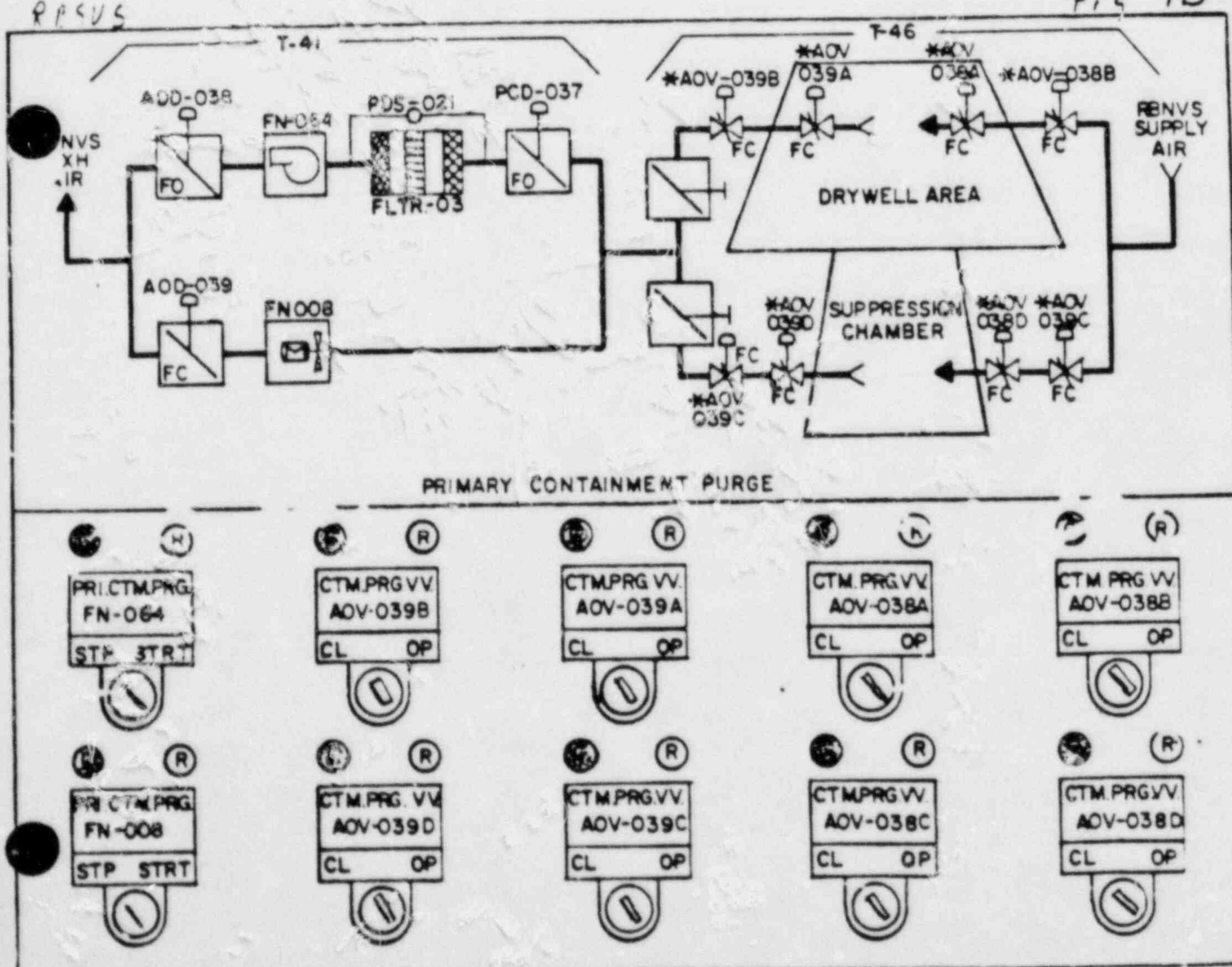

TE-062
PDS-014
PRI. CTM. PURGE
RBNVS SUPPLY AIR TO COOL COILS
TE-082A-D
PCD-011A
PCD-011B
FN-02A
FN-02B
ACU-13
FS-020A
FS-020B
*AOV-035B
*AOV-035A
FC
OUT DOOR AIR
RBNVS EXH
RBSVS FILTER TRAINS
PRIMARY CMT. PRG.
FT-020
*MOD-036A
*MOD-036B
*MOD-036C
*FN-003A
*FN-003B
*FN-003C
PDS-045B
PDS-045C
PDS-045A
PDS-046C
PDS-046A
PDS-046B
*AOD-40A
REFUEL LVL.
*AOD-40B
R.B.
*AOD-41B
*AOD-41A
PTNTLY. CNTMTD. AREA
RB VENT EXH AIR FLOW X1000CFM
130 120 100 80 60 40 20 0
RBNVS TEMP SUPPLY AIR DC-F°
125 100 75 50 25 0
R.B. NORMAL VENT. WTR
CL
OP
M
A
RB ISO VLV AOV-035B
RB ISOL VLV AOV-035A
CL A OP
RB SUPP FN FN-02A
RB SUPP FN FN-02B
STP STRT
ISOL VLV. AOV-37B
ISOL VLV. AOV-37A
RB EXH FN FN-3A
RB EXH FN FN-3B
RB EXH FN FN-3C
REFUEL LVL EXH DMPR AOD-40A
REFUEL LVL EXH DMPR AOD-40B
CTM AREA EXH DMPR AOD-41A
REFUEL LVL EXH DMPR AOD-41B
G
W
R

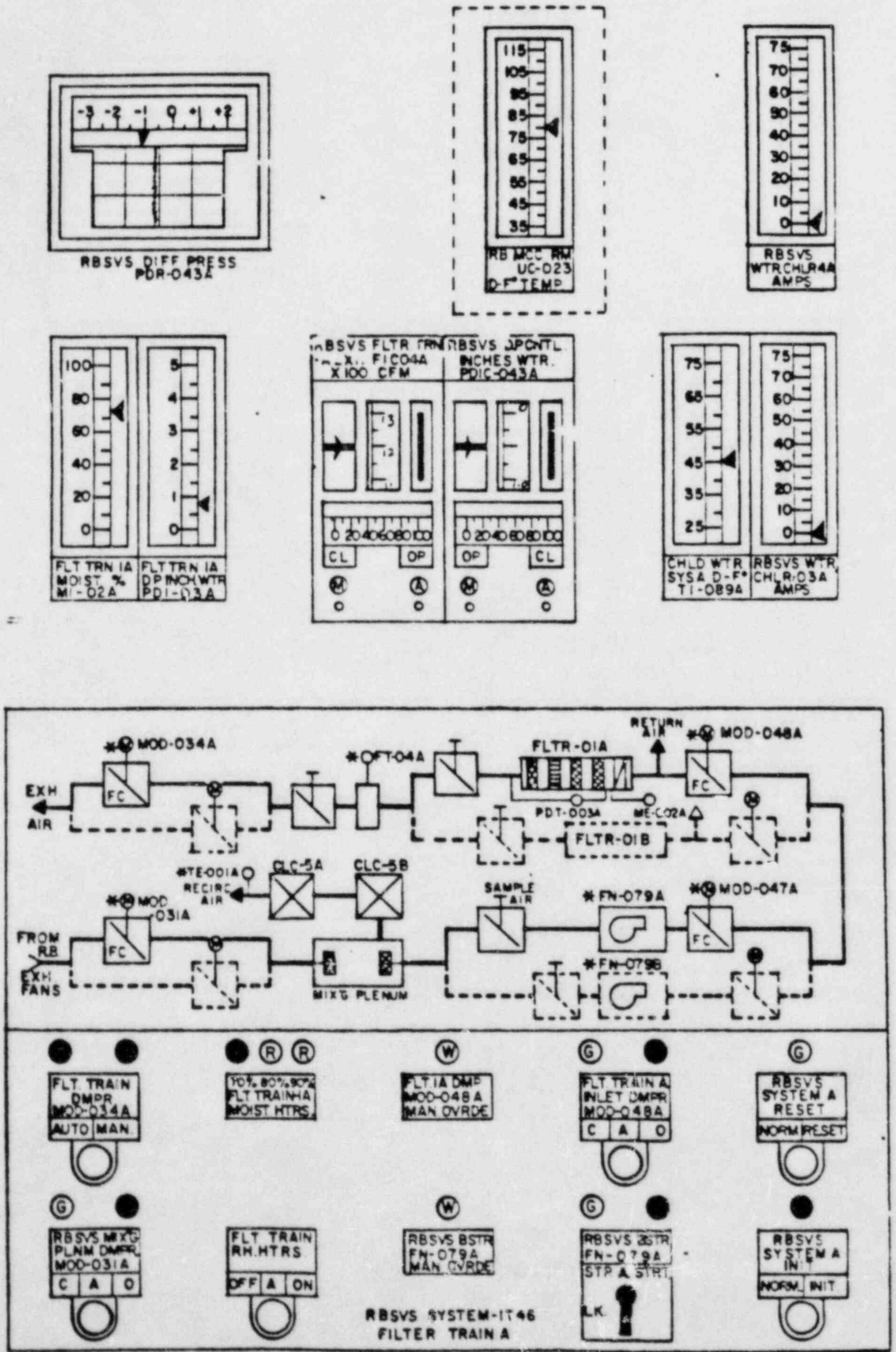
3082 CNTMT PURGE [illegible] HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	3013 RBSVS SYS A CHLR MTR OVLD	3014 RBSVS SYS B CHLR MTR OVLD	3090 PASP SYS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
3[illegible] CN[illegible] PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS SYS A CHILL WTR INOP	3020 RBSVS SYS B CHILL WTR INOP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	3091 RBSVS CHLR DEMIN PURGE FLOW HI	3095 DRYWELL UNIT CLR DIFF P HI
3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3113 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3052 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	3092 RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI
1	2	3	4	5	6	7	8	9	10

PNL - VC2

RBSVS

Fig 1D





RBSVS DIFF PRESS
PDR-043A
RB MCC RM
UC-023
D-F° TEMP
RBSVS
WTR CHLR 4A
AMPS
FLT TRN IA
MOIST. %
MI-02A
FLT TRN IA
DP INCH WTR
PDI-03A
RBSVS FLTR TRN
X 100 CFM
RBSVS DPCNTL
INCHES WTR.
PDIC-043A
CL
OP
CHLD WTR
SYS A D-F°
TI-089A
RBSVS WTR
CHLR-03A
AMPS
EXH
AIR
MOD-034A
FC
FT-04A
FLTR-01A
RETURN
AIR
MOD-048A
PDT-003A
ME-C02A
FLTR-01B
TE-001A
RECIRC
AIR
CLC-5A
CLC-5B
MOD
-031A
SAMPLE
AIR
FN-079A
MOD-047A
FROM
RB
EXH
FANS
MIX'G PLENUM
FN-079B
FLT. TRAIN
DMPR
MOD-034A
AUTO
MAN.
70%, 80%, 90%
FLT TRAIN IA
MOIST. HTRS.
FLT. IA DMP
MOD-048 A
MAN OVRDE
FLT TRAIN A
INLET DMPR
MOD-048A
C A O
RBSVS
SYSTEM A
RESET
NORM
RESET
RBSVS MIX'G
PLNM DMPR
MOD-031A
C A O
FLT TRAIN
RH. HTRS
OFF A ON
RBSVS BSTR
FN-079A
MAN. OVRDE
RBSVS BSTR
FN-079A
STP A STRT
LK
RBSVS
SYSTEM A
INIT
NORM.
INIT
RBSVS SYSTEM-IT46
FILTER TRAIN A

Fig 1E

* May be the cause of RBSUS

	1	2	3	4	5	6	7	8	9	10
A	3057 VC2 ANN GND DETECTED	3081 RBSVS FLT TRN FLOW HI/LO	3072 RBSVS FLT TRN A DEGRADED	1073 RBSVS FLT TRN B DEGRADED	1083 PASF ACU/FILTER TROUBLE	1079 RB DIFF P HI	3051 * RB EXH FANS AUTO TR'	305? RB EXH FANS DEGRADED	3086 RB VENT EXH FLOW LO	1088 RB EXH FANS DMPRS DEGRADED
B	3076 RBSVS SYS A UNIT CLR DEGRADED	3075 RBSVS SYS B UNIT CLR DEGRADED	3084 RBSVS SYS A INIT	1085 RBSVS SYS B INIT	1089 RB SPLT FAN MTR TEMP HI	1080 * RB DIFF P LO	1078 RB EXH AIR TEMP HI	3049 RB SPLY FANS AUTO TRIP	3050 * RB SPLY FLT DIFF P L	1051 * RB SPLY AIR TEMP LO
C	3015 RBSVS SYS A UNIT CLR INOP	3016 RBSVS SYS B UNIT CLR INOP	3093 RBSVS SYS A INIT LCTL	1094 RBSVS SYS B INIT LCTL	3097 RBSVS IN PLENUM DMPR A OPEN	1098 RBSVS IN PLENUM DMPR B OPEN	1087 RB SPLY FAN OC TRIP	3100 RB VENT ISOL VV A LCTL	1101 RB VENT ISOL VV B LCTL	1099 RBHVS EXH DMPRS TROUBLE

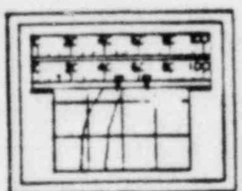
PNL-601

1009 REFUELING FLOOR RAD HI		1010 Rx BLDG RAD HI		1178 * REFUEL LEVEL DIV I VENT RAD HI	1179 * REFUEL LEVEL DIV II VENT RAD HI		118? REFUE LEVEL VE? I ?? RAD ALERT		1173 RB MC ROOMS TEMP HI/LO

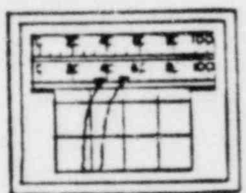
Fig. 2 G

PNL - VC?

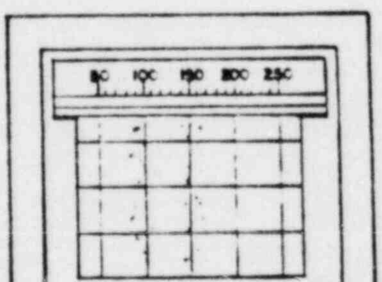
[illegible] T PURGE F P HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	3013 RBSVS SYS A CHLR MTR OVLD	3014 RBSVS SYS B CHLR MTR OVLD	3090 PASF SYS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
3076 CNTMT PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS SYS A CHILL WTR INOP	3020 RBSVS SYS B CHILL WTR INOP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	309[illegible] RBSVS CHLR DEMIN PURGE FLOW HI	3095 DRYWELL UNIT CLR DIFF P HI
3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3052 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	309[illegible] RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI
1	2	3	4	5	6	7	8	9	10



DW UC-7A, ME-015A
MOISTURE RECORDER



DW UC017B, ME-015E
MOISTURE RECORDER



PRI CONTMT AREA TEMP
1T47, TRS-01C

DRYWELL UNIT COOLERS - SYSTEM 1T47

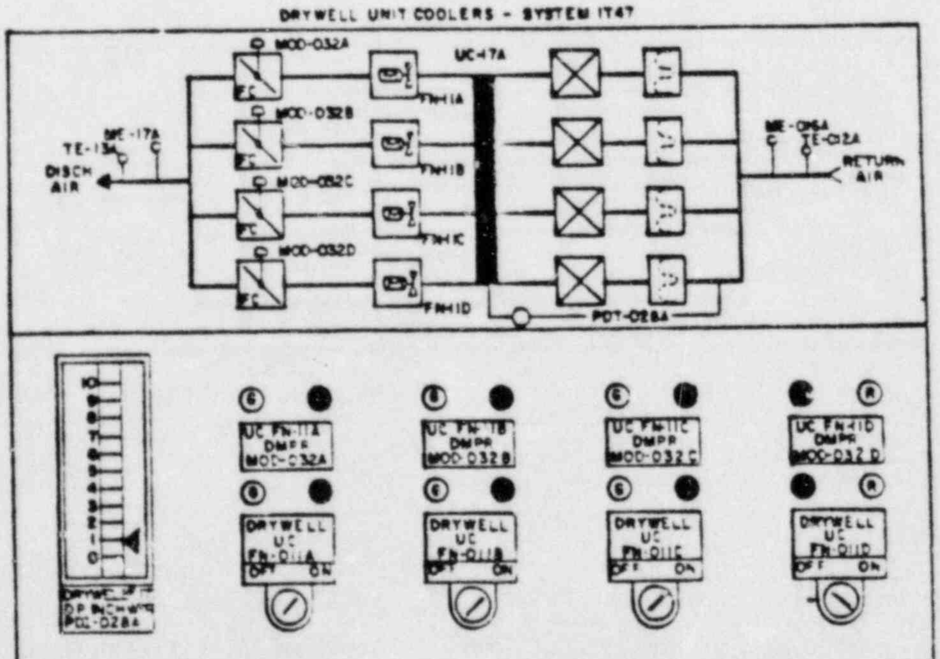
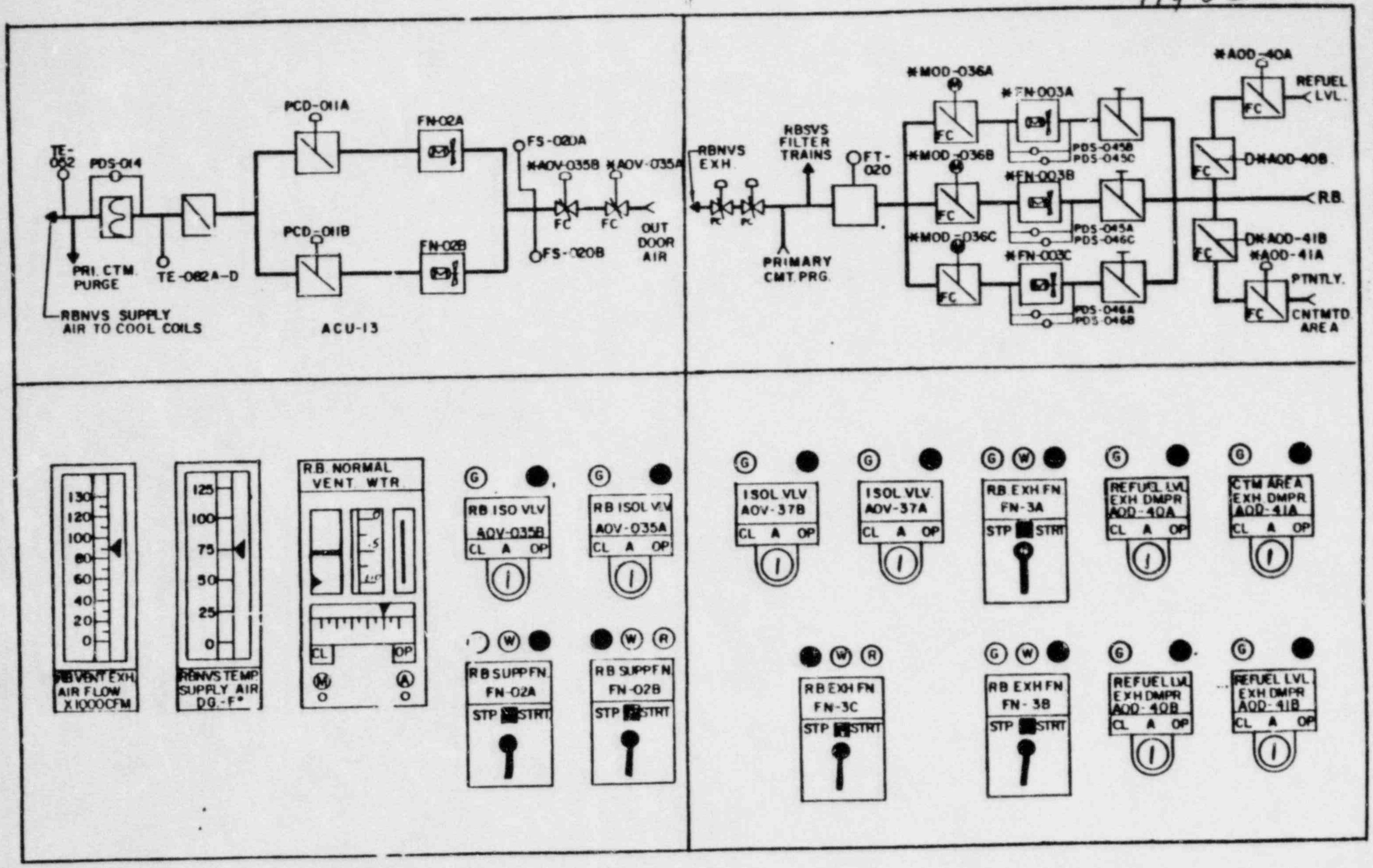


Fig 2H

Fig 3C


TE-062
PDS-014
PRI. CTM. PURGE
RBNVS SUPPLY AIR TO COOL COILS
TE-082A-D
PCD-011A
PCD-011B
FN-02A
FN-02B
ACU-13
FS-020A
FS-020B
*AOV-035B
*AOV-035A
FC
OUT DOOR AIR
RBNVS EXH.
RBSVS FILTER TRAINS
PRIMARY CMT. PRG.
FT-020
*MOD-036A
*MOD-036B
*MOD-036C
*FN-003A
*FN-003B
*FN-003C
PDS-045B
PDS-045C
PDS-045A
PDS-046C
PDS-046A
PDS-046B
*AOD-40A
REFUEL LVL.
*AOD-40B
RB.
*AOD-41B
*AOD-41A
PTNTLY. CNTMTD. AREA
RB VENT EXH. AIR FLOW X1000CFM
130 120 100 80 60 40 20 0
RBNVS TEMP. SUPPLY AIR DG.-F°
125 100 75 50 25 0
R.B. NORMAL VENT. WTR.
CL OP
RB ISO VLV AOV-035B
RB ISOL VLV AOV-035A
CL A OP
RB SUPP FN. FN-02A
RB SUPP FN. FN-02B
STP STRT
ISOL VLV. AOV-37B
ISOL VLV. AOV-37A
RB EXH FN FN-3A
RB EXH FN FN-3C
RB EXH FN FN-3B
REFUEL LVL EXH DMPR AOD-40A
CTM AREA EXH DMPR AOD-41A
REFUEL LVL EXH DMPR AOD-40B
REFUEL LVL EXH DMPR AOD-41B

May be followed by *

2A

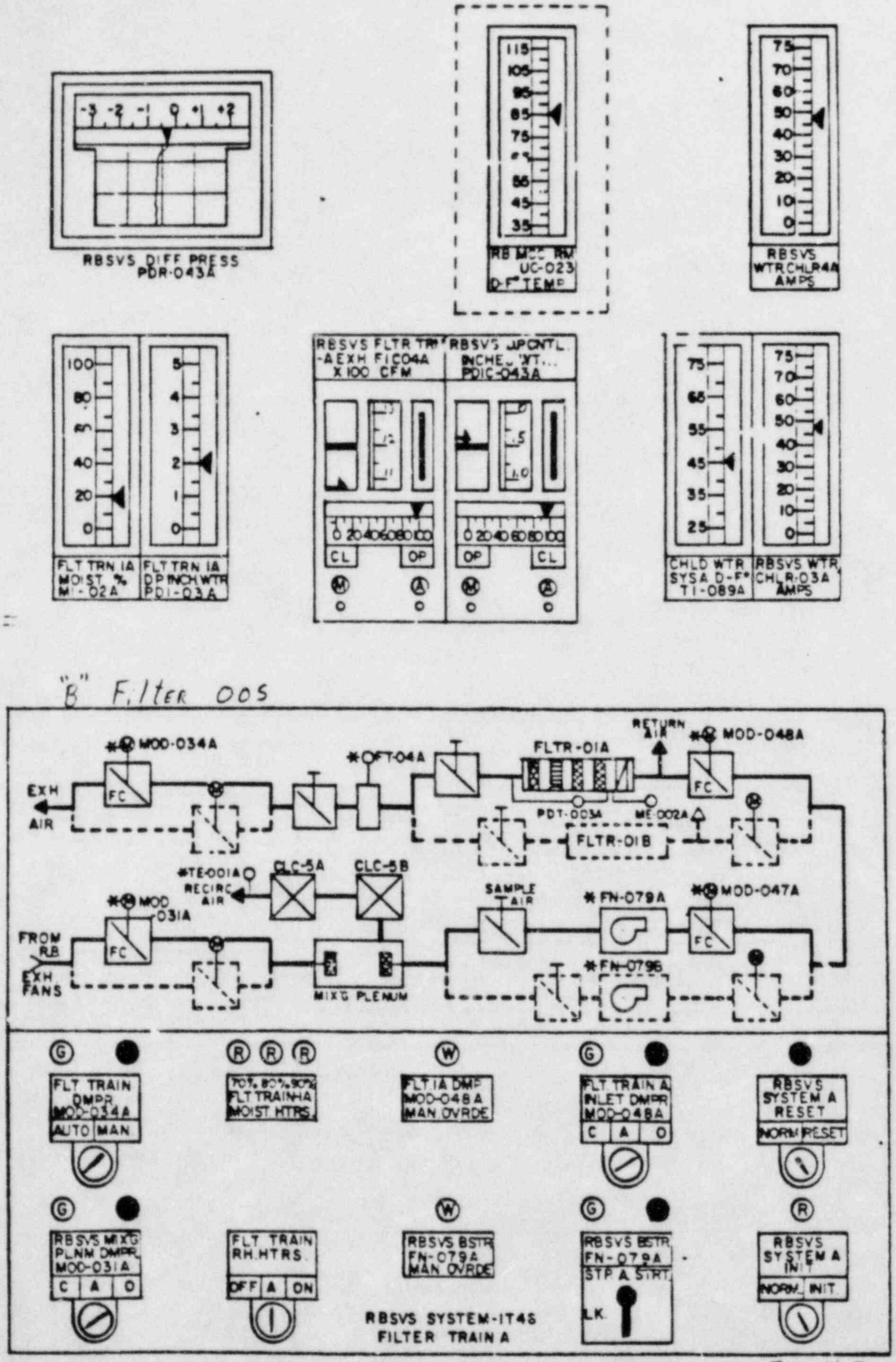
	1	2	3	4	5	6	7	8	9	10
A	3057 VC2 ANN GND DETECTED	3081 RBSVS FLT TRN FLOW HI/LO	3072 RBSVS FLT TRN A DEGRADED	3073 RBSVS FLT TRN B DEGRADED	3083 PASF ACU/FILTER TROUBLE	3079 RB DIFF P HI	3053 RB EXH FANS AUTO TRIP	3054 RB EXH FANS DEGRADED	3086 RB VENT EXH FLOW LO	3088 RB EXH FANS DMPRS DEGRADED
B	3076 RBSVS SYS A UNIT CLR DEGRADED	3075 RBSVS SYS B UNIT CLR DEGRADED	3084 RBSVS SYS A INIT	3085 RBSVS SYS B INIT	3089 RB SPLY FAN MTR TEMP HI	3080 RB DIFF P LO	3078 RB EXH AIR TEMP HI	3049 * RB SPLY FANS AUTO TRIP	3050 RB SPLY FLT DIFF P HI	3051 RB SPLY AIR TEMP LO
C	3015 RBSVS SYS A UNIT CLR INOP	3016 RBSVS SYS B UNIT CLR INOP	3093 RBSVS SYS A INIT LCTL	3094 RBSVS SYS B INIT LCTL	3097 RBSVS IN PLENUM DMPR A OPEN	3098 RBSVS IN PLENUM DMPR B OPEN	3087 RB SPLY FAN OC TRIP	3100 RB VENT ISOL VV A LCTL	3101 RB VENT ISOL VV B LCTL	3099 RBHVS EXH DMPRS TROUBLE

PNL-601

1009 REFUELING FLOOR RAD HI		1010 Rx BLDG RAD HI		1178 REFUEL LEVEL DIV I VENT RAD HI	1179 REFUEL LEVEL DIV II VENT RAD HI		1180 REFUEL LEVEL VENT EXH RAD ALERT		1173 RB HC ROOMS TEMP HI/LO

PNL - VC2

Fig 3G.



RBSVS DIFF PRESS
PDR-043A
RB MCC RM
UC-023
D-F° TEMP
RBSVS
WTR CHLR 4A
AMPS
FLT TRN IA
MOIST %
MI-02A
FLT TRN IA
DP INCH WTR
PDI-03A
RBSVS FLTR TRN
-A EXH FIC04A
X 100 CFM
CL
OP
CHLD WTR
SYS A D-F°
TI-089A
RBSVS WTR
CHLR-03A
AMPS
"B" Filter OOS
MOD-034A
EXH
AIR
OFT-04A
FLTR-01A
RETURN
AIR
MOD-048A
PDT-003A
ME-002A
FLTR-01B
TE-001A
RECIRC
AIR
CLC-5A
CLC-5B
SAMPLE
AIR
FN-079A
MOD-047A
MOD
031A
FROM
RB
EXH
FANS
MIXG PLENUM
FN-079B
FLT TRAIN
DMPR
MOD-034A
AUTO
MAN
70% 80% 90%
FLT TRAIN IA
MOIST HTRS.
FLT IA DMP
MOD-048A
MAN OVRDE
FLT TRAIN A
INLET DMPR
MOD-048A
C
A
O
RBSVS
SYSTEM A
RESET
NORM
RESET
RBSVS MIXG
PLNM DMPR
MOD-031A
FLT TRAIN
RH. HTRS.
OFF
ON
RBSVS BSTR
FN-079A
MAN OVRDE
STP A STRT
LK
RBSVS
SYSTEM A
INIT
NORM
INIT
RBSVS SYSTEM-IT4S
FILTER TRAIN A

Fig 4E

2A

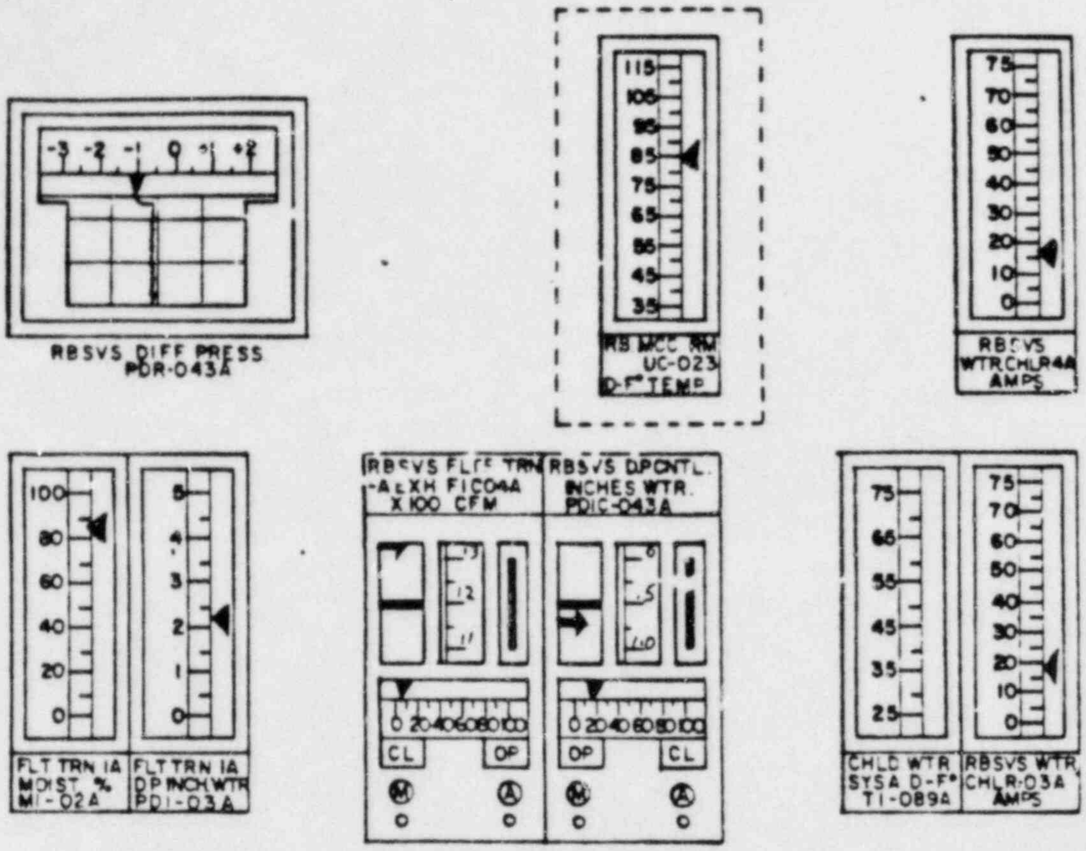
	1	2	3	4	5	6	7	8	9	10
A	3057 VC2 ANN GND DETECTED	3081 RBSVS FLT TRN FLOW HI/LO	3072 RBSVS FLT TRN A DEGRADED	3073 RBSVS FLT TRN B DEGRADED	3083 PASF ACU/FILTER TROUBLE	3079 RB DIFF P HI	3053 RB EXH FANS AUTO TRIP	3054 RB EXH FANS DEGRADED	3086 RB VENT EXH FLOW LO	3088 RB EXH FANS DMPRS DEGRADED
B	3074 RBSVS SYS A UNIT CLR DEGRADED	3075 RBSVS SYS B UNIT CLR DEGRADED	3084 RBSVS SYS A INIT	3085 RBSVS SYS B INIT	3089 RB SPLY FAN MTR TEMP HI	3080 RB DIFF P LO	3078 RB EXH AIR TEMP HI	3049 RB SPLY FANS AUTO TRIP	3050 RB SPLY FLT DIFF P HI	3051 RB SPLY AIR TEMP LO
C	3015 RBSVS SYS A UNIT CLR INOP	3016 RBSVS SYS B UNIT CLR INOP	3093 RBSVS SYS A INIT LCTL	3094 RBSVS SYS B INIT LCTL	3097 RBSVS IN PLENUM DMPR A OPEN	3098 RBSVS IN PLENUM DMPR B OPEN	3087 RB SPLY FAN OC TRIP	1100 RB VENT ISOL VV A LCTL	1101 RB VENT ISOL VV B LCTL	1099 RBHVS EXH DMPRS TROUBLE

PNL-601

1009 REFUELING FLOOR RAD HI		1010 Rx BLDG RAD HI		1178 REFUEL LEVEL DIV I VENT RAD HI	1179 REFUEL LEVEL DIV II VENT RAD HI		1140 REFUEL LEVEL VENT EXH RAD ALERT		1173 RB HC ROOMS TEMP HI/LO

PNL - VC2

Fig 4 G



"6" Filter OOS

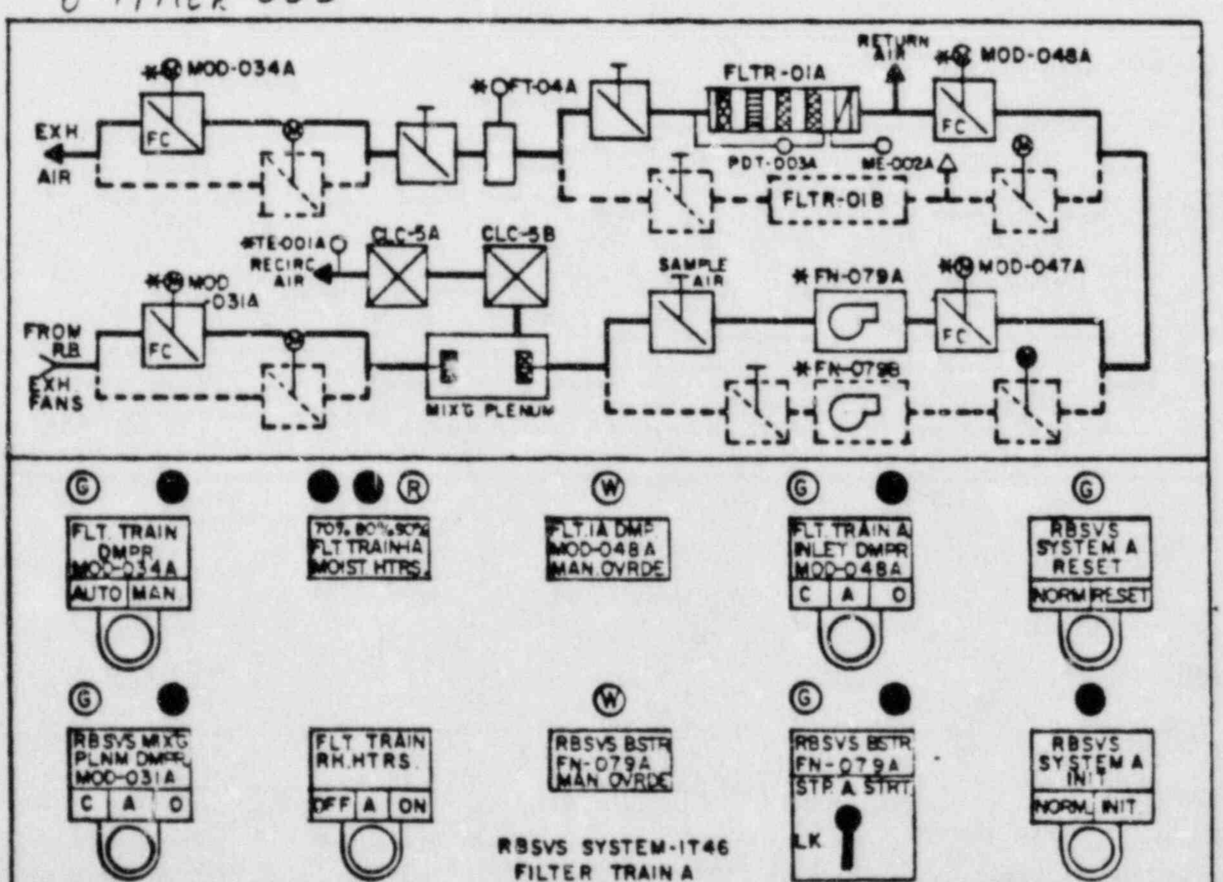


Fig 5E

7A

	1	2	3	4	5	6	7	8	9	10
A	3057 VC2 ANN GND DETECTED	3081 RBSVS FLT TRN FLOW HI/LO	3072 RBSVS FLT TRN A DEGRADED	1073 RBSVS FLT TRN B DEGRADED	3083 PASF ACU/FILTER TROUBLE	1079 RB DIFF P HI	1053 RB EXH FANS AUTO TRIP	10_5 RB F d FANS I : RADED	3086 RB VENT EXH FL.W LO	1088 RB EXH FANS DMPRS DEGRADED
B	3074 RBSVS STS A UNIT CLR DEGRADED	3075 RBSVS STS B UNIT CLR DEGRADED	3084 RBSVS STS A INIT	1085 RBSVS STS B INIT	3089 RB SPLY FAN MTR TEMP HI	1080 RB DIFF P LO	1078 RB EXH AIR TEMP HI	3049 RB SPLY FANS AUTO TRIP	3050 RB SPLY FLT DIFF P HI	3051 RB SPLY AIR TEMP LO
C	3015 RBSVS STS A UNIT CLR INOP	3016 RBSVS STS B UNIT CLR INOP	3093 RBSVS STS A INIT LCTL	1094 RBSVS STS B INIT LCTL	3097 RBSVS IN PLENUM DMPR A OPEN	1098 RBSVS IN PLENUM DMPR B OPEN	3087 RB SPLY FAN OC TRIP	3100 RB VENT ISOL VV A LCTL	3101 RB VENT ISOL VV B LCTL	3099 RBHVS EXH DMPRS TROUBLE

PNL-601

1007 REFUELING FLOOR RAD HI		1010 Rx BLDG RAD HI		1178 REFUEL LEVEL DIV I VENT RAD HI	1179 REFUEL LEVEL DIV II VENT RAD HI		1180 REFU : LEVEL VENT EXH RAD ALERT		1173 RB MG ROOMS TEMP HI/LO

PNL - VC2

Fig 5G

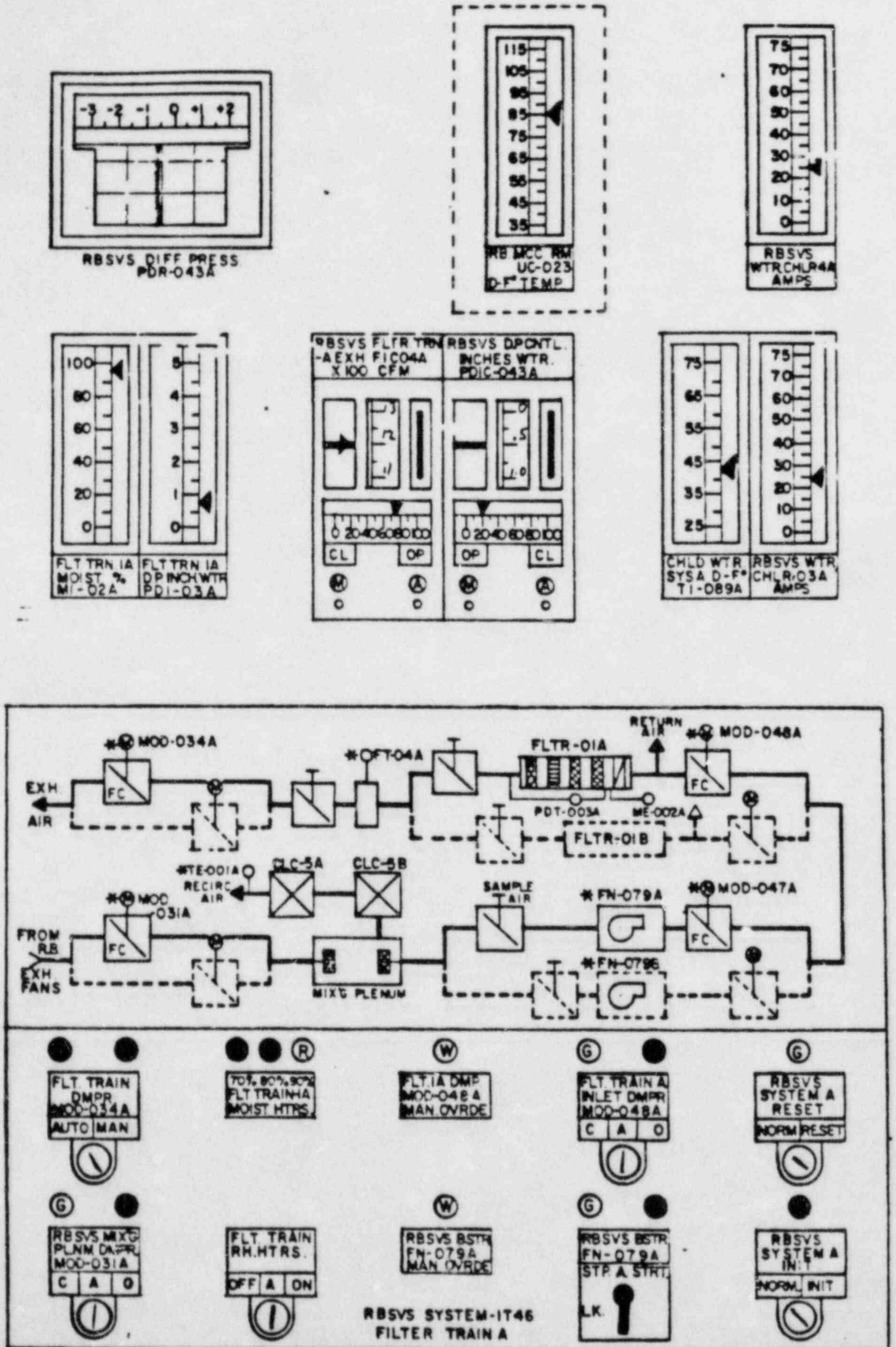

RBSVS DIFF PRESS PDR-043A
RB MCC RM UC-023 D-F° TEMP
RBSVS WTR CHLR 4A AMPS
FLT TRN 1A MOIST % MI-02A
FLT TRN 1A DP INCH WTR PDI-03A
RBSVS FLTR TRN -A EXH FIC04A X 100 CFM
RBSVS DP CNTL. INCHES WTR. PDIC-043A
CHLD WTR. SYS A D-F° TI-089A
RBSVS WTR CHLR 03A AMPS
MOD-034A
EXH. AIR
FT-04A
FLTR-01A
RETURN AIR
MOD-048A
PDT-003A
ME-002A
FLTR-01B
TE-001A
RECIRC AIR
CLC-5A
CLC-5B
MOD-031A
FROM RB EXH FANS
MIX'G PLENUM
SAMPLE AIR
FN-079A
MOD-047A
FN-079B
FLT. TRAIN DMPR. MOD-034A
AUTO MAN
70% 80% 90% FLT TRAIN 1A MOIST HTRS.
FLT. 1A DMP MOD-048A MAN. OVRDE
FLT. TRAIN A INLET DMPR MOD-048A
C A O
RBSVS SYSTEM A RESET
NORM RESET
RBSVS MIX'G PLNM DMPR. MOD-031A
C A O
FLT. TRAIN RH. HTRS.
OFF A ON
RBSVS BSTR FN-079A MAN. OVRDE
RBSVS BSTR FN-079A STP. A STRT.
LK.
RBSVS SYSTEM A INIT
NORM. INIT
RBSVS SYSTEM-1T46 FILTER TRAIN A

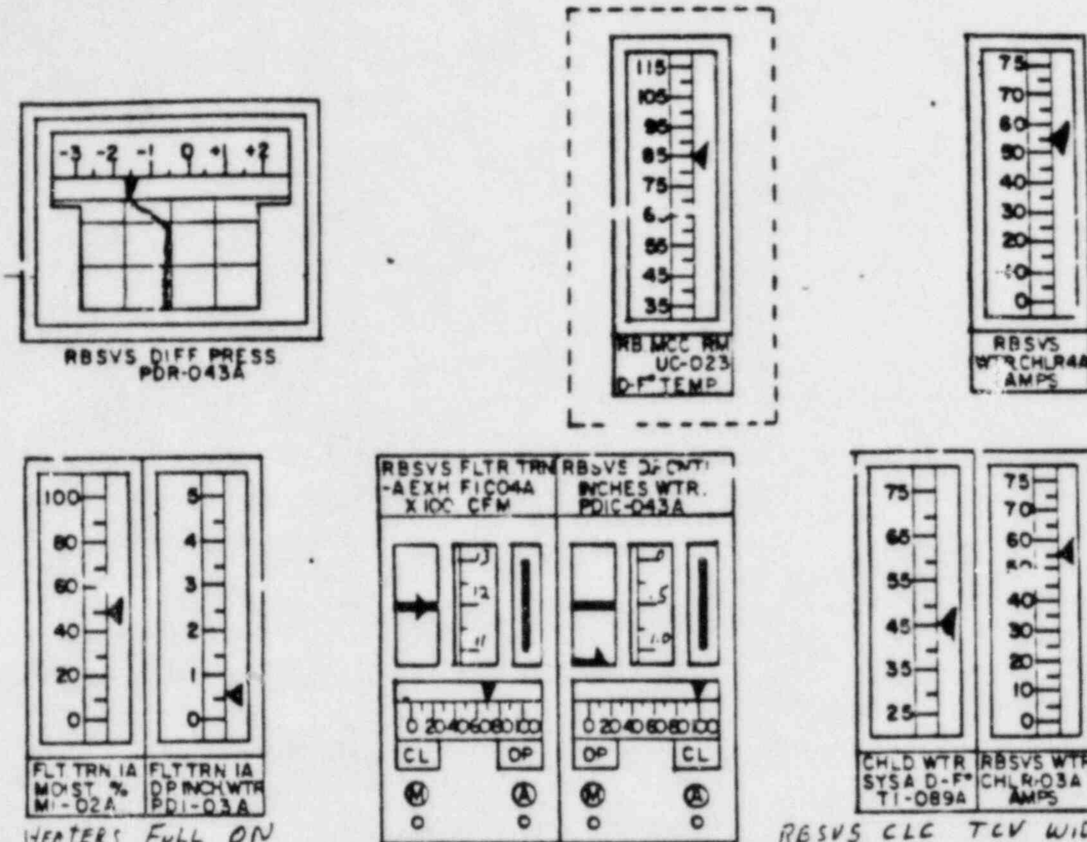
Fig 6E

7A

	1	2	3	4	5	6	7	8	9	10
A	3057 VC2 ANN GND DETECTED	3081 RBSVS FLT TRN FLOW HI/LO	3072 RBSVS FLT TRN A DEGRADED	3073 RBSVS FLT TRN B DEGRADED	3081 PASF ACU/FILTER TROUBLE	3079 RB DIFF P HI	3053 RB EXH FANS AUTO TRIP	3054 RB EXH FANS DEGRADED	3086 RB VENT EXH FLOW LO	3088 RB EXH FANS DMPRS DEGRADED
B	3074 RBSVS SYS A UNIT CLR DEGRADED	3075 RBSVS SYS B UNIT CLR DEGRADED	3084 RBSVS SYS A INIT	3085 RBSVS SYS B INIT	3089 RB SPLY FAN MTR TEMP HI	3080 RB DIFF P LO	3078 RB EXH AIR TEMP HI	3049 RB SPLY FANS AUTO TRIP	3050 RB SPLY FLT DIFF P HI	3051 RB SPLY AIR TEMP LO
C	3015 RBSVS SYS A UNIT CLR INOP	3016 RBSVS SYS B UNIT CLR INOP	3093 RBSVS SYS A INIT LCTL	1094 RBSVS SYS B INIT LCTL	3097 RBSVS IN PLENUM DMPR A OPEN	3098 RBSVS IN PLENUM DMPR B OPEN	3087 RB SPLY FAN OC TRIP	1100 RB VENT ISOL VV A LCTL	3101 RB VENT ISOL VV B LCTL	1099 RBHVS EXH DMPRS TROUBLE

PNL-601

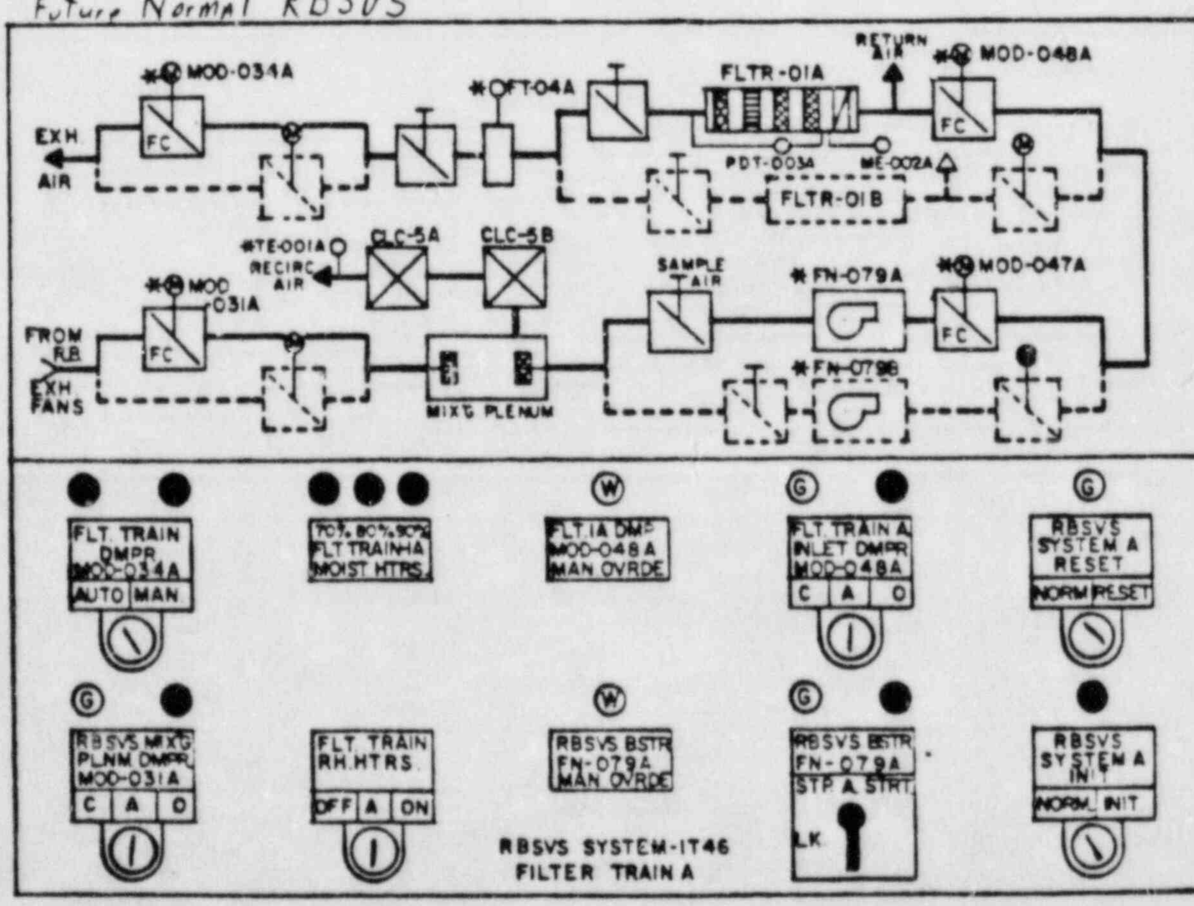
1009 REFUELING FLOOR RAD HI		1010 Rx BLDG RAD HI		1178 REFUEL LEVEL DIV I VENT RAD HI	1179 REFUEL LEVEL DIV II VENT RAD HI		1180 REFUE LEVEL VENT EXH RAD ALERT		1173 RB MC ROOMS TEMP HI/LO



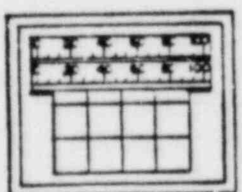
= HEATERS FULL ON

RBSVS CLC TCV WIDE OPEN
RBSVS UC TCV Modulates on Temp

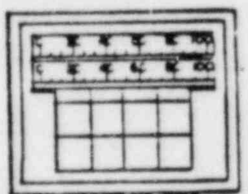
Future Normal RBSUS



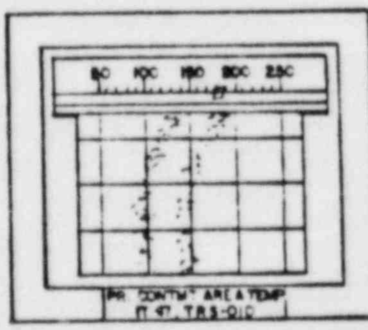
PURGE P HI	3058 SVI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	3013 RBSVS SYS A CHLR MTR OVLD	3014 RBSVS SYS B CHLR MTR OVLD	3090 PASF SYS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
3076 CNTMT PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS SYS A CHILL WTR INOP	3020 RBSVS SYS B CHILL WTR INOP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	3091 RBSVS CHLR DEMIN PURGE FLOW HI	3093 DRYWELL UNIT CLR DIFF P HI
3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3052 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	3092 RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI
1	2	3	4	5		7	8	9	10



DW UC17A, ME-015A
MOISTURE RECORDER



DW UC017B ME-015B
MOISTURE RECORDER



Increasing trend to cause a weighted Average at 145°F by the process computer program ⇒ Cnmt Control SP

DRYWELL UNIT COOLERS - SYSTEM IT47

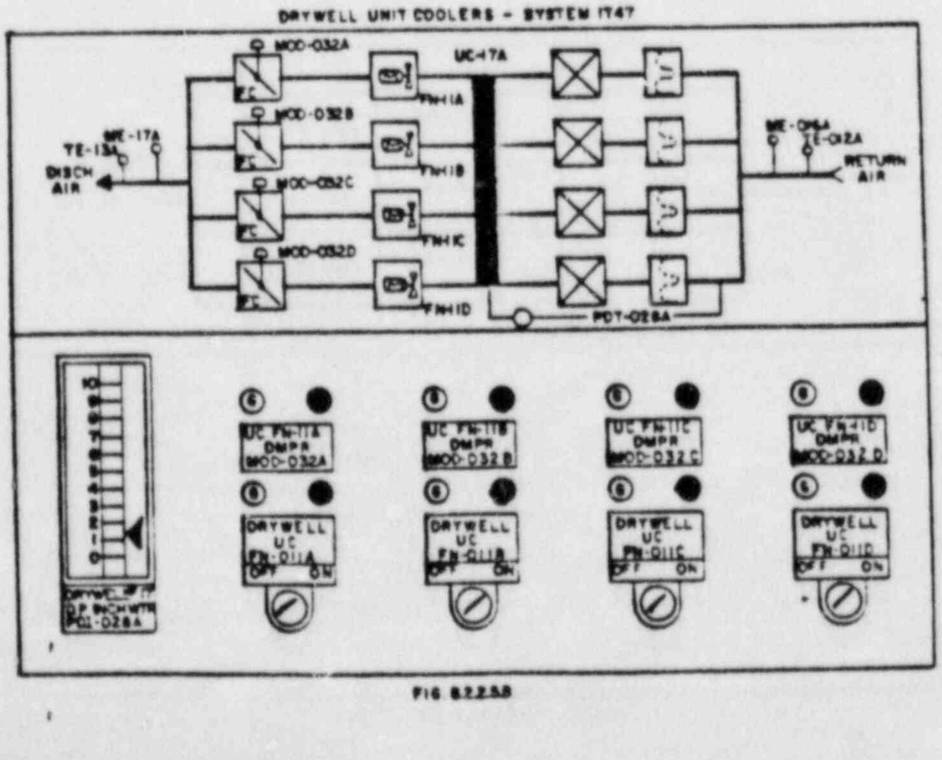
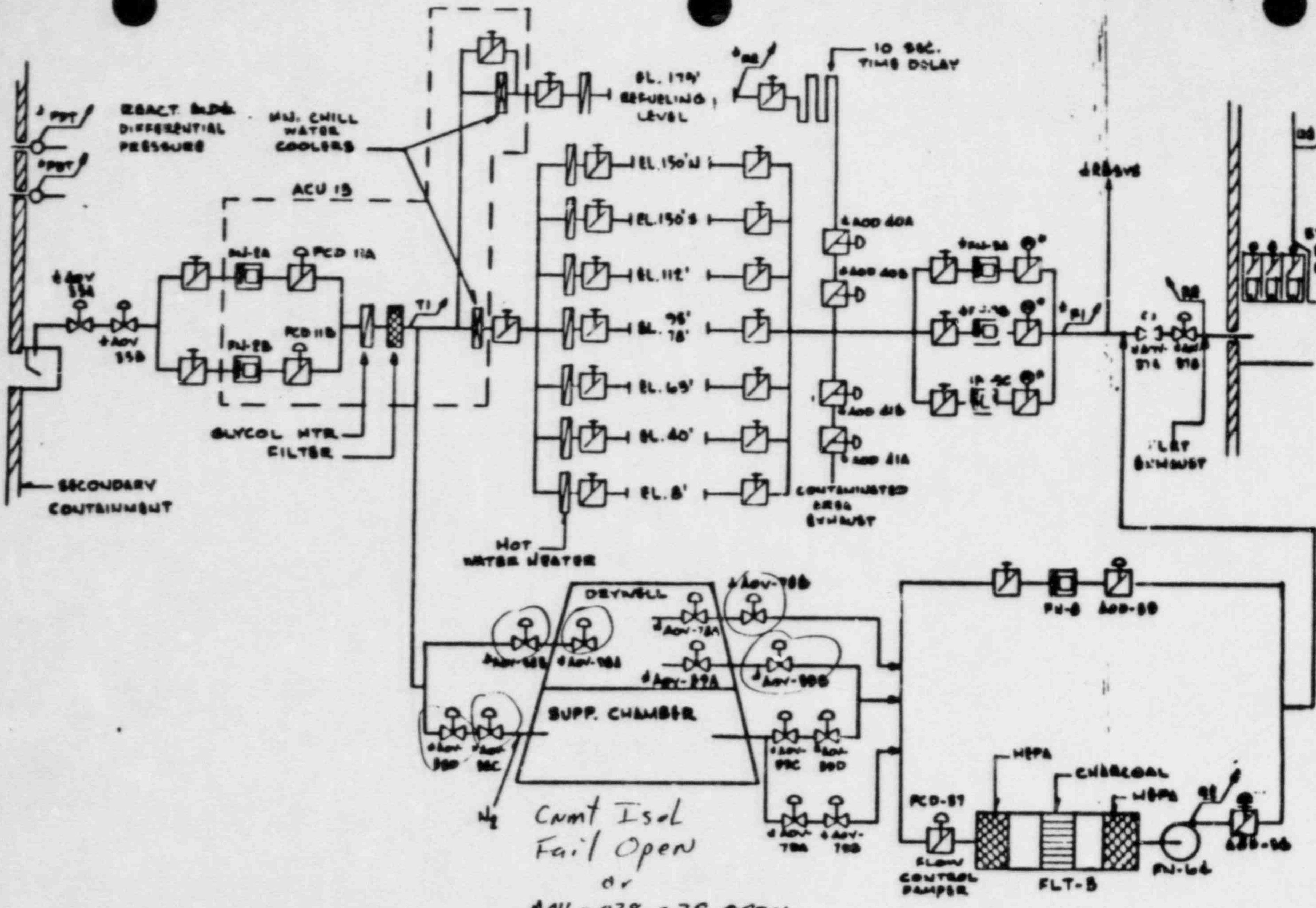


FIG 8.2.2.5.B



Cnmt Isol
Fail Open
or
AOU-038, 039 OPEN
in Modes 1, 2, 3

~~Loss of Primary Cnmt Integrity~~

* SAFETY RELATED COMPONENTS

REACT. BLDG. NORMAL VENTILATION &
PRIMARY CONT. PURGE SYSTEM

SNPS Hot License Systems Tour Checklist

System: Containment Ventilation

Initials

1. Control Room

		Initials
VC-1	Panel	
VC-2	Panel	
MXP	Panel	

Especially Note RBSVS Recirc Air Temp Records

RBSVS Flow Recorder

2. Port H_2 Recombiner Backpanel

AOV-Ø78A(B) and 079 A(B)

Fan 64 control switch

3. Relay Room

VX Panels

86 devices

UC TIC's

The following personnel attended the Hot License System tour on the ______ system.

SIGNATURE	PRINT NAME	SECTION

Training Instructor/Date

HVAC - CONTROL ROOM (CRAC)

STUDENT HANDOUT FOR SHIFT

(SRO) ADVISOR TRAINING PROGRAM

Prepared by: C Ackerman 5/4/84
Instructor / ~~Date~~

Rev. 0 Date 5/10/84

Reviewed by: Marchin P. Richard 5/4/84
Training Specialist / Date

1.0 LESSON PLAN: HVAC - Control Room (CRAC)

2.0 LECTURE DURATION: 2 hrs./ 0 min.

3.0 MATERIALS REQUIRED FOR STUDENTS:

3.1 HVAC - Control Room Student Handout

3.2 HVAC - Control Room SP 23.412.01

3.3 Technical Specifications

4.0 MATERIALS REQUIRED FOR INSTRUCTOR:

4.1 Overhead Projector

4.2 White Board & Pens or equivalent

4.3 Transparencies

5.0 REFERENCE MATERIAL:

5.1 CRAC System Description and references within 1020.412

5.2 HVAC - Control Room SP 23.412.01

5.3 HVAC Control Room Emergency Mode SP 24.412.02

5.4 FSAR Section 7.3.1.3.1,.2,.3

9.4.1.1,.2,.3,.4,.5

5.5 SNPS Technical Specifications Section 3/4.7.2

6.0 SCOPE OF THE LECTURE:

To teach the student flow paths, major components, and system operation.

7.0 LEARNING OBJECTIVES:

At the end of this lecture the student should:

7.1 State the purpose of the CRAC system as given in the student handout.

7.2 Given a diagram of the CRAC system, trace out the flowpath for:

a) Normal Operation

b) Emergency Operation

c) Control Room Purge

7.3 Given a CRAC control panel display and without use of procedures:

a) Verify automatic actions associated with an Emergency Operation initiation signal has occured.

b) Identify a failure of the system to emergency operate.

c) Identify a standby filter train auto start.

8.0 LESSON OUTLINE:

8.1 Theory

8.1.1 System Purpose

Maintain a habitable atmosphere in the main control room during all modes of plant operation including accident conditions.

8.1.2 Design Bases

.1 The system is designed to provide ventilation and cooling in the main control room during all phases of plant operations including design basis accident (DBA) conditions.

.2 The system is designed to maintain temperature less than 75°F and humidity less than 60 percent to insure proper operation of equipment, and for personnel comfort.

.3 The system is designed to provide minimum ventilation requirements (500CFM) and maintain a positive pressure above atmospheric pressure to prevent unmonitored air leakage into the main control room during isolation.

.4 The system is designed to permit continuous personnel occupancy of the control room following a DBA. This is accomplished by system isolation, filtering, and recirculation to maintain radiation levels within acceptable limits.

.5 The system is designed to provide radiation monitoring of the outside air supply to the main control room.

8.1.2 Design Bases

.6 The system is designed to meet safety related and seismic category I requirements as follows:

a. emergency power system supply upon loss of off-site power

b. tornado missile protected

c. redundant A/C units, filter trains, filter booster fans, outdoor intakes, and indication are provided

.7 The toilet fan and purge fan are not safety related.

NOTE: Nuclear Safety - related instruments and components are denoted by an asterisk (*).

8.2 <u>Physical Description</u>

8.2.1 General System Description

.1 Two 100% Capacity A/C Units

.2 Two 100% Capacity filter trains

.3 Two 100% Capacity filter booster fans

.4 Two tornado missile protected outdoor air intakes and one missile protected exhaust air outlet

.5 toilet exhaust fan

.6 purge fan

.7 necessary ducting, dampers, controls and instrumentation

.8 All controls, instrumentation, annunciators, and alarms are located on panel 1H11*PNL-VC1 in control room (except local controls described later).

.9 Operational modes

a. normal - system maintains control room temperature less than 75°F and provides control room ventilation

b. emergency - system filters intake air and a portion of recirculated air, maintaining the control room above atmospheric and providing ventilation to maintain the control room habitable thru the accident.

1) Emergency Initiation

a) Rx water level low, _ -38"

b) Drywell Hi Press, _ 1.69 psig

c) High Rad Refuel Level Exh. duct, _ 35 mr/hr.

d) Rx Bldg diff press low, .25" H_2O

8.2.2 Major Equipment Description

.1 A/C Units (*ACU-Ø7A and B) - two 100% capacity A/C units, one normally operating, supply the control room, control room HVAC equipment room, and Watch Engineer's office. Each unit includes, in direction of flow; two filters, cooling cooling, and fan.

a. A/C Unit Data:

- cooling water requirements: 120 GPM for RBSVS and CRAC chilled water system

- location: control room HVAC equipment room

b. Fan Data:

- Type: Vaneaxial

- Capacity: 24,200 CFM

.2 Filter Booster Fans (*FN-Ø25A and B) - Two 100% capacity filter booster fans, one of which operates during an emergency condition, provide flow through the filter train and increase control room pressure above atmospheric to prevent contamination infiltration.

a. Fan Data:

- Type: centrifugal

- Capacity: 4,000 CFM

.3 Purge Fan (FN-Ø65) - Removes smoke and fire extinguishing agents from control room. Fig. 8.2.2.3

a. Fan Data:

- Type: Vaneaxial

- Capacity: 20,000 CFM

.4 Toilet Exhaust Fan (FN-Ø26) - Provides minimum ventilation exhaust from control during normal operation.

a. Fan Data:

- Type: Centrifugal

- Capacity: 500 CFM

.5 Filter Trains (*FLT-Ø2A and B) - Two 100% capacity filter trains, consisting of a prefilter, two high efficiency particulate air (HEPA) filters, and a charcoal filter. Used during emergency conditions to reduce radioactive contaminants to a safe level in control room.

a. Filter Train Data:

- Prefilter:

  - filter media: fiberglass

- HEPA filters:

  - filter media: fiberglass

- Charcoal filters:

  - filter media: charcoal

  - ignition temperature: 340°C minimum

8.2.3 Electrical Distribution <u>Fig. 8.2.3</u>

.1 See figures <u>Fig. 8.2.3.1</u>

8.3 <u>Principles of Operation</u>

8.3.1 System Operational Modes

.1 Normal Operation

a. One of 2 A/C units running supplying control room HVAC equipment room and Watch Engineer's office <u>Fig. 8.3.1.1</u>

b. Recirculate all but 500 CFM which is exhausted by toilet exhaust fan

c. 500 CFM required for ventilation is drawn from outdoors through the control room A/C units.

.2 Operating During Emergency Conditions <u>Fig. 8.3.1.2</u>

The CRAC system will automatically initiates into the EMERGENCY MODE as a result of:

a. Rx water level low, _ -38"

b. Drywell pressure high _ 1.69 psig

c. Rx Bldg Refuel Level exhaust rad. high, _ 35 mr/hr.

d. Rx Bldg Diff Pressure Low, 25" H_2O

Auto Actions:

a. Previously running *ACU-07A(B) continues to run

b. Stby *ACU-07B(A) starts if previously running ACU stops

c. Filter booster *FN-025A starts, *FN-025B starts if *FN-025A fails to start

d. Toilet exh. FN-065, purge exh FN-026 receive stop signals

e. Emergency outdoor air inlets *MOV-031 A&B and *MOV-032 A&B OPEN.

f. Normal outdoor air inlet *AOD-036 A&B CLOSE.

g. Air Conditioning Unit Crossover *AOD-037A&B CLOSE

h. Purge exhaust *AOV-038A&B CLOSE

i. Toilet exhaust *AOV-039A&B CLOSE

3. Abnormal Operations

a. Manual Initiation for Emergency Operation

1) Indication

- o Failure CRAC to auto initiate upon receipt of valid init. signal
- o Failure CRAC manual initiation switch to align CRAC to Emergency operation

2) C.R. Operator will manually align the CRAC system to the Emergency Operation mode as per SP 23.412.01.

   o Supply Emergency air to Air Cond. units

   o Place a filter train in service to supply filtered outside air to pressurize the control room

b. Control Room Purge Startup

   1) Indication

      o Smoke or fire protection agents in the control room

   2) Control Room must be provided a source of external air prior to using Control Room purge fan

   3) Open Purge Exhaust Isolation *AOV-038 A&B and start purge FN-065 on VC-1.

NOTE: Purging the Control Room of smoke or fire protection agents may be performed only during the NORMAL Operating mode of the CRAC system.

c. Loss of Station Air

   1) Loss of station air will not affect CRAC system in Emergency operation.

      o All air operated valves and dampers fail in their Emergency mode position

   2) To provide a supply of fresh air to the control room, open Emergency Air Inlet Isol *MOV-031A and/or B, or *MOV-032A and/or B.

d. Loss of Offsite Power

   1) Loss of Offsite power will have no effect during Emergency operation.

   2) Toilet Exh FN-026 and Control Rm Purge FN-065 (if operating) will trip. All other loads will return to original position when emergency buses are reenergized.

e. Outdoor Air Supply High Radiation

1) Upon receipt of HIGH RADIATION OUTDOOR AIR SUPPLY A(B) or 1D11*PNL-080 & ann. is verified.

- o initiate CRAC sys A(B) in the Emergency mode
- o determine which intake is alarming and isolate that intake

.4 Testing Modes

a. Automatic functions may be tested during normal operations and all equipment will be tested periodically.

.5 Tech Specs

3/4.7.2 CONTROL ROOM AIR CONDITIONING SYSTEM

3.7.2 Two independent control room air conditioning systems shall be OPERABLE

APP: All OPERATIONAL CONDITIONS and when irradiated fuel is being handled in the secondary containment

8.3.2 Precautions

.1 Reactor Bldg Stdby Ventilation System and Control Room Air Conditioning Chill Water System 'A' supplies CRAC *ACU-07A only. RBSVS and CRAC chilled Water System 'B' supplies CRAC *ACU-07B only. Operation of the CRAC units and water chillers must be coordinated.

o Recognition

RBSVS/CRAC system status on VC-1 indicating cooling water to respective loop's ACU.

.2 Ensure an external source of air is provided by opening the appropriate doors prior to starting purge exhaust fan FN-065.

o Recognition

One of three approved egress flow paths is open.

.3 The CRAC system is nuclear safety-related. Corresponding redundant components (A and B) should never be rendered inoperable at the same time.

o **Recognition**

CRAC system status as indicated on VC-1

8.3.3 Instrumentation and Control

.1 Main Control Room Controls (1H11*PNL-VC1)

a. A/C Units (*ACU-007A and B) and Filter Booster Fans (*FN-025A and B)

- individual control switches; STOP, AUTO, START, PULL-TO-LOCK; spring return to AUTO

b. Purge Fan (FN-Ø65)

- selector switch; START, STOP, spring return to midposition

c. Toilet Exhaust Fan (FN-Ø26)

- selector switch; START, STOP

d. Outdoor Air Supply Valves (*MOVØ31A and B) and (*MOVØ32A and B)

- selector switches; OPEN, CLOSE, spring return to mid position

e. Normal air intake valves (*AOVØ36A and B); return air dampers (*AOD37A and B); exhaust isolation valves (*AOVØ39A and B)

- Control switches; OPEN, AUTO, CLOSE

f. Purge Exhaust Duct Valves (*AOVØ38A and B)

- selector switches; OPEN, CLOSE, spring return to mid-position

g. Emergency CRAC System Initiation

- momentary contact; NORMAL INITIATE, spring to return to normal

h. Emergency CRAC System Initiation Reset :

- momentary contact; NORMAL, RESET, spring to return to normal

.2 Instrumentation

a. Control Room

o CRAC air inlet flow

o CRAC air inlet rad monitors

b. Local

o Differential Pressure

oo prefilter

oo HEPA filters

oo charcoal filter

oo A/C prefilter

oo Dust stop filters

.3 Annunciators

The following CRAC annunciators are located on VC-1.

ANN	CONTROL ROOM VERIFICATION
3031(3) CONT RM ACU-7A(B) FLT DIFF P HI	o Dispatch E.O. locally for verification
3034 CO_2 PURGE FAN AUTO TRIP	o CO_2 fan "green" light ill. with CS in AUTO-AFTER-START
3035(6) CRAC SYSTEM A(B) TROUBLE	o Check CRAC status on VC-1
3037(41)CONT RM FM-25 A(B) FLT DIFF P HI	o Dispatch EO locally for verification
3127(8) EMER CRAC SYS A(B) INITIATION	o CRAC system in emergency mode.
3129 CRAC AIR SUPPLY FLOW LOW	o Dispatch EO locally for verification.

.4 Local Controls

a. Purge Fan (FN-Ø65)

- selector switch; START, STOP, spring return to midposition.

b. Purge Exhaust Duct Valves (*AOVØ38A and B) (EL.Ø63, control bldg.)

- selector switches; OPEN, CLOSE, spring return to midposition

.5 Modulating Controllers

a. (*TCVØ21A and B) controls amount of cooling water flow to A/C units cooling coils. Modulating by a signal from temperature indicating controllers (*TICØ21A and B) in the control room which receive a signal from air temperature elements (*TEØ21A and B).

.6 Interlocks

a. A/C Unit Fans (*ACU-Ø7A and B) and Fan Discharge Dampers (*MODØ34A and B)

- Start - Control switch in AUTO and low flow signal from other A/C unit.

- Stop - Associated discharge damper not fully open after 15 sec. time delay.

b. Filter Booster Fans (*FN-Ø245A and B) and Filter Booster Fan Discharge Dampers (*MODØ33A and B)

- Start - Control Switch in AUTO, accident signal present, OR low flow from other booster fan.

- Stop - Discharge damper not fully open 15 sec. time delay.

c. CRAC Toilet Exhaust Fan (FN-Ø26)

- Start - Both exhaust duct isolation valves (*AOVØ39A and B) fully open.

- Stop - Either exhaust duct isolation valve not fully open

d. Purge Fan (FN-Ø65) and Purge Damper (MODØ35)

- Start - Both Purge Exhaust Isolation Valve not fully open

- Stop - Either Purge Exhaust Isolation Valve not fully open

e. Purge Exhaust Isolation Valves (*AOVØ38A and B)

- Open - No accident signal present

- Close - Accident signal present

f. Supply Duct Isolation Valves (*AOVØ36A and B), ACU Crossover Supply air Dampers (*AOVØ37A and B), and Exhaust Duct Isolation Valves (*AOVØ39A and B)

- Open - no accident signal present

- Close - accident signal present

g. Outdoor Air Intake Isolation Valves (*MOVØ31A and B) and (*MOVØ32A and B)

- Open - accident signal present

- Close - control switch in CLOSE

- Manual Override - allows intentional closing of valve with accident signal present.

8.3.4 System Interrelations

.1 Start-Up

a. CRAC is nuclear safety - related and requires no support other than:

- power from emergency buses

- chilled water from RBSVS and CRAC Chilled Water System

- instrument air

.2 Shutdown

a. may cause:

- decrease in instrument accuracy

- improper equipment operation due to excessive temperatures

- prevent control room from remaining habitable during accident condition

8.4 SUMMARY

The purpose of the Control Room Air Conditioning System is to provide temperature and humidity control in the main control room, and maintain a positive pressure and a habitable atmosphere in the main control room during accident conditions. The system operates in either the normal or emergency mode and is auto initiated by any of the following:

a) Reactor water level low 38", or Hi Drywell Press 1.69 psig.

b) High radiation in the reactor building refueling level exhaust duct 35 mr/hr

c) Reactor building differential pressure .25" H_2O

During normal operation outdoor air (500CFM) enters two supply duct isolation valves (*AOVØ36A and B), mixes with recirculation air and enters one of the A/C units (ACU-Ø78A or B). The A/C unit fan discharges the cooled air to the main control room, main control room HVAC equipment room, and Watch Engineer's office. An amount of air equal to the ventilation intake (500CFM) is drawn through register in the toilets, kitchen, and storage rooms, and passed by the Toilet Exhaust Fan (FN-Ø26) to the exhaust air outlet.

During emergency operation supply duct isolation valves (*AOVØ36A and B) close. Outside air (1000 CFM) is diverted to two filter trains (*FLT-Ø2A and B). The air passes through one filter train to the associated filter booster fan (*FN-Ø25A and B) and is then mixed with recirculated air prior to entering the A/C units. Exhaust duct isolation valves close upon emergency initiation which, in conjunction with the filter booster fan, raises, control room pressure. This reduces the possibility of airborne radiation entering the control room.

9.0 TRANSPARENCIES CONTAINED IN THIS LESSON INCLUDE:

Fig. No.	Description
8.2.1	Control Room Air Conditioning System
8.2.2	Control Room Air Conditioning System
8.2.3	Electrical Distribution
8.2.3.1	120 VAC Panel Loads
8.3.1.1	Normal Operating Mode
8.3.2.3	Emergency Operating Mode
8.3.1.3	Smoke Removal Mode

DATA SHEET

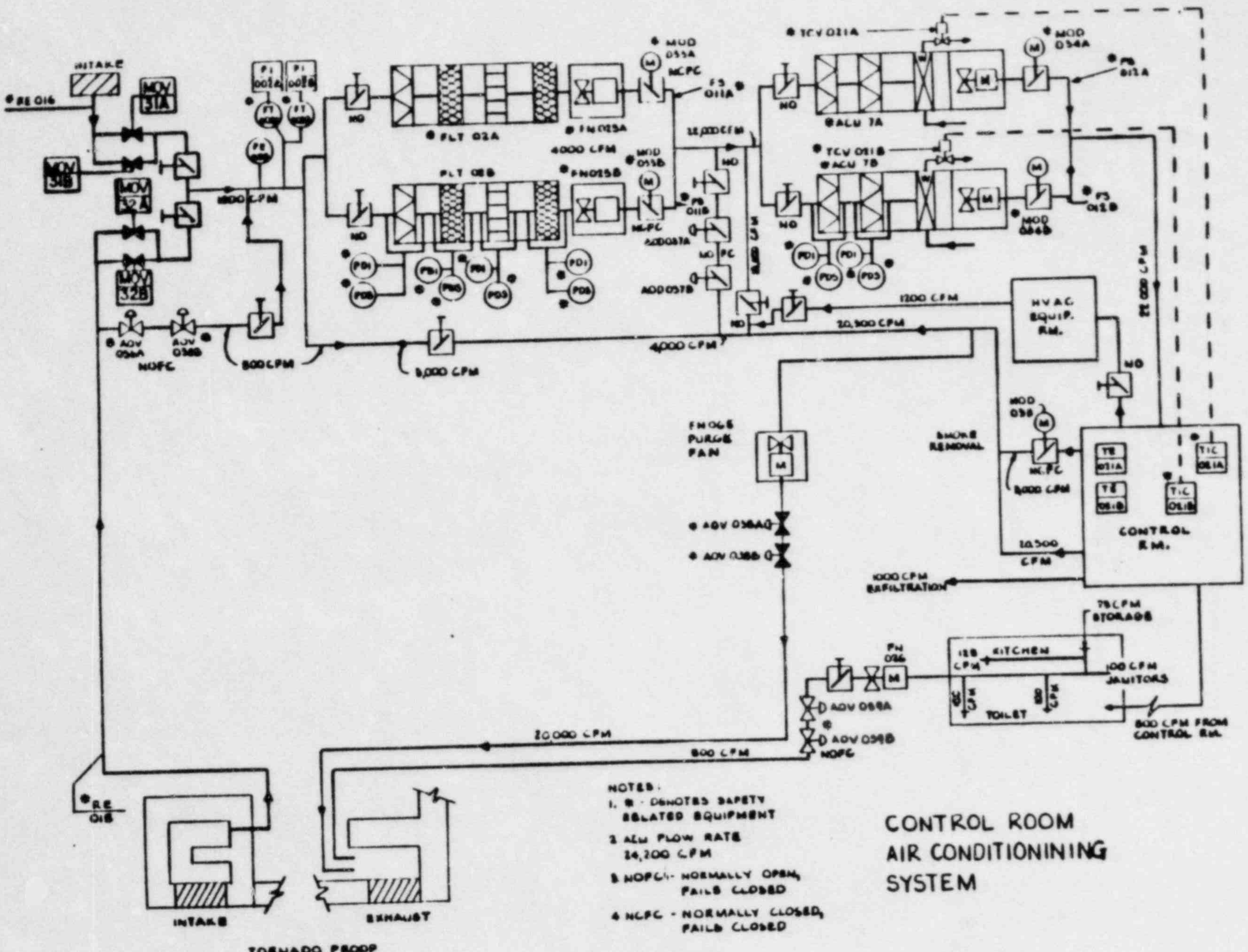
Temperature maintained by system - 75°F

Minimum ventilation requirements - 500 CFM

Operational modes - normal, emergency, smoke removal

Auto initiations -
1) Reactor water level low -38" or 1.69 psig Drywell
2) high radiation in the reactor building refueling level 35mr/hr
3) reactor building differential pressure .25" H_2O

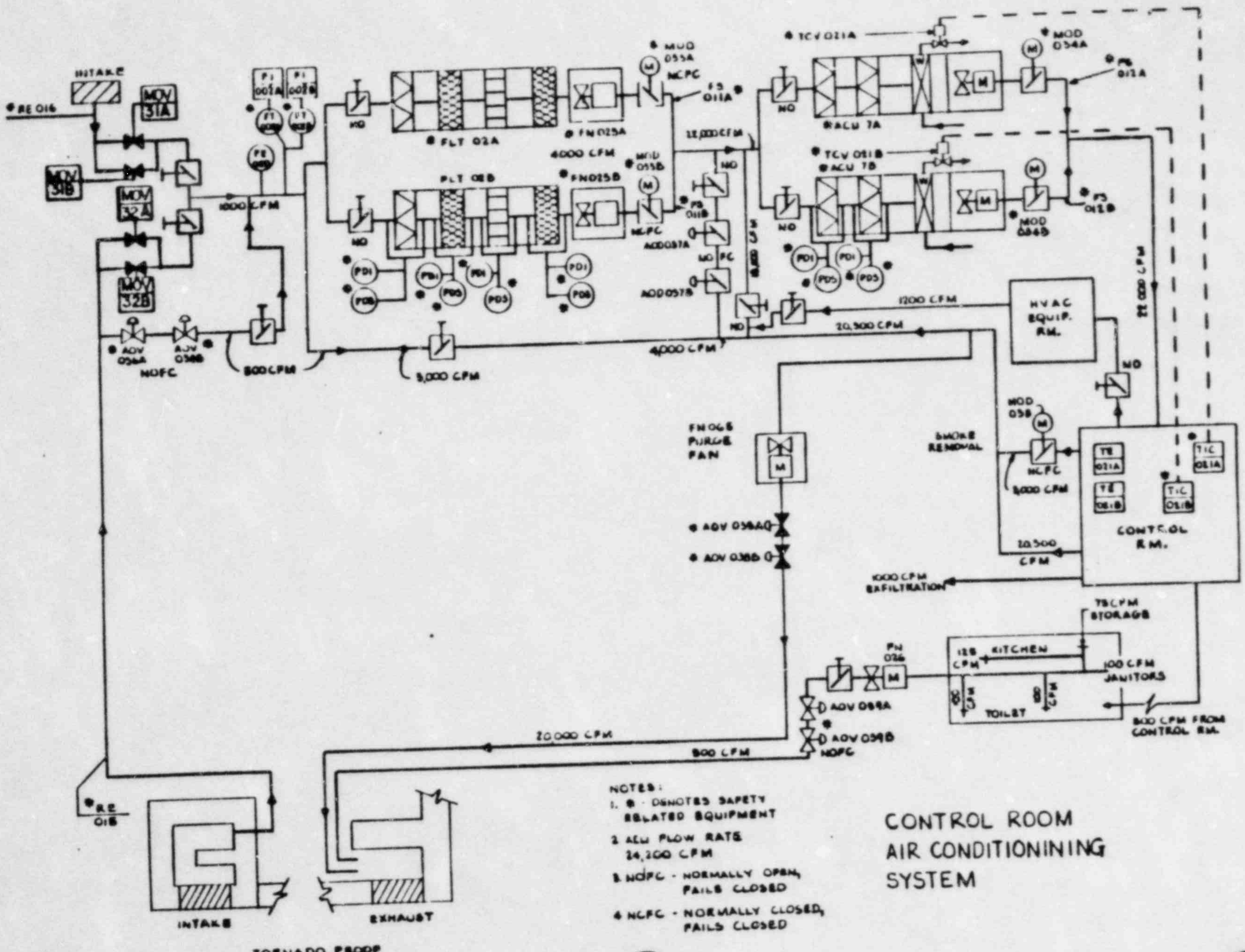
8.2.1.a



NOTES:

1. ⊛ - DENOTES SAFETY RELATED EQUIPMENT
2. ACU FLOW RATE 24,200 CFM
3. NOFC - NORMALLY OPEN, FAILS CLOSED
4. NCFC - NORMALLY CLOSED, FAILS CLOSED

CONTROL ROOM
AIR CONDITIONINING
SYSTEM

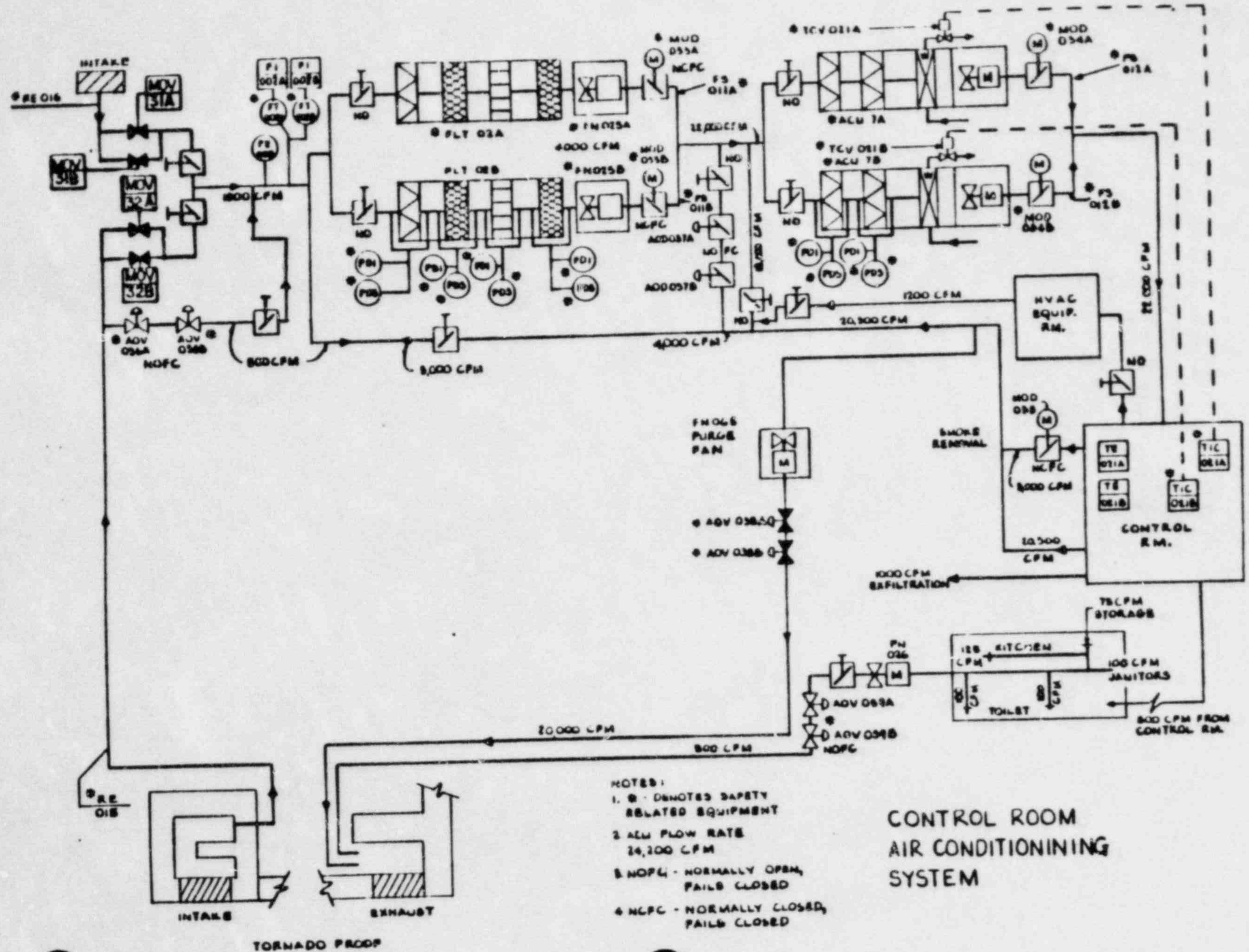


NOTES:
1. ● - DENOTES SAFETY RELATED EQUIPMENT
2. ACU FLOW RATE 24,200 CFM
3. NOFC - NORMALLY OPEN, FAILS CLOSED
4. NCFC - NORMALLY CLOSED, FAILS CLOSED

CONTROL ROOM
AIR CONDITIONINING
SYSTEM

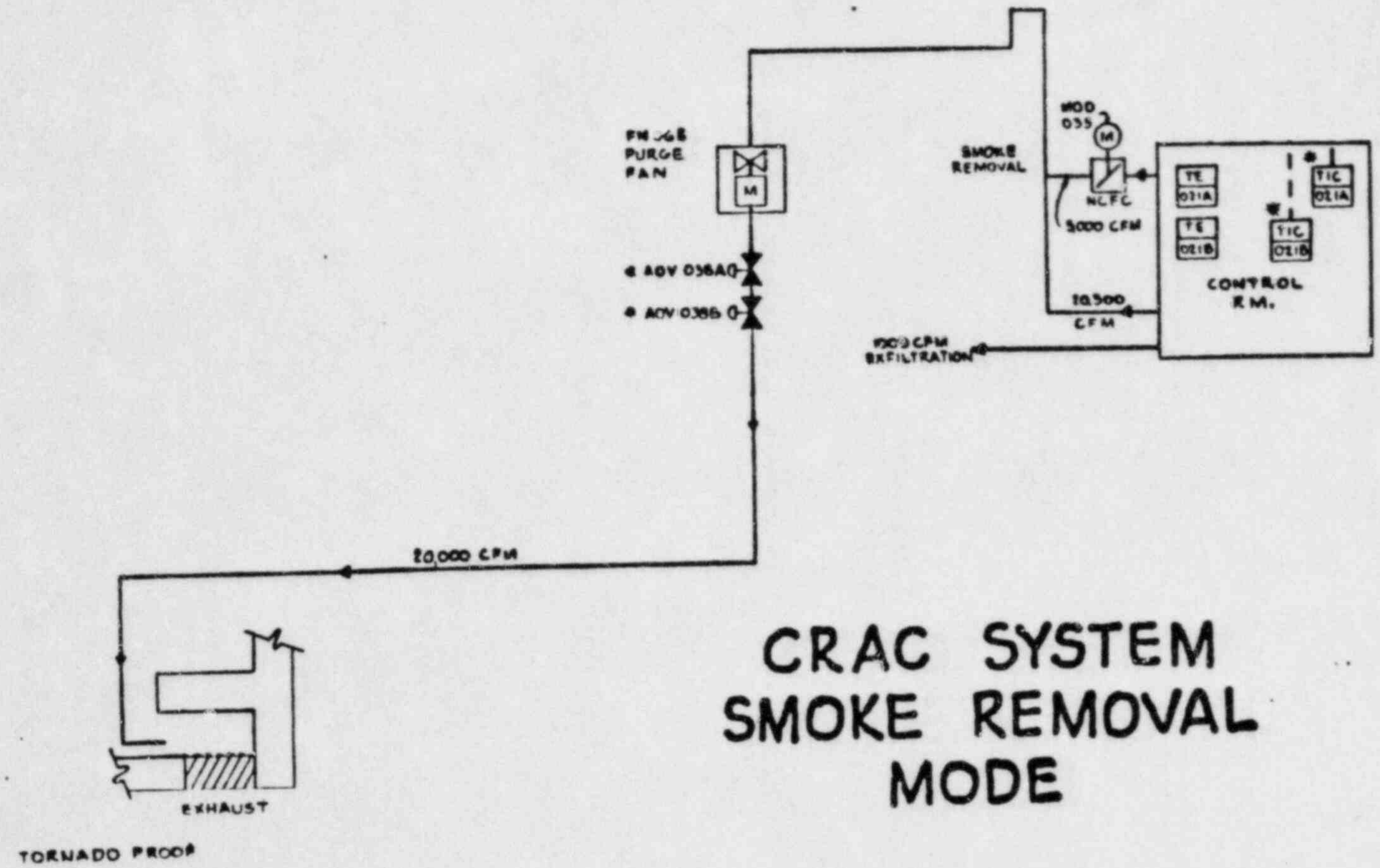
8.2.1.6.

8.2.1c



NOTES:
1. ⊕ - DENOTES SAFETY RELATED EQUIPMENT
2. ACU FLOW RATE 24,200 CFM
3. NOFC - NORMALLY OPEN, FAILS CLOSED
4. NCFC - NORMALLY CLOSED, FAILS CLOSED

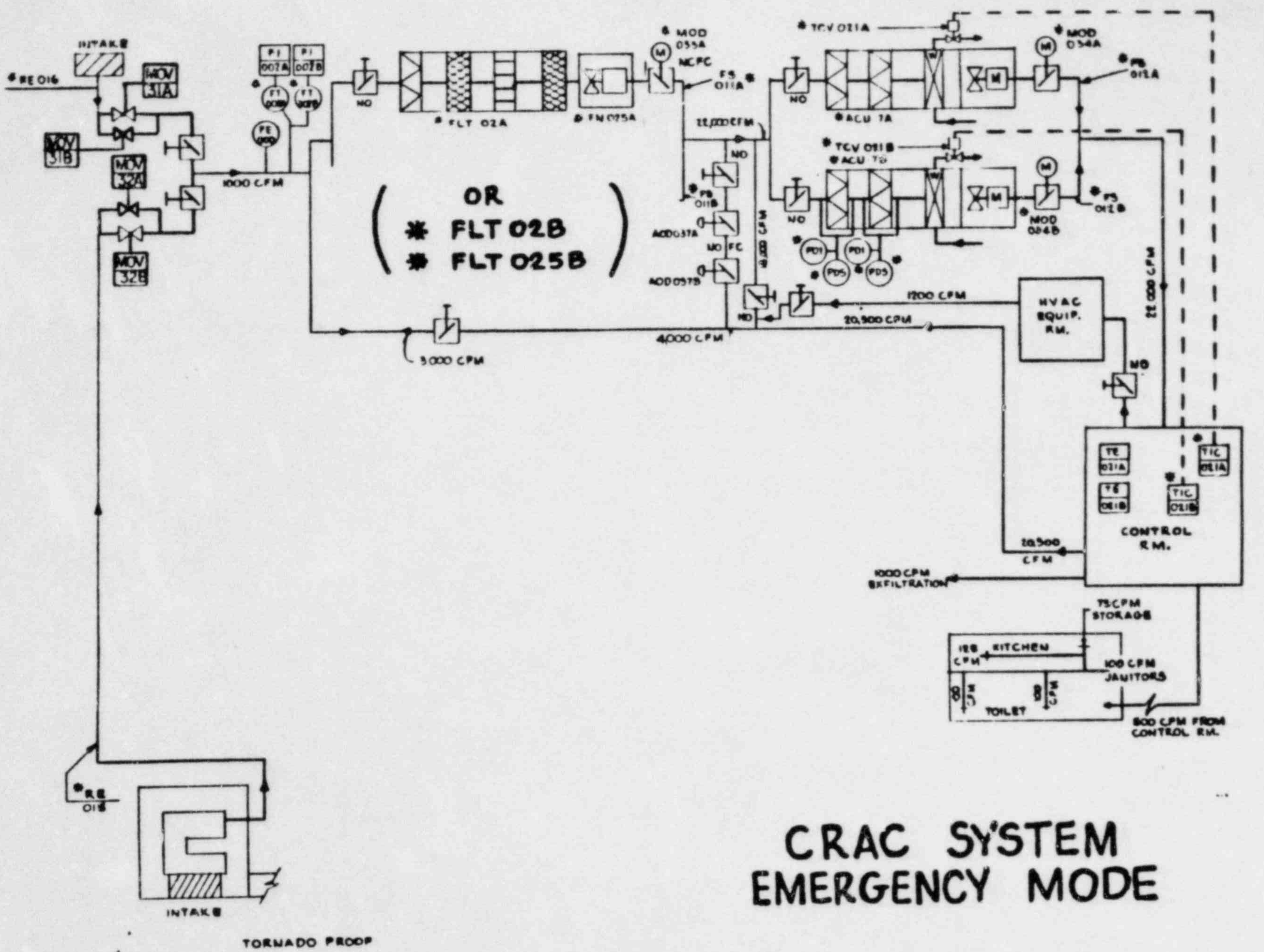
CONTROL ROOM
AIR CONDITIONINING
SYSTEM



CRAC SYSTEM SMOKE REMOVAL MODE

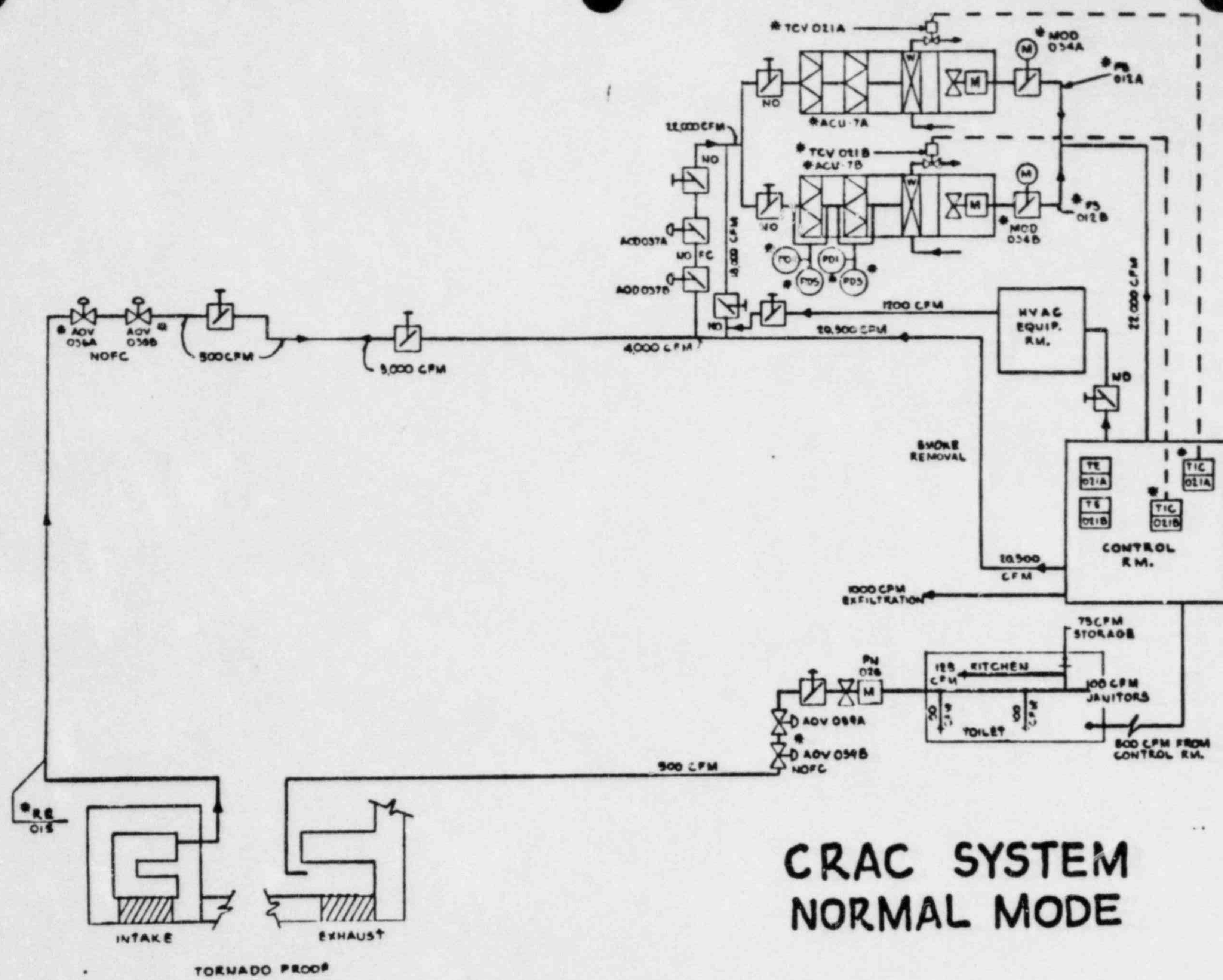
-24-

8.3.1.3



CRAC SYSTEM EMERGENCY MODE

V.3.1.2



CRAC SYSTEM NORMAL MODE

B.3.1.1

120 VAC DISTRIBUTION PANEL LOADS

1R35*PNL-R1

*AOV036A
*AOV038A
*AOV039A
*AOD037A

1R35*PNL-R3

*MOD033A
*MOD034A

1R35*PNL-B1

*AOV036B
*AOV038B
*AOV039B
*AOD037B

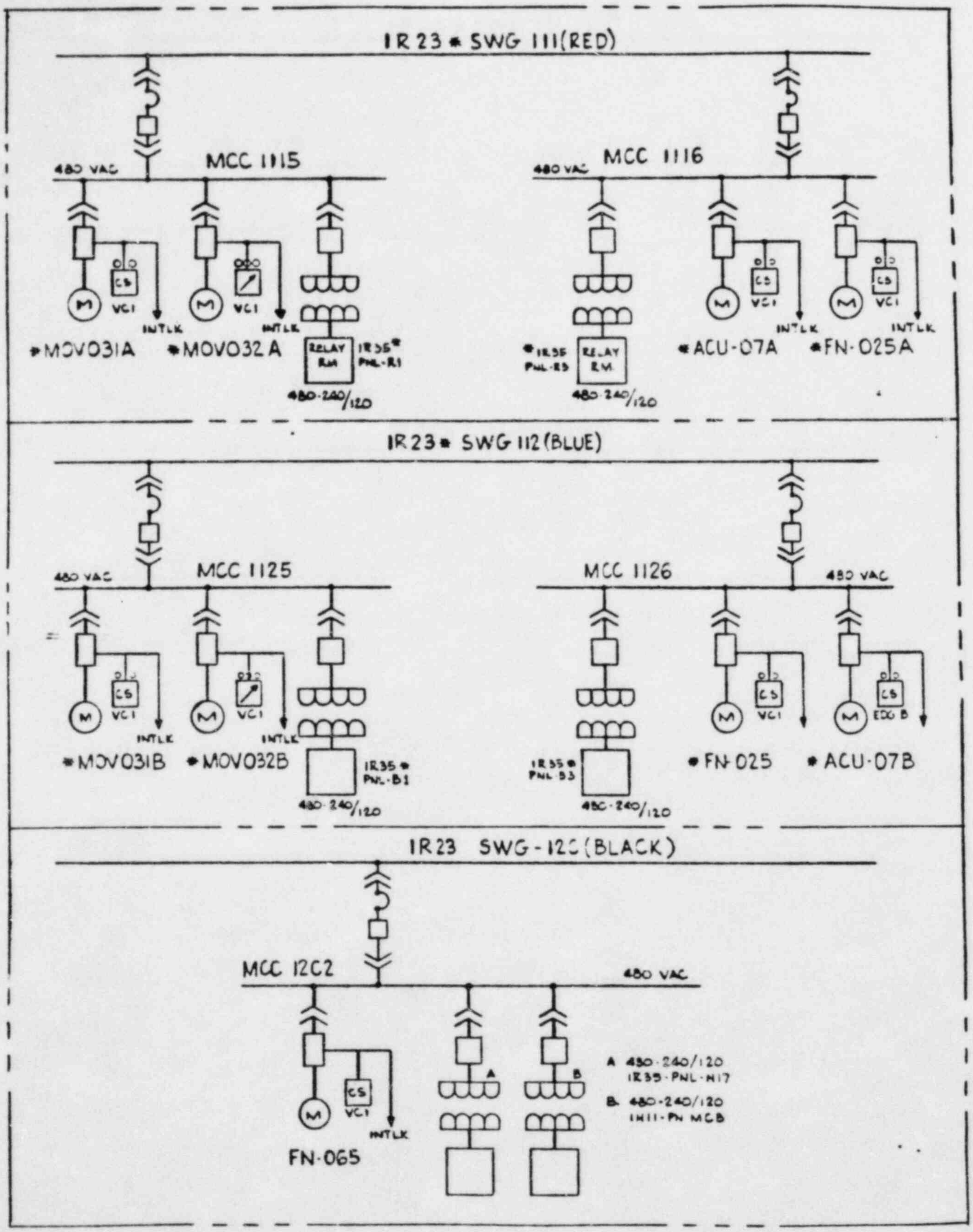
1R35*PNL-B3

*MOD033B
*MOD034B

1R35-PNL-N17

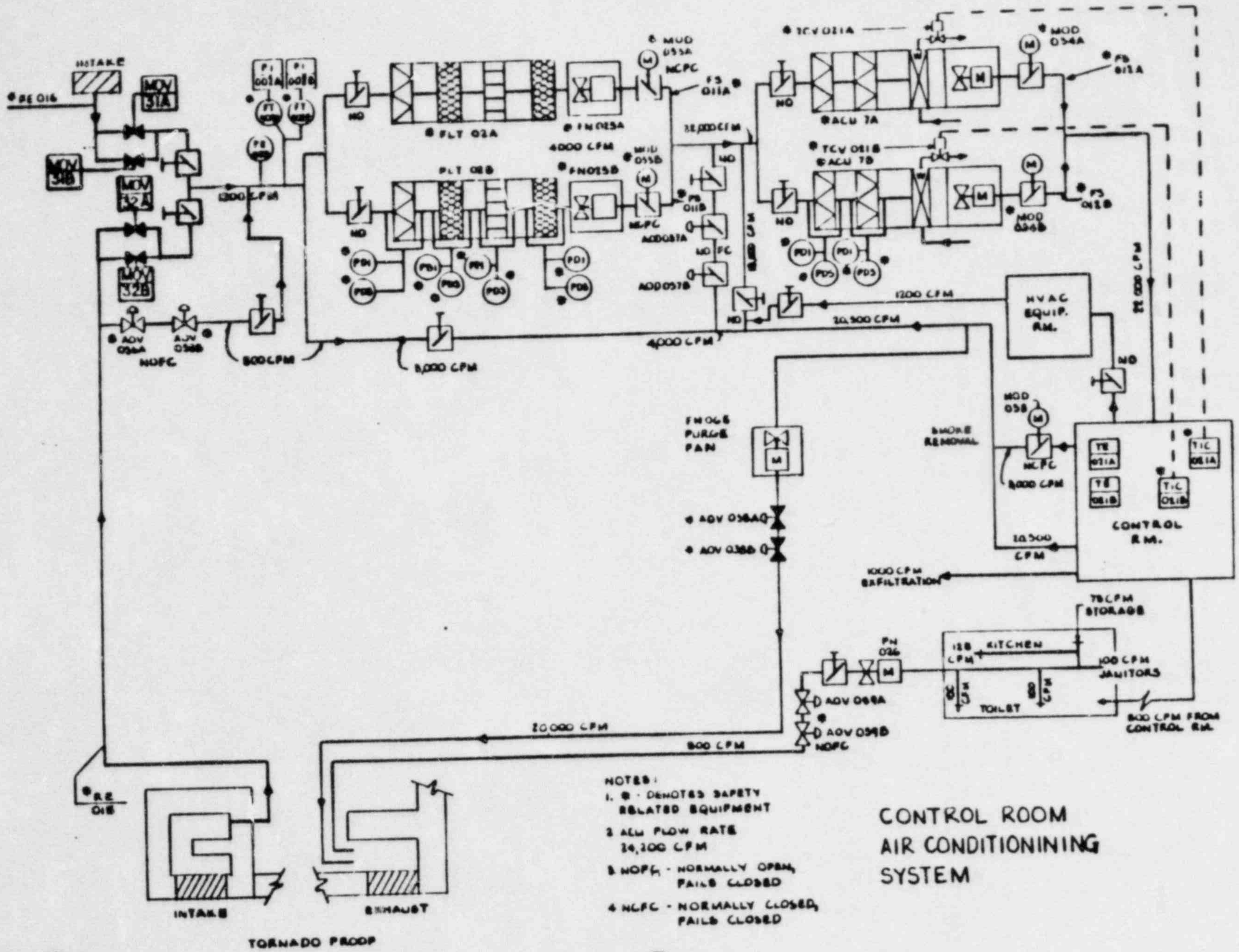
MOD035

8.2.3.1



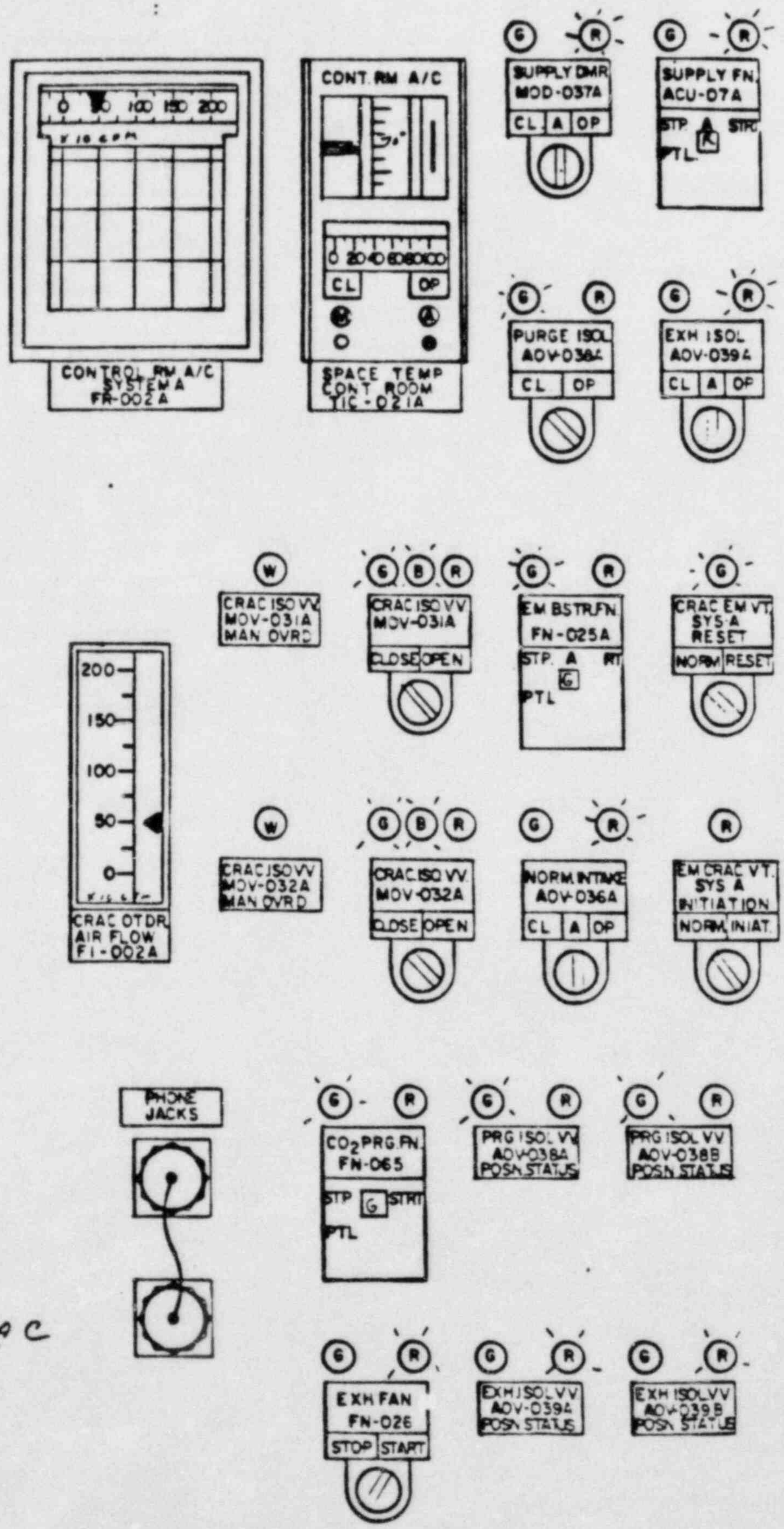
1R23 * SWG 111 (RED)
MCC 1115
480 VAC
VC1
INTLK
*MOV031A
*MOV032A
RELAY RM
1R35* PNL-R1
480-240/120
MCC 1116
480 VAC
*1R35 PNL-R3
RELAY RM
480-240/120
*ACU-07A
*FN-025A
1R23* SWG 112 (BLUE)
MCC 1125
480 VAC
*MOV031B
*MOV032B
1R35* PNL-B1
480-240/120
MCC 1126
480 VAC
1R35* PNL-B3
480-240/120
*FN-025
*ACU-07B
EDG B
1R23 SWG-12C (BLACK)
MCC 12C2
480 VAC
FN-065
A 480-240/120 1R35-PNL-H17
B 480-240/120 1H11-PN MCB

8.2.3!



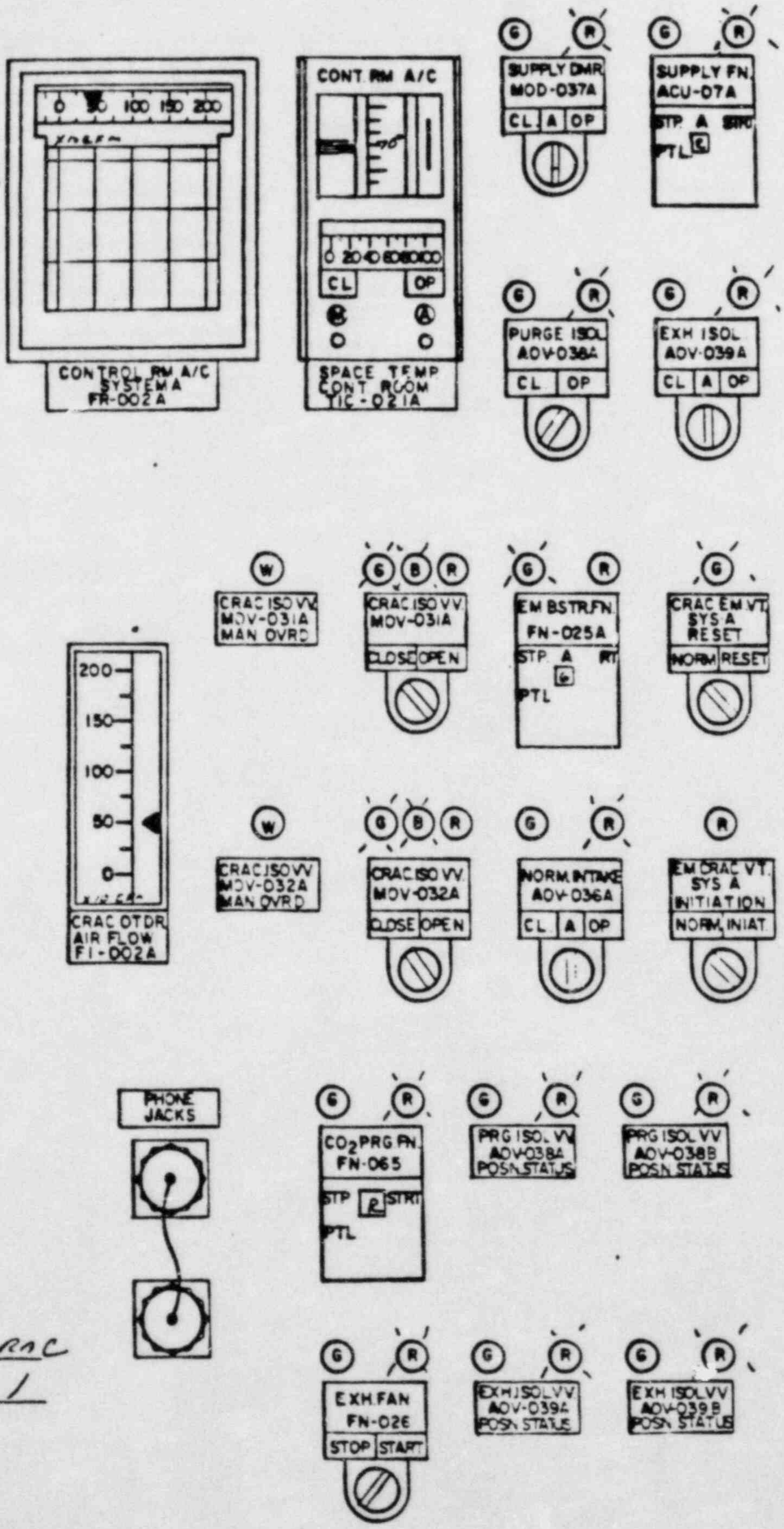
NOTES:
1. ⊛ - DENOTES SAFETY RELATED EQUIPMENT
2. ACU FLOW RATE 34,200 CFM
3. NOFC - NORMALLY OPEN, FAILS CLOSED
4. NCFC - NORMALLY CLOSED, FAILS CLOSED

CONTROL ROOM
AIR CONDITIONINING
SYSTEM



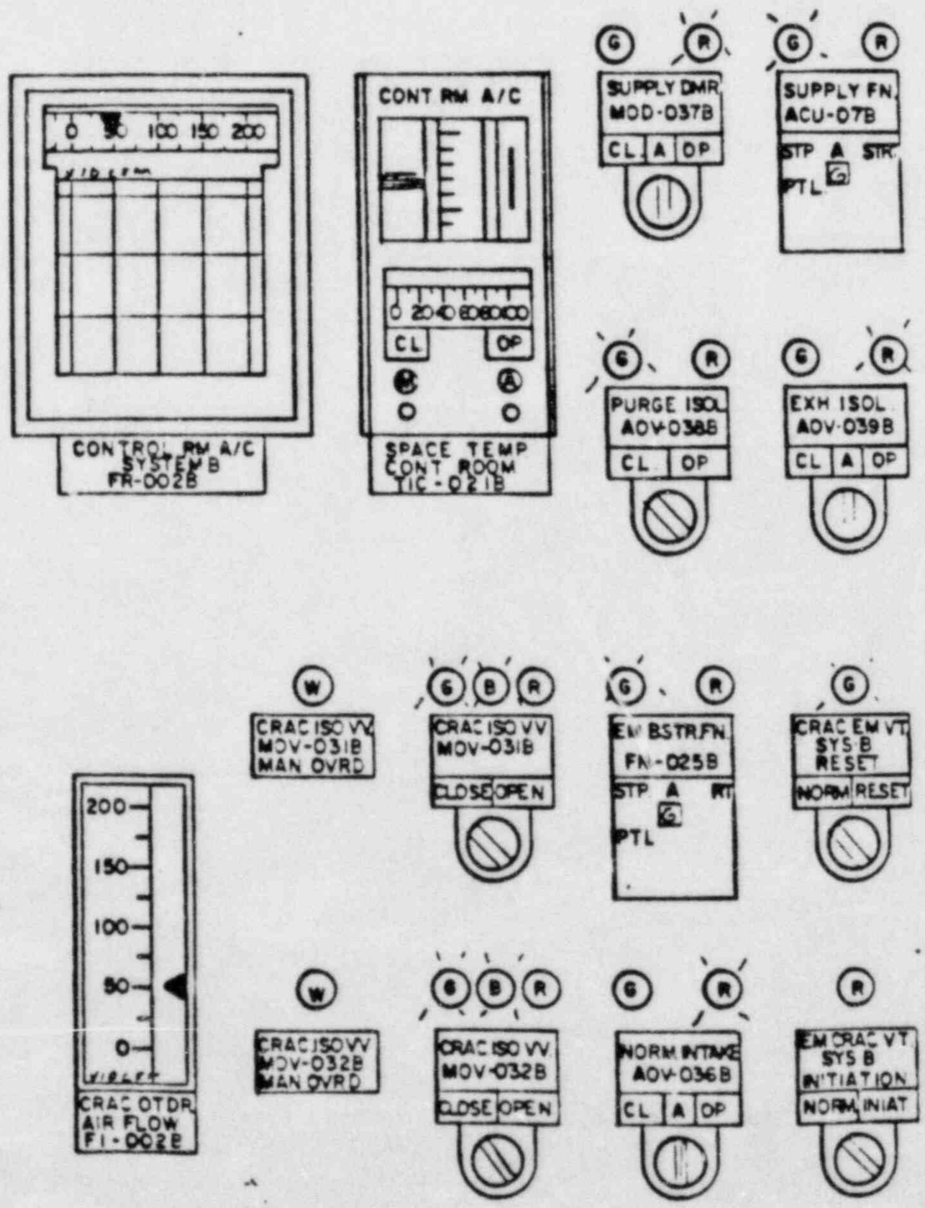
Handout #1a CRAC

Normal Ops



Handout #3a CRAC
Smoke Removal

[illegible] TB Fans Auto Trip	[illegible] TB Vent Fan Mtr Temp Hi		3123 Chem Lab Vent Trouble	[illegible] BLD Vent Trouble	3035 Crac Sys A Degraded	[illegible] Crac Sys B Degraded	3118 Screenwell BLDG Space Temp Hi/Lo	[illegible] Screenwell BLDG Vent A Inop	[illegible] Screenwell BLDG Vent B Inop
3120 TB BSTR Exh Fan Auto Trip	3130 TB BSTR Exh Fan Mtr Temp Hi		3121 Rx BLDG Vent Trouble	3122 Rx Control Rm Vent Flt Diff P Hi	3127 Emer Crac Sys A Init	3128 Control Rm Sys B Init	[illegible] Control Rm ACU-7A Flt Diff P Hi	3033 Control Rm ACU-7B Flt Diff P Hi	
[illegible] TBKF Oil Rm Exh Flow Lo			[illegible] Rx Rm Vent Flt Diff P Hi	[illegible] Rm Vent Flow Lo	[illegible] CO_2 Purge Fan Auto Trip	3037 Control Rm Fan-25A Flt Diff P Hi	[illegible] Control Rm Fan-25B Flt Diff P Hi	3124 Crac Air Sply Flow Lo	

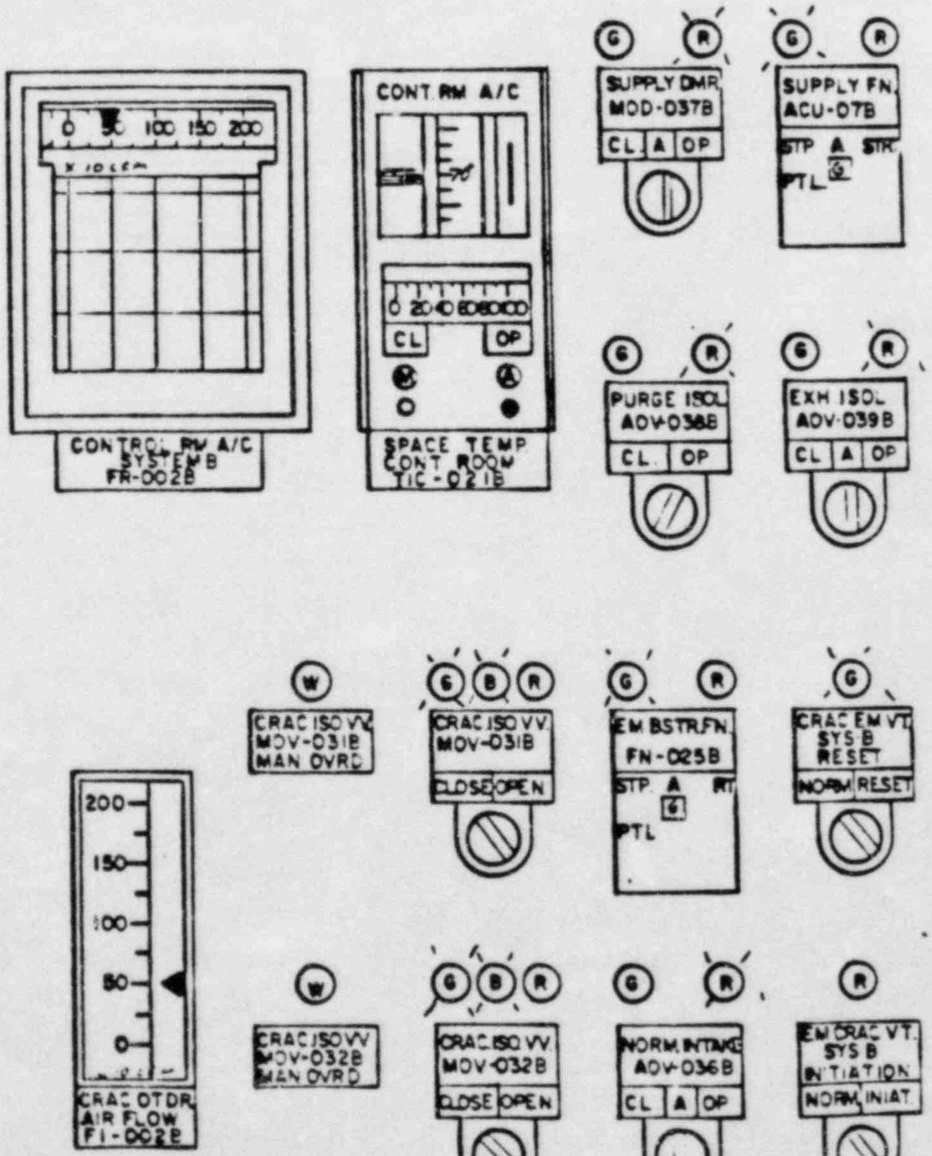


Handout #16 CRAC

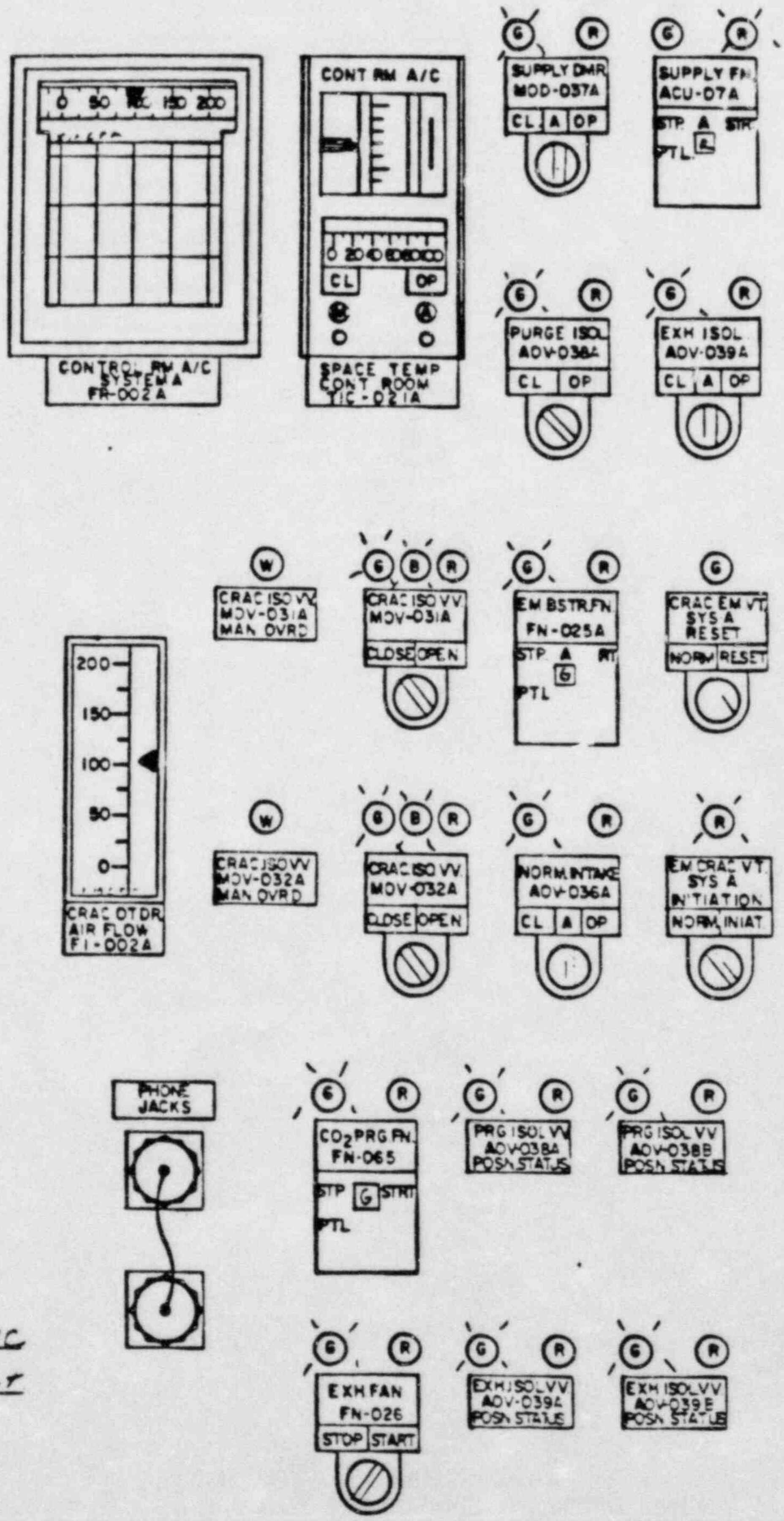
Normal Ops

10

[illegible] TB [illegible] Auto Trip	[illegible] TB Vent Fan [illegible] Temp Hi		[illegible] Chem Lab Vent Trouble	[illegible] [illegible] BLDG Vent Trouble	3033 Crac Sys A Degraded	[illegible] Crac Sys B Degraded	3118 Screenwell BLDG Space Temp Hi/Lo	[illegible] Screenwell BLDG Vent A Inop	[illegible] Screenwell BLDG Vent B Inop
3120 TB BSTR Exh Fan Auto Trip	3130 TB BSTR Exh Fan Air Temp Hi		3121 Rw BLDG Vent Trouble	3122 Rw Control Rm Vent Flt Diff P Hi	3127 Emer Crac Sys A Init	3128 Control Rm Sys B Init	3031 Control Rm ACU-7A Flt Diff P Hi	3033 Control Rm ACU-7B Flt Diff P Hi	
[illegible] [illegible] Rm Lab Flow Lo			[illegible] Rw Rm Vent Flt Diff P Hi	[illegible] [illegible] Rm Vent Flow Lo	[illegible] CO_2 Purge Fan Auto Trip	3037 Control Rm Fan-23A Flt Diff P Hi	[illegible] Control Rm Fan-23B Flt Diff P Hi	3124 Crac Air Sply Flow Lo	



Handout #36 CRAC
Smoke Removal

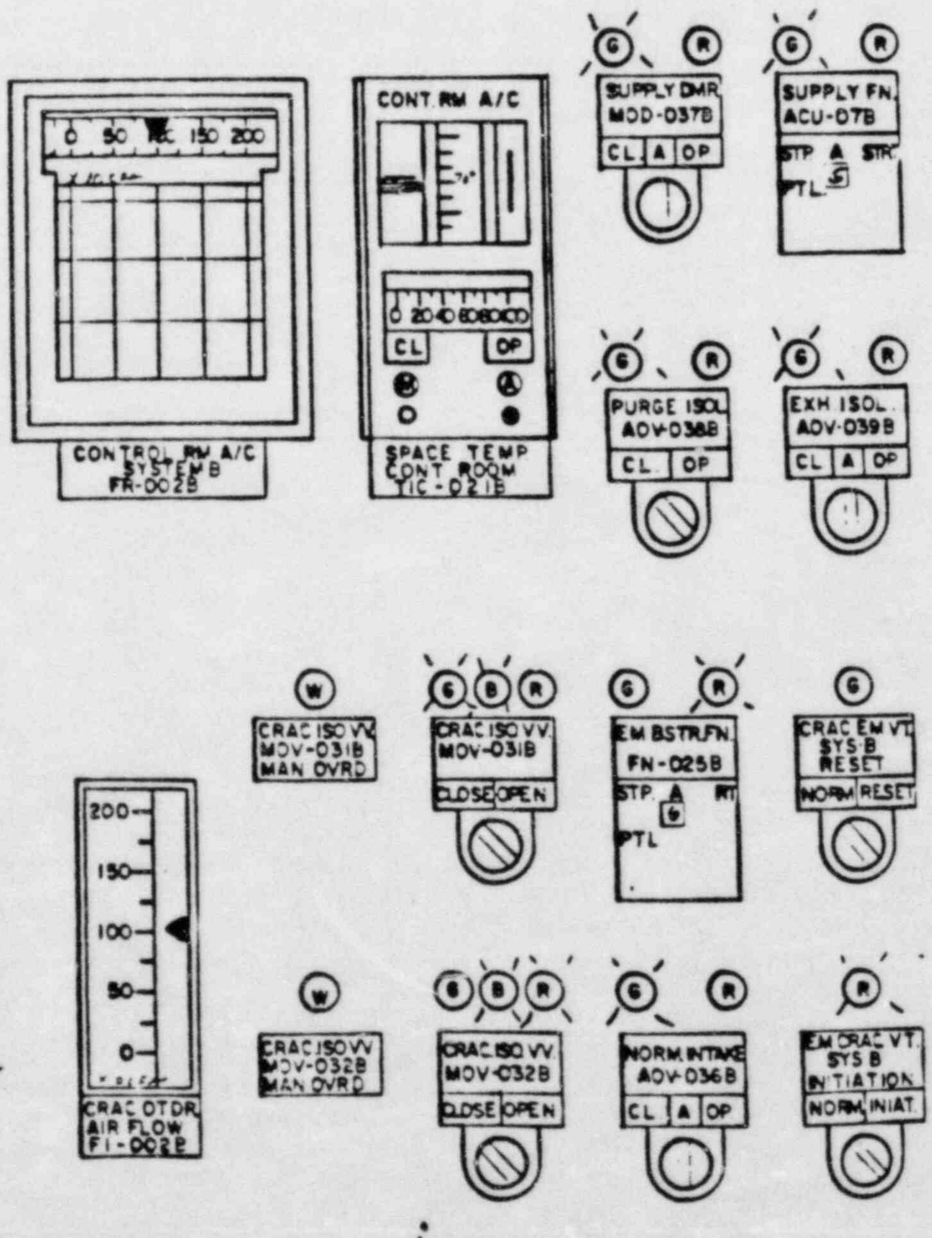


Handout #4a CRAC

Emergency Ops - Stby unit

33

[illegible] TB [illegible] Auto Trip	[illegible] TB Vent Fan [illegible] Temp Hi		3123 Chem Lab Vent Trouble	[illegible] RWS BLDG Vent Trouble	3035 Crac Sys A Degraded	[illegible] Crac Sys B Degraded	3110 Screenwell BLDG Space Temp Hi/Lo	[illegible] Screenwell BLD Vent A Loop	[illegible] Screenwell BLD Vent B Loop
3120 TB BSTR Exh Fan Auto Trip	3130 TB BSTR Exh Fan [illegible] Temp Hi		3121 Rw BLDG Vent Trouble	3122 RW Control Rm Vent Flt Diff P Hi	3127 Emer Crac Sys A Init	3128 Control Rm Sys B Init	3031 Control Rm ACU-3A Flt Diff P Hi	3033 Control Rm ACU-7B Flt Diff P Hi	
[illegible] Turb Oil Rm [illegible] Flow Lo			3126 Rw Rm Vent Flt Diff P Hi	[illegible] [illegible] Rm Vent Flow Lo	[illegible] CO_2 Purge Fan Auto Trip	3037 Control Rm Fan-25A Flt Diff P Hi	[illegible] Control Rm Fan-25B Flt Diff P Hi	3129 Crac Air Sup Flow Lo	



Handout # 46 CRAC
Emergency Ops - Stby Unit

REACTOR BLDG. NORMAL VENTILATION SYS

STUDENT HANDOUT FOR

SHIFT (SRO) ADVISOR TRAINING

LILCO SYS: 418

S&W SYS: T41

Rev. Ø Date: 5/10/84

Prepared by: Marjolin [illegible] 6/5/84
Training Specialist / Date

Approved by: Ken [illegible] 6/5/84
Training Supervisor / Date

1.0 LESSON PLAN: Reactor Building Normal Ventilation System (RBNVS)

2.0 LECTURE DURATION: 2 hrs. 0 min.

3.0 MATERIALS REQUIRED FOR STUDENTS:

3.1 RBNVS Lesson Plan

4.0 MATERIALS REQUIRED FOR INSTRUCTOR:

4.1 Available Graphics

5.0 REFERENCE MATERIAL:

5.1 RBNVS/Pri. Cont. Purge System Description, 1020.418

5.2 RBSVS System Description, 1020.405

5.3 FSAR

5.3.1 Containment Air Purification and Cleanup Systems, 6.2.3

5.3.2 RBSVS Instrumentation and Controls, 7.3.2.4

5.3.3 RBNVS, 9.4.2

5.3.4 Primary Containment Purge System, 9.4.9

5.4 Tech. Spec, Appendix I

6.0 SCOPE OF LECTURE:

To teach the student the duct arrangement, major components, instrumentation, system operation and system interrelations of the RBNVS and Primary Containment Purge System.

7.0 OBJECTIVES - Containment Ventilation Systems

7.1 State the purpose of the containment ventilation systems as given in the Student Handout.

7.2 Given diagrams of the systems trace out the flowpath for:

1. Normal operation
2. Primary Containment Purge and/or venting
3. Operation with an RBSVS Initiation Signal present

7.3 Given a diagram of the Containment ventilation Systems and system parameters available in the Control Room, identify the following system malfunctions:

1. Drywell cooling coil leak
2. Improper operation of RBNVS Pressure Control Dampers
3. Clogged RBSVS Filter Train
4. Improper operation of the RBSVS Exhaust Flow Control Dampers
5. Improper operation of a RBSVS Filter Train Preheater
6. Containment Ventilation Rad Isolation (Future)

7.4 State all Tech. Spec Requirements that must be performed within one hour for the Containment Ventilation Systems.

7.5 Given values for the following parameters, determine if RBSVS should Auto Initiate

1. Radiation in the Refueling Level Return Duct
2. Drywell Pressure
3. Reactor Water Level
4. Reactor Building Differential Pressure
5. Reactor Building Supply Air Conditioning Unit Coil Air Temperature
6. Reactor Building Inlet or Outlet Valve Positions
7. Status of Power to the Normal Station 480V busses.

8.0 LESSON OUTLINE

8.1 Theory

8.1.1 Purpose of the RBNVS is to remove Reactor Building heat gains and maintain a subatmospheric pressure in the Reactor Building to prevent the unmonitored release of Reactor Building air.

8.1.2 Purpose of Primary Containment Purge System is to vent and/or purge the primary containment atmosphere.

8.1.3 Design basis

.1 Maintain a maximum exhaust temperature of:

a. 110°F on the refueling level

b. 104°F in the remainder of the reactor building.

c. 130°F in the reactor building steam pipe tunnel.

.2 Ensure airflow is from areas of low potential contamination to areas of higher potential contamination.

.3 Maintain the reactor building at a negative pressure of 1 in. water gauge during normal operation.

(NOTE: 0.3" H_2O starts the RBSVS)

.4 Remove heat gained from piping and equipment in the secondary containment.

.5 Filter primary containment purge exhaust flow during periods of excess airborne radiation.

.6 Safety related components are 100% redundant and have complete physical and electrical separation.

8.2 Physical Description

8.2.1 General System Description

Figure 1

.1 RBNVS

Outside air is drawn in by one of two supply fans on El 112 in reactor building. The discharge damper of each fan is controlled by the reactor building differential pressure. Supply flow is throttled to maintain a subatmospheric pressure of .5 - 1.0 in W.G. A glycol pré-heater operates to maintain a minimum supply temperature. Air is filtered and passed through one of three ducts. One duct supplies the primary containment purge system. A second duct containing a cooling coil and bypass damper supplies air to the refueling level. The third duct also contains a cooling coil and supplies the lower levels of the reactor building. Each branch duct contains a hot water heating coil. Each level has similar air conditioning controls. Hot water heaters are controlled by temperature sensors in the exhaust ducts to maintain minimum temperatures. Coolers are controlled by temperature sensors in the exhaust ducts to maintain a maximum temperature. A minimum temperature of 75 F out of each cooler is limited by a temperature sensor downstream of the cooler in the supply ducts. Air is drawn from each level and the potentially contaminated areas by two of the three exhaust fans. Figure 2

The refueling level exhaust duct is designed so that the time required for airborne radiation to travel from the radmonitors to the isolation valve (1Ø seconds) is greater than the time lag from the radmonitor actuation until valve closure. The air is discharged to the suction of the station booster exhaust fans. The refueling level and potentially contaminated area exhaust ducts have air operated isolation dampers which close on RBSVS initiation.

Figure 1

Local cooling is provided by unit coolers in the steam tunnel, reactor water clean up heat exchanger room. The RBSVS unit coolers can provide additional cooling if necessary.

The RBNVS and Primary Containment Purge System are operated from the control room at panel VC2.

.2 Primary Containment Purge System

a) Fresh air or nitrogen is supplied to the drywell and/or suppression pool to inert/deinert or to supply fresh air during maintenance. Fresh air purged is normally exhausted by FN-8 to the RBNVS exhaust fan discharge. During the inertion process or during periods of high airborne activity in the drywell and/or suppression pool, FN-64 and Filter 03 are used to provide a lower flow path through a filtering medium. Flow through the filter train is controlled by a flow control damper (FCD-37) and is limited to 1200 SCFM maximum.

NOTE: Maximum flow rate with FN-64 will be limited to 1000 SCFM. This is the maximum nitrogen makeup rate to the drywell or suppression chamber.

b) New primary containment exhaust lines have been installed from both the drywell and suppression chambers. These new lines are smaller (6 inch vice 18 inches) and were added as a consideration for the isolation valve closing times. It was projected that during a DBA, the main isolation valves may not meet the required Tech Spec shutting times. The new smaller lines and valves will meet all required shutting times under DBA conditions. The addition of the new smaller exhaust lines means that none of the primary containment main isolations valves need be opened during plant operations.

8.2.2 Major Equipment Description

.1 Air conditioning unit (ACU-13) and reactor building supply fans (FN-2A,B)

a. The unit includes:

1) Two, 100% capacity fans and pressure control discharge dampers

2) Glycol preheat coil

3) Filter

4) Refueling level cooling coil and bypass damper

5) Reactor Building lower levels cooling coil

b. Fans 2A,B

1) Two, 100% capacity, vaneaxial fans

2) 89,000 CFM each

3) 2A - Normal 480 VAC MCC

2B - Normal 480 VAC MCC

c. PCD 11A,B

Air operated dampers which modulate to control the reactor building differential pressure at .5 - 1.0 in W.G.

d. Refueling level cooling coil

1) Main chilled water supplies cooling

e. Reactor building lower level cooling coil

1) Main chilled water supplies cooling

f. Glycol preheat coil

1) Glycol used to prevent coil freezing during winter months.

.2 Reactor building exhaust fans

a. Fans (FN 3A,B,C)

1) Three, 50% capacity, vaneaxial fans

2) 45,000 CFM

3) 3A - 480 VAC DIV I Emergency Bus

3B - 480 VAC DIV II Emergency Bus

3C - 480 VAC DIV III Emergency Bus

.3 Primary Containment

a. Fan (FN 8)

1) 10,000 CFM, vaneaxial fan

2) Normal 480 VAC MCC

.4 Primary Containment Purge Filter Exhaust Fan

a. Fan (FN-64)

1) 1,200 CFM, centrifugal fan

2) Normal 480 VAC MCC

.5 Primary Containment Purge Filter

a. Filter (FLT-3)

1) HEPA (99.97% Eff.) (pre-filter prevents plugging charcoal)

2) Charcoal (99.99% Eff. Iodine Removal)

3) HEPA (99.97% Eff.) (post-filter catches)

.6 Steam Pipe Tunnel Unit Cooler

a. Unit Cooler (UC-15)

1) Recirculates and cools air in tunnel

2) Consists of - Filter
- Main Chill Water Cooler
- Two 50% Capacity Fans & discharge dampers

3) Supplied by normal 480V MCC

NOTE: Loss of this cooler during operation will result in a RWCU isolation & main steam line drain valves

.7 RWCU Pump Room Unit Coolers (UC-16A/B)

1) Consists of - Filter, cooler & fan

2) Fan supplies by 480V normal MCC

3) Chiller supplied by main chilled water

NOTE: Loss of cooler may cause RWCU isolation during normal operation

.8 RWCU Heat Exchanger Room Unit Cooler (UC-18)

1) Consists of - Filter, cooler & fan

2) Fan supplied by - 480V normal MCC

3) Cooler supplied by main chilled water

NOTE: Loss of cooler may cause RWCU isolation during normal operation.

8.3 Principles of Operation

8.3.1 System Operational Modes

Figure 4

	Normal	Purge	RBSVS
AOV35A,B	Open	Open	Closed
FN 2A,B	1 Running	1 Running	OFF
AOD 40A,B	Open	Open	Closed
AOD 41A,B	Open	Open	Closed
FN 3A,B	2 Running	2 Running	1 Running
AOV 37A,B	Open	Open	Closed
AOV 38, 39A & B	Closed	*Note 1	Closed
AOV 38, 39C & D	Closed	*Note 2	Closed
FN-8	OFF	*Note 3	OFF
FN-64	OFF	*Note 4	OFF
UC15(FN30A, B)	2 Running	2 Running	OFF
UC16A,B & 18	Running	Running	OFF
RBSVS Unit Coolers	*Note 5	*Note 5	ON

During normal operation the reactor building is maintained at a subatmospheric pressure by modulation of the supply fan discharge dampers (PCD 11A,B). The refueling level is maintained at a lower pressure with respect to the rest of the building by adjustment of balancing dampers. Air to each floor level is individually controlled by duct heaters and coolers. Local cooling is provided by unit coolers. The RBSVS unit coolers are used during RBNVS operation to control local temperatures. The RBSVS cooling coils CLC-5A/B apply maximum cooling when RBSVS initiates.

The primary containment is purged only during RBNVS operation when access to the primary containment is required or a high airborne condition exists.

*Note 1 - Open when purging drywell

*Note 2 - Open when purging suppression pool

*Note 3 - Running during purge with low airborne activity

*Note 4 - Running during purge with high airborne activity

*Note 5 - Could be running to control temperature in local areas of the R.B.

NOTE: When purging the drywell or suppression chamber during power operations, refer to Tech Specs for containment oxygen limits.

RBSVS Initiation Signals

1. High radiation in refueling level exhaust duct 35 mr/hr.
2. High drywell pressure (1.69 psig)
3. Low reactor vessel water level (-38")

4. Low reactor building differential pressure (.0.3 in. W.G.)

5. Loss of power to normal 480V busses (sensed of 4160 VAC busses)

6. Vent supply <u>and</u> exhaust valves <u>not</u> full open.

7. Manual initiation on VC2

During RBSVS operation the RBNVS is changed from flow through ventilation to the recirculation mode and the primary containment purge is stopped. In the recirculate mode air is drawn only from the R.B. lower levels by an exhaust fan. The air is then supplied to the RBSVS system where is passes through isolation dampers, mixing plenum and two coolers before being returned to the refueling level. Air passes to the lower levels through floor openings.

8.3.2 Technical Specifications

3.6.5.2 The reactor building ventilation system automatic isolation valves shown in Table 3.6.5.2-1 shall be OPERABLE with isolation times less than or equal to the times shown in Table 3.6.5.2-1.

3.6.1.8 The drywell and suppression chamber purge supply and exhaust isolation valves shall be OPERABLE and:

a. Each 18-inch purge valve shall be sealed closed.

b. Each 4-inch purge and 6-inch vent purge valve may be open for purge system operation for inerting, de-inerting, pressure control, and to perform the test required by Specification 3.6.4, ACTION c.2.

8.3.3 Hazards and Precautions -Refer to Containment & Ventilation Supplement.

8.3.4 Instrumentation and Controls

.1 Main Control Room (VC2)

a. Indications

Steam Pipe Tunnel Temp.

UC-15 Supply Temp.

UC-15 Return Temp.

R.B. Exhaust Flow

R.B. Diff. Press. Ind.

R.B. Diff. Press. Rec.

b. Fan Controls

FN 2A,B	UC-15	FN30A,B
FN 3A,B,C	UC-16A,B	
FN 8, 64		

c. Valve & Damper Controls

R.B. supply isolation valves AOV35A, B

R.B. exhaust isolation valves AOV37A,B

Refueling level return dampers AOD 40A,B

Contaminated area return dampers AOD 41A,B

Prim. Cont. Purge supply valves AOV 38A, B,C,D

Prim. Cont. Purge exhaust valves AOV 39A,B,C,D

8.3.5 Interlocks

.1 RBSVS initiation secures operation of the RBNVS. When RBSVS is manually reset on VC2 the RBNVS will automatically resume operation.

.2 Each fan is interlocked with its discharge damper. When the fan is energized the damper opens. Failure of the damper to open shuts the fan off. Fan 64 is also interlocked in the same manner with filter inlet damper FCD-37.

.3 Fans 8 and 64 are interlocked so that only one fan is running at a time. These fans will not start if there is no suction path from the primary containment.

8.3.6 System Interrelations

.1 Startup

a. The RBNVS requires support from the following systems for normal operation:

1) Normal station power

2) Emergency busses energized

3) Glycol heating system

4) Hot water heating system

5) Instrument air

6) Main chilled water system

7) <u>The RBSVS must be started to get 0.3" W.G. to allow the RBNVS to start.</u>

The RBNVS will operate only when there is no RBSVS initiation signal present.

.2 Shutdown

a. If the RBNVS fails, the RBSVS will receive an initiating signal and start operating.

b. Both RBNVS and RBSVS should never be inoperable at the same time when there is fuel in the reactor building.

8.4 Summary

8.4.1 Purpose of system

.1 Provide ventilation for the reactor building

.2 Remove reactor building heat gains

.3 Maintain a subatmospheric pressure in the secondary containment (.5 - 1.0 in. W.G.)

.4 Purge the primary containment during periods of access and maintenance.

8.4.2 RBNVS operation is stopped by RBSVS initiation. RBNVS is non-safety related though components shared with RBSVS are nuclear safety designed.

FORM ON FILE

REACT. BLDG. NORMAL VENTILATION &

PRIMARY CONT. PURGE SYSTEM

FIGURE 1

FORM ON FILE

POTENTIALLY CONTAMINATED AREA EXHAUST

FIGURE 2

FORM ON FILE

REACTOR BUILDING MISCELLANEOUS COOLING -SYSTEM 1T41

FIGURE 3

FORM ON FILE

REACT. BLDG. NORMAL VENTILATION &

PRIMARY CONT. PURGE SYSTEM

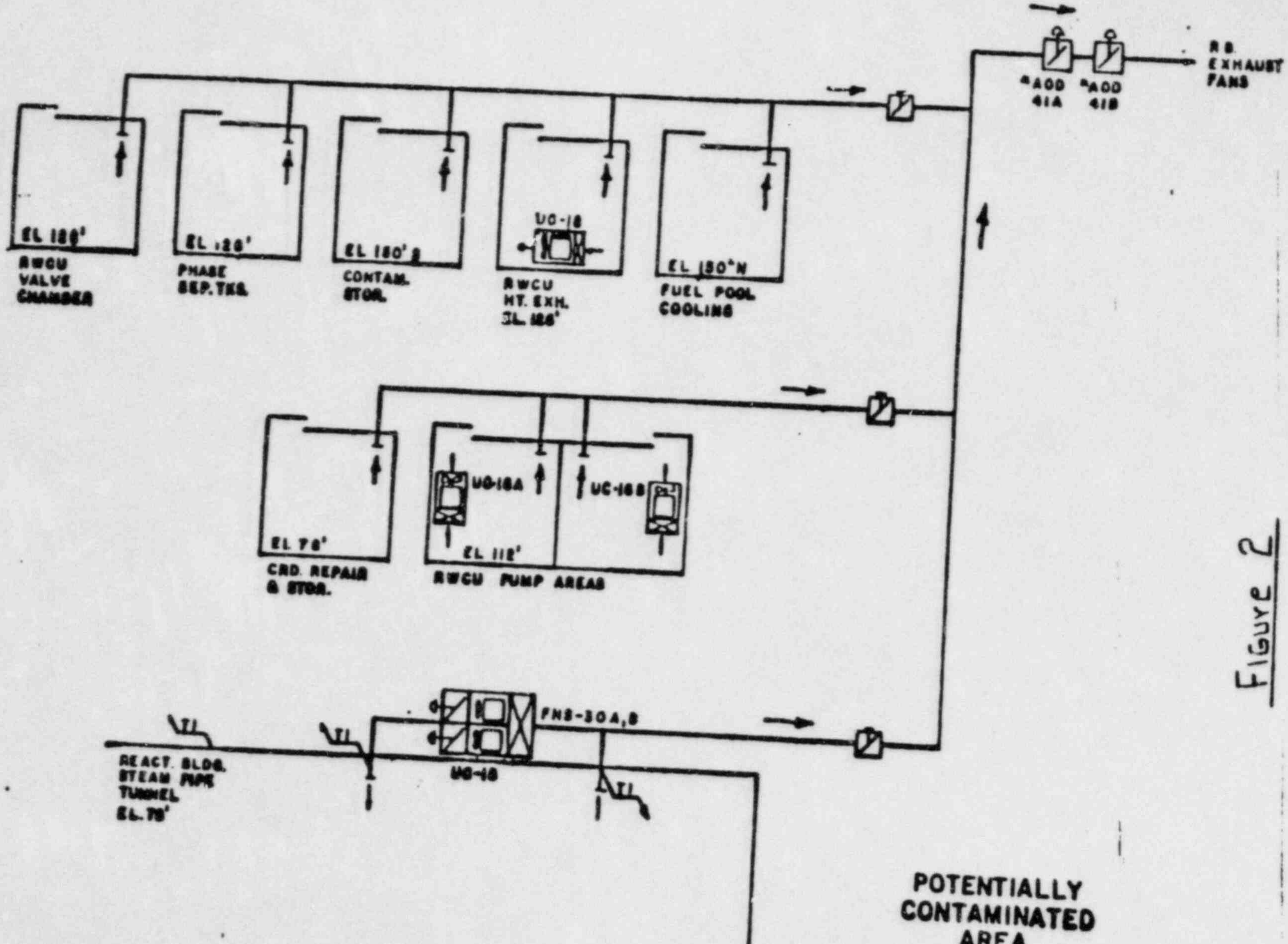


Figure 2

POTENTIALLY CONTAMINATED AREA EXHAUST

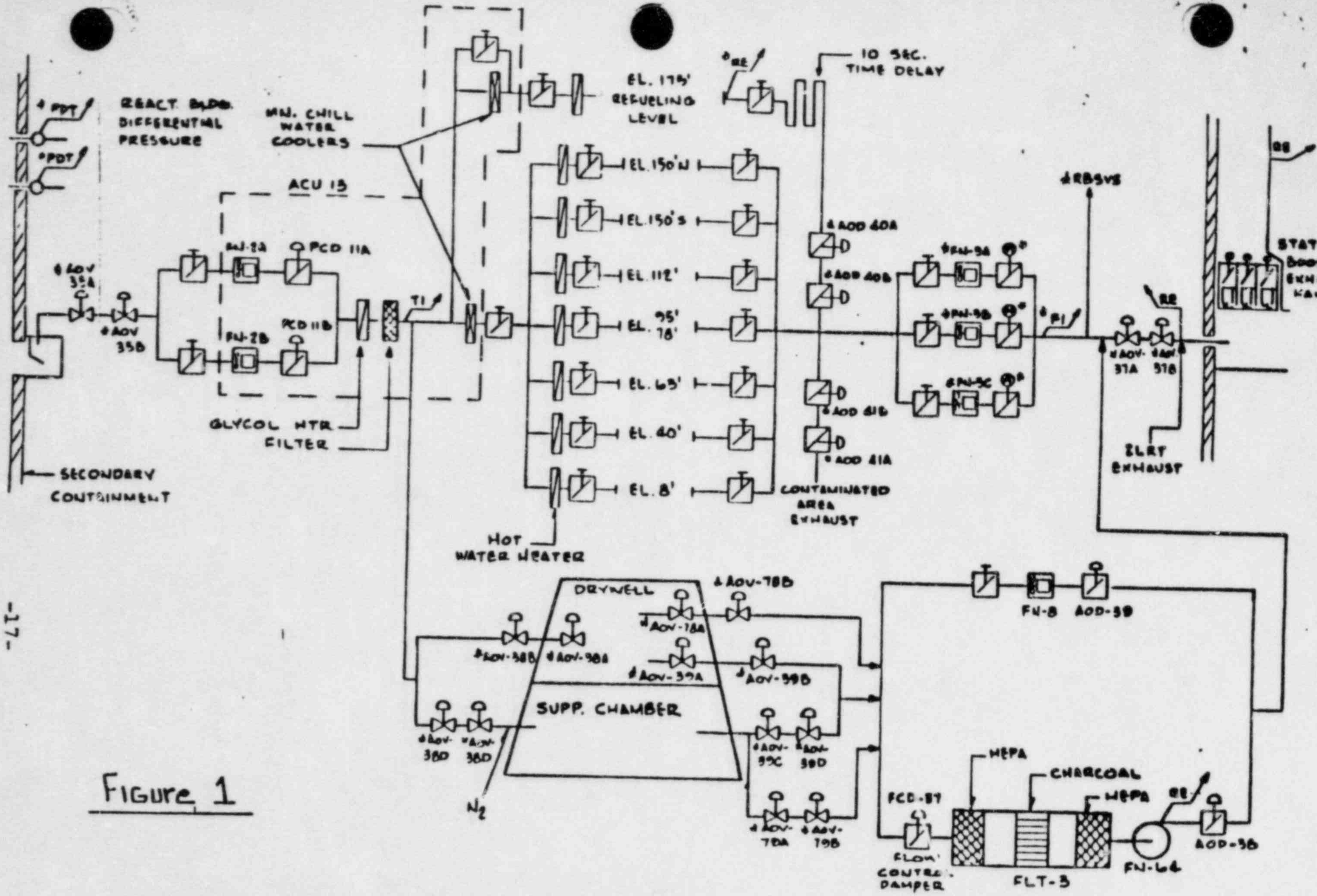


Figure 1

* SAFETY RELATED COMPONENTS

REACT. BLDG. NOR AL VENTILATION &

RBSVS & CRAC CHILLED WATER SYSTEM

STUDENT HANDOUT FOR SHIFT (SRO)

ADVISOR TRAINING PROGRAM

Prepared by: 5/4/84
TRAINING INSTRUCTOR/DATE

Rev. 0 Date: 5/11/84

Approved by: 5/7/84
OPERATIONS TRAINING SPECIALIST/DATE

1.0 LESSON PLAN: RBSVS & CRAC Chilled Water System

2.0 LECTURE DURATION: 2 hrs./ 0 min.

3.0 MATERIALS REQUIRED FOR STUDENTS: SUPPLIED BY:

3.1 RBSVS & CRAC chilled water System Description 102Ø.421 — 1. Training Supervisor

4.0 MATERIALS REQUIRED FOR INSTRUCTOR: SUPPLIED BY:

4.1 Overhead Projector — 1. Training Supervisor

4.2 White Board & Pens — 2. Training Supervisor

4.3 Transparencies — 3. Training Supervisor

5.0 REFERENCE MATERIAL:

5.1 System Description 102Ø.421 (RBSVS & CRAC chilled water system) including any references therein

6.0 SCOPE OF THE LECTURE:

To teach the student the piping arrangement, major components, instrumentation, system operation, and system interrelations of the RBSVS & CRAC chilled water system.

7.0 OBJECTIVES:

7.1 State the purpose of the Reactor Building Standby Ventilation (RBSVS) and Control Room Air Conditioning (CRAC) Chilled Water System as given in the student handout.

7.2 Given a diagram of the system trace out the flowpath for:

a) Normal Operation

b) Operation with an RBSVS initiation

c) Condensing water controlled flow

7.3 Given a diagram of the RBSVS/CRAC Chilled Water System and system parameters available in the control room, identify the following system malfunctions:

a) Major System Leakage

b) Minor Air Leakage from one surge tank

c) Minor Air Leakage into one surge tank

d) Chiller trip or failure to start due to low chilled water return temperature.

e) Chilled water pump trip

f) Component failure that makes the system inoperable

g) Malfunctioning water chiller

h) Systems cross-connected

i) Chiller overload due to high heat load

j) Improper System interrelations operations (i.e "B" chiller loop and "A" CRAC I/S)

7.4 Without the use of procedures

a) Verify automatic initiation and/or isolation of the system

b) State how to manually initiate the system as per SP 23.421.01.

c) State the requirements as contained in SP 23.421.01 for shutting down the system after it has started due to a valid initiation signal.

7.5 Given the status of RBSVS/CRAC chilled water and tech specs, state any action required.

8.0 <u>LESSON OUTLINE</u>

8.1 <u>Theory</u>

8.1.1 Purpose of the System

.1 Provide chilled water to the control room air conditioning units.

.2 Provide chilled water to the relay, emergency switchgear, and computer rooms air conditioning unit.

.3 Provide chilled water to the reactor building cooling coils when the RBSVS is in operation.

.4 Provide a means of rejecting heat from the above locations to the L.I. Sound.

8.2 Physical Description

8.2.1 General Description

Fig. 8.2.1a&b

.1 Two identical subsystems

.2 Each loop contains:

a) 2 water chillers

b) 2 condensing water pumps

c) 2 chilled water pumps

d) 1 surge tank

e) 1 control room air conditioning unit

f) 1 relay, emergency switchgear and computer room air conditioning unit

g) 2 RHR & CS pump area unit coolers

h) RBSVS cooling coil

i) 2 refueling level unit coolers

8.2.2 Major Equipment Description

.1 Water chiller units (WC-ØØ3 A/B, ØØ4 A/B) (El. 63 of control Bldg)

a) capacity: 275 tons

b) refrigerant: R-11 (Freon)

c) Compressor motor power supplies — Fig. 8.2.2.1C5

1) WC-ØØ3A - bus 101 - Red

2) WC-ØØ3B - bus 102 - Blue

3) WC-ØØ4 A/B - bus 103 - Orange

d) Lube oil pump power supplies

1) P-231A - DIV I

2) P-231B - DIV II

3) P-233A/B - DIV III

e) Purge pump power supplies

1) P-232A - DIV I

2) P-232B - DIV II

3) P-234A/b - DIV III

.2 Chilled water circulating pumps (El. 63 control Bldg) Fig. 8.2.2.2

a) P-137A - DIV I

b) P-137B - DIV II

c) P-138A/B - DIV III

.3 Condensing water pumps (El. 63 control bldg) Fig. 8.2.2.3

a) P-139A - DIV I

b) P-139B - DIV II

c) P-140A/B - DIV III

.4 Surge Tanks (2) (El. 63 Control Bldg) Fig. 8.2.2.4

8.3 Principles Of Operation

8.3.1 Refrigeration Cycle Fig. 8.3.1

.1 2 stage compressor draws freon gas from evaporator, compresses it, and sends it to condenser

.2 Freon gives up heat to condensing water (service water), condenses, and collects in bottom of condenser

.3 Condensed freon flows through flow control device into evaporator

.4 Freon is atomized and absorbs heat from chilled water passing through evaporator tubes

.5 purge unit

a) Withdraws non-condensibles and freon gas from condenser

b) gases are cooled by chilled water and freon settles to bottom of purge drum where it is reclaimed. Water is removed by a manual blow off valve. Non condensibles build up press., and blow out through relief valve.

.6 Lube oil

a) electric heater maintains lube oil at 130°F to boil off entrained refrigerant

8.3.2 Condensing Water Loop

.1 Water supplied from service water system through pressure control valve PCV-Ø93

.2 Used to remove heat from condenser

.3 A (B) service water train supplies A (B) chilled water system

.4 TCV's Recirc Water as needed to maintain 77 F inlet to condenser

8.3.3 Chilled Water Loop   Fig. 8.3.3

.1 Flow path

a) chilled water pump

b) water chiller (evap)

c) chilled water supply header

d) coolers and A/C units

e) chilled water return header

1) surge tank pressurized to 110 psi

f) PCV maintains P between supply and return headers

.2 subsystems A & B cross connected by MOV-Ø34 A/B & MOV-Ø33 A/B (normally closed)

.3 cross tie valve bypasses (AOV-Ø69 A/B + Ø68A/B) normally open to keep subsystem cool in stand-by

.4 surge tank on chilled water pump return line is pressurized to 110 psig with service air

a) due to difference in surge tank elevation (control building El. 63') and refuel level unit coolers (El. 175')

b) ensures a completely filled system

c) when initially filling system or refilling after maintenance, pressure and level is maintained manually

d) after all components are vented and highest point of system is at 5 psi, level and pressure are controlled automatically

8.3.4 System Operational Modes

.1 Normal Operation <u>Fig. 8.3.4.1</u>

a) one water chiller and its associated chilled water pump and condensing water pump operating

b) other 3 chillers lined up for auto initiation and condenser tubes flushed with demin water

c) Crosstie valves (MOV-Ø33A (B) and MOV-Ø34A (B)) closed and crosstie bypass valves (AOV-Ø68A (B) and AOV-Ø69A (B)) open. Thus, only one loop is operating.

d) RHR & CS pump area unit coolers, RBSVS cooling coil and refueling level unit coolers outlet valves closed.

1) Restricting Orifice maintains sufficient flow to maintain piping at operating temp.

2) Provided with thermostats so that outlet TCV's may be used if heat gain becomes excessive.

e) chilled water supply temp. is maintained at 45°F by varying the compressor inlet vanes. (Vanes open more if temp is 45°F and close more if temp is 45°F)

.2 Abnormal Operation

a) Loss of normal power, not accompanied by an accident signal, will trip the operating chiller.

b) Must be manually restarted

.3 Emergency Operation

a) Upon receipt of accident signal

1) all 4 chilled water pumps start

2) all 4 chillers receive a start permissive and will start if chilled water temperature exceeds 48°F

3) the crosstie bypass valves (AOV-Ø68A/B and AOV-Ø69A/B) close

4) the RBSVS cooling coil TCV's fully open

8.3.6 Hazards and Precautions - (See Supplement)

8.3.7 Instrumentation and Control (SD 1020.421 sec. 7)

.1 Control room instrumentation on 1H11*PNL-VC-2

a) System A(B) chilled water supply temperature

b) WC - ØØ3A(B), -ØØ4A(B) Ammeter

.2 Local Instrumentation

a) See Table 1

.3 Controls

a) Main Control Room Panel 1H11*PNL-VC-2 Fig. 8.3.7.3a

1) water chiller units - start, auto, stop, pull-to-lock

2) chilled water pumps - off, auto, on

3) condensing water pumps - off, auto, on

4) crosstie valves - MOV-Ø33A/B & Ø34A/B

5) crosstie bypass valves - AOV-Ø68A/B & Ø69A/B

6) chiller isolation valves - MOV-Ø31A/B & Ø32A/B

b) Local Panels 1M50*PNL-03A, 03B, 045 & 04B

1) Lights

power on (white)

Lo Oil Press. (red)

BRG Point 1 hi oil temp (red)

Hi cond press (red)

Low evap temp (red)

BRG Point 2 hi oil temp (red)

Hi motor temp (red)

Compressor run required (red)

Oil pump run required (red)

Purge system run required (red)

Compressor stop required (green)

2) Switches

Fault reset - used to reset trips from:

low oil press.

low evap temp.

hi bearing #1 or 2 oil temp.

hi condenser press.

Oil pump - auto-run

Purge system - run-off-auto

8.3.8 Interlocks

.1 Water chillers — Fig. 8.3.8.1

a) The chillers will start after a time delay when the control switch is placed in start or a start signal from emergency bus program is received and if no trip signals are present and the 30 minute recycle inhibit timer has timed out.

1) The time delay allows the oil pump to establish bearing oil pressure

2) The recycle inhibit timer starts timing when the chiller is started

b) With the control switch in AUTO and an RBSVS initiation signal present, the chillers will start, after a time delay, when chilled water temperature increases to greater than 48°F if no trip signals are present. A~ RBSVS initiation signal bypasses the 30 minut~ recycle inhibit timer.

c) The chillers will trip on any of the following signals:

1) Motor overcurrent

2) Oil pump not running

3) Chilled water pump stopped

4) Low chilled water return temperature

5) Stop signal from emergency bus program

6) Low condensing water flow

7) Low chilled water flow

8) Low evaporator temperature

9) High bearing oil temperature

10) High condenser pressure

11) High motor temperature

12) Low Oil pressure

2. Water chiller oil pumps

a) Start when:

1) no motor overload exists

2) control switch in RUN
or
control switch in auto and a chiller start signal present

b) Stop when:

1) control switch in auto and the chiller tripped and a time delay timed out
or
2) motor overload

3. Water chiller purge pumps

a) Start when:

1) no motor overload present

2) purge operating pressure below setpoint

3) control switch in run
or
control switch in auto & associated water chiller running

b) stops when:

1) control switch in off
or
2) purge operating pressure above setpoint
or
3) motor overload

.4 Water chiller oil sump heater

a) on when oil sump temp. 130°F

b) off when oil sump temp. 130°F

.5 Chilled water pumps

a) start

1) no motor overload
and
2) control switch in on
or
3) chiller start required
or
4) RBSVS initiation

.6 Chilled water pumps

b) stop

1) control switch in OFF
or
2) Control switch in AUTO and chiller start permissive not present & RBSVS initiation signal reset
or
3) motor overload

.7 Condensing Water Pump & Discharge Valves

a) start

1) no motor overload
and
2) service water pressure NOT low
and
3) control switch in ON or Control Switch in AUTO and chiller start permissive present

b) stop

1) control switch in OFF

2) Control switch in AUTO and no chiller start permissive

3) Service water pressure low

4) Motor overload

.8 MOV-Ø33A/B - chilled water crosstie isolation

MOV-Ø34A/B - chilled water crosstie isolation

MOV-Ø31A/B - crosstie valve

MOV-Ø32A/B - crosstie valve

a) Open

1) control switch in open

b) Close

1) control switch in close

.9 AOV-Ø68A/B - crosstie bypass valve Fig. 8.3.8.8

AOV-Ø69A/B - crosstie bypass valve

a) Open - all of the following:

1) control switch in open

2) No RBSVS initiation signal

3) surge tank pressure not low

4) surge tank level Low Low

b) Close - any one of the following:

1) control switch in close

2) RBSVS initiation signal present

3) surge tank pressure low

4) surge tank level Low Low

.10 LCV-Ø25A/B makeup valves

a) open

1) surge tank level low

b) close

1) surge tank level high

.11 AOV-Ø39A/B - Condenser Flush Valves

AOV-Ø4ØA/B - Condenser Flush Valves

a) open

1) control switch in open

b) close - any one of the following:

1) control switch in close

2) demineralized water to cond. high flow

8.3.4 System Interrelations

.1 Emergency Buses

.2 Service water

.3 Instrument Air

.4 Service Air

.5 Demin water system

.6 Control room air conditioner

.7 Relay, emerg. switchgear & computer room air conditioner

.8 RBSVS

8.4 Summary

8.4.1 Purpose

.1 Provide chilled water to control room air conditioning unit.

.2 Provide chilled water to the relay, emergency switchgear, and computer room air conditioning units.

.3 Provide chilled water to the reactor building cooling coils when the RBSVS is in operation.

.4 Provide a means a rejecting heat from the above areas to the L.I. Sound.

8.4.2 Basic Flow Path — Fig. 8.4.2.1

.1 Refrigeration cycle

a) compressor

b) condenser

c) evaporator (water chiller)

.2 Condensing water loop — Fig. 8.4.2.2

a) service water supply header

b) condenser

c) service water discharge header and/or condensing water pump to be recycled

.3 Chilled water loop — Fig. 8.4.2.3

a) chilled water pump

b) water chiller (evaporator)

c) chilled water supply header

d) coolers and A/C units

e) chilled water return header

8.4.3 Actuation signals — Fig. 8.4.3

.1 Low reactor building differential press

.2 Failure of reactor building normal ventilation

.3 Low reactor water level

.4 Hi drywell pressure

.5 Refuel Floor hi rad

.6 Loss of power to normal 480 V buses

8.4.4 Tech. Specs.

.1 See Supplement

9.0 TRANSPARENCIES CONTAINED IN THIS LESSON INCLUDE:

Fig. No.	Description
8.2.1A&B	RBSVS & CRAC chilled water system flow diagram
8.2.2.1C54	Power Feed Development
8.2.2.2	Chilled water pump operating curve
8.2.2.3	Condensing water pump operating curve
8.2.2.4	Surge Tank diagram
8.2.5	Power feed diagram
8.3.1	Simplified Refrigeration cycle
8.3.2	Condensing water loop A
8.3.3	Chilled water loop A
8.3.4.1	Normal Operation
8.3.4.3	Emergency Operation
8.3.4.3.C	Accident Signals
8.3.6.3	Train components
8.3.7.3	Control room controls PNL-VC-2 (LTR)
8.3.8.1	Water chiller start logic
8.3.8.5	Chilled water pump logic
8.3.8.6	Condensing water pump & discharge valve logic
8.3.8.7	Crosstie & Isolation valve logic
8.3.8.8	Crosstie bypass valve logic
8.4.2.1	Simplified Refrigeration Cycle
8.4.2.2	Condensing Water flow diagram
8.4.2.3	Chilled water flow diagram
8.4.3	Accident Signals

10.0 Tables contained in this lesson include:

Table 1	Local Instrumentation

DATA SHEET

1. Two identical subsystems

2. Nuclear safety related system

3. 1 subsystem normally operating with crosstie MOVs closed and crosstie bypass AOVs open

4. Condenser on idle water chillers must be flushed with demin water to prevent excessive corrosion

5. Systems divide in 2 separate Loops consisting of:

   2 chillers
   2 chilled wtr. pps
   2 condensing wtr. pps (service water)

6. Each Loop provide duplicate (100% redundant) cooling coils

7. In the event of 1Ø3 diesel failure WC-3A and 3B can be connected to make 1 complete system of 2 chillers

LOCAL INSTRUMENTATION

PARAMETER	Norm.	Max.	Min.
Water chiller outlet flow (FI083A&B) (FI08) A&B)	610 gpm	LTR	LTR
Surge Tank gauge glass (LG 027) A&B)	11-12"	37"	9"
Surge Tank pressure (PI 028) A&B)	110 psi	165 psi	92 psi
Chilled water pump suct. press. (PI-041 A&B) (PI-051 A&B)	110 psi	165 psi	92 psi
Chilled water pump disch. press (PI-042A&B) (PI-052A&B)	LTR	LTR	LTR
Water chiller evap. press. (PI-046 A&B) (PI-056 A&B)	LTR	LTR	LTR
Water chiller cond. press. (PI-048 A&B) (PI-058 A&B)	LTR	LTR	LTR
Subsystem chilled water supply temperature (TI-020 A&B)	40°F	LTR	LTR
Subsystem chilled water return temperature (TI-021 A&B)	LTR	LTR	LTR
Water chiller evap. inlet temp. (TI-037 A&B) (TI-038 A&B)	LTR	LTR	LTR
Water chiller evap. outlet temp. (TI-045 A&B) (TI-055 A&B)	40°F	LTR	LTR
Condensing water outlet flow (1P41-FI047 A&B) (1P41-FI057 A&B)	470 gpm	LTR	LTR
Condensing water pump suct. press (1P41-PI-051 A&B) (1P41-PI-056 A&B)	15 psia	25 psig	15 psia
Condensing water pump disch. press (1P41-PI-052 A&B) (1P41-PI-057 A&B)	42 psia	LTR	LTR
Condensing water inlet temp. (1P41-TI-053 A&B) (1P41-TI-058 A&B)	77°	LTR	LTR
Condensing water outlet temp. (1P41-TI-090 A&B) (1P41-TI-091 A&B)	LTR	LTR	LTR

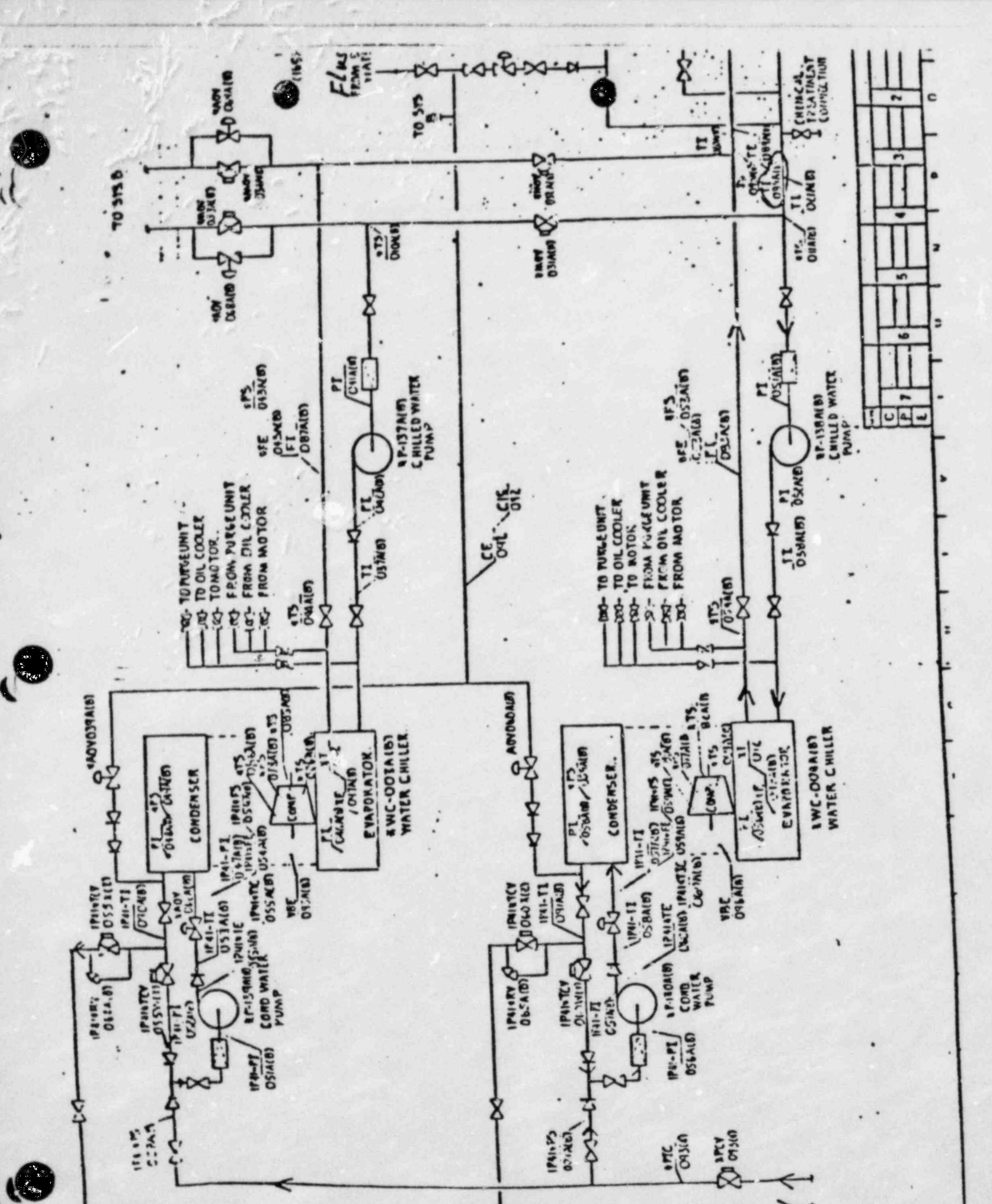
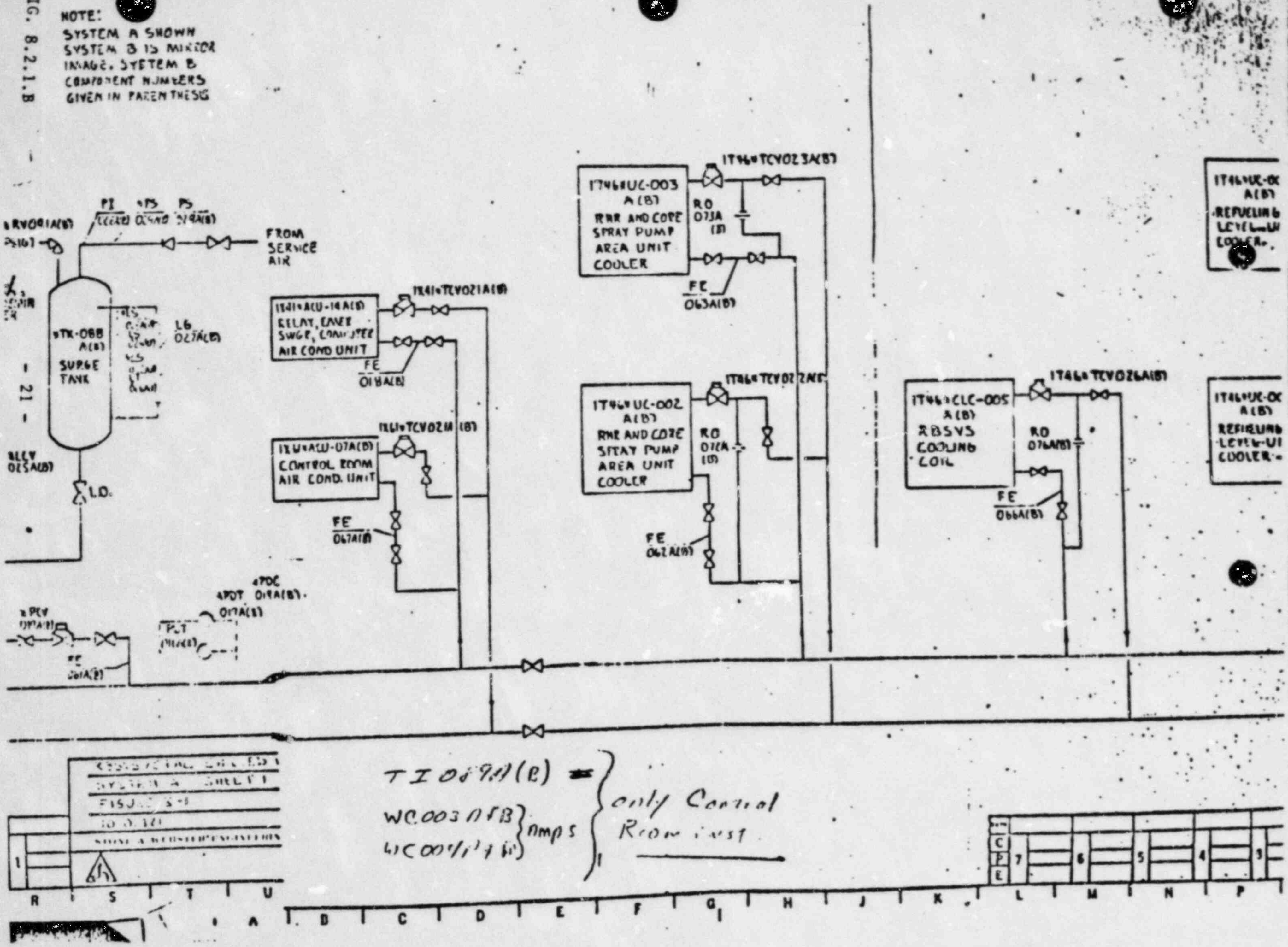
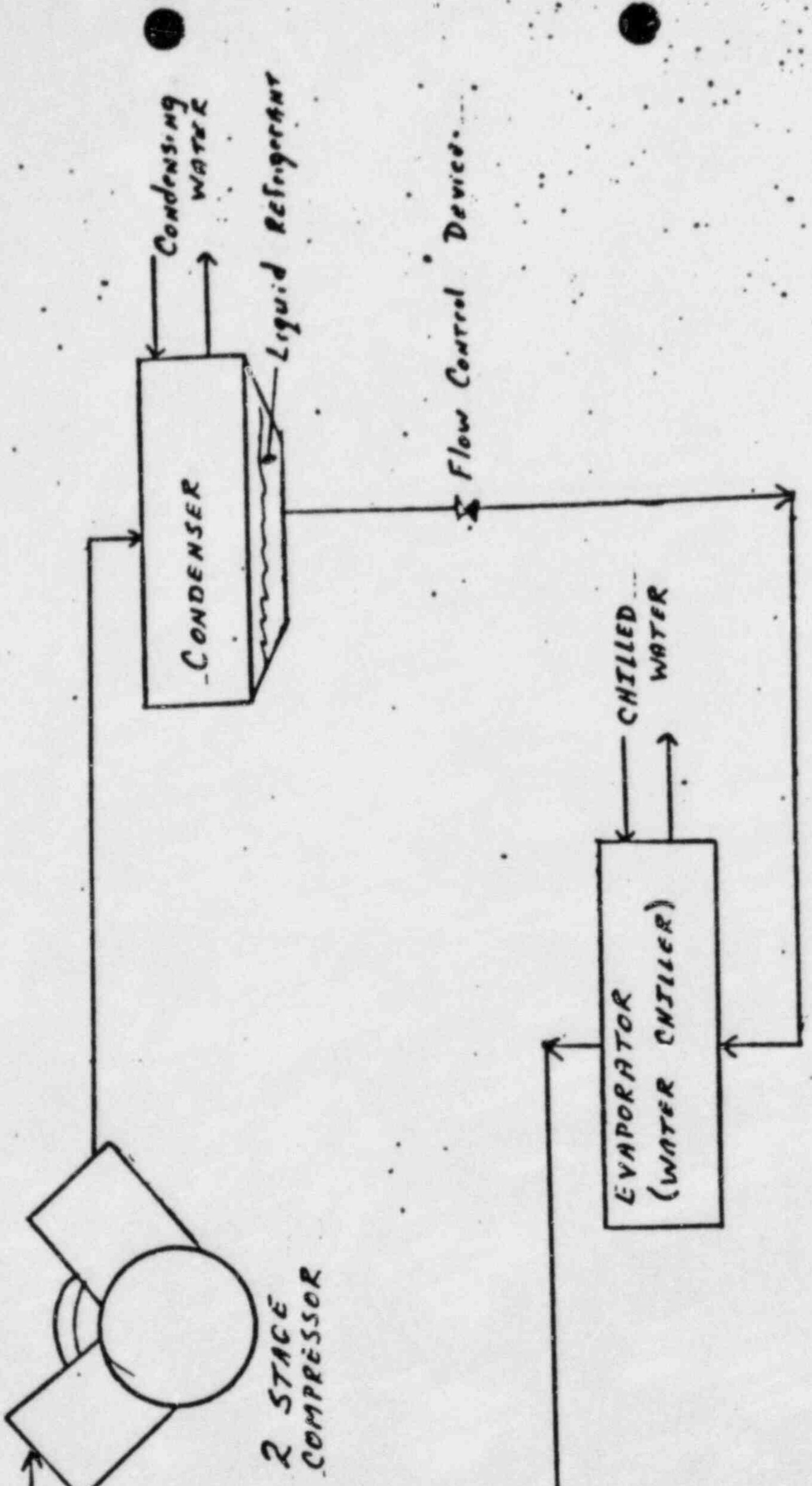

CONDENSER
EVAPORATOR
WATER CHILLER
CHILLED WATER PUMP
COND WATER PUMP
TO PURGE UNIT
TO OIL COOLER
TO MOTOR
FROM PURGE UNIT
FROM OIL COOLER
FROM MOTOR
COMP.
TO SYS B
CHEMICAL TREATMENT CONNECTION

FIG. 8.2.1.A

FIG. 8.2.1.B


NOTE:
SYSTEM A SHOWN
SYSTEM B IS MIRROR
IMAGE. SYSTEM B
COMPONENT NUMBERS
GIVEN IN PARENTHESIS
FROM
SERVICE
AIR
SURGE
TANK
L.O.
RELAY, CABLE
SWGR, COMPUTER
AIR COND UNIT
CONTROL ROOM
AIR COND. UNIT
RHR AND CORE
SPRAY PUMP
AREA UNIT
COOLER
RBSVS
COOLING
COIL
REFUELING
LEVEL UNIT
COOLER
FE
RO
WC 003 A & B
only Control
Room exist
amps

- 21 -



Simplified Refrigeration Cycle. (overlay)
Fig. 8.3.1

FIG. 8.3.1

RBSVS AND CRAC CHILLED WATER SYSTEM

STUDENT HANDOUT SUPPLEMENT

Date: 5/2/84

Prepared by: [signature] 5/4/84
Training Instructor / Date

Handout #: OST-1-421

Revision #: Ø

Approved by: [signature] 5/6/84
Operations Training Specialist / Date

I FLOW PATHS FIG. 1 & 10

A. NORMAL OPERATION - During normal plant operation one chiller is in operation with the chilled water cross connect bypass valves open. The condensing water pump takes a suction on the service water header and discharges through the chiller condenser. The condensing water is either discharged to the service water return header or recirced back to the condensing water pump suction as needed to control the condenser inlet temperature. The chilled water pump discharges through the chiller evaporator where the chilled water is cooled. The chilled water is then distributed to the individual loads. Each load has a temperature control valve that throttles the chilled water flow to maintain the desired area temperature. The cross connect bypass valves allow sufficient flow through the non-operating chilled water system to maintain it at operating temperature. The chilled water is returned to the chilled water pump suction. A pressure control valve connected between the supply and return headers maintains the system differential pressure to ensure proper operation of the temperature control valves and provide minimum flow protection for the chilled water pumps.

FIG. 2 & 10

B. OPERATION with an RBSVS Initiation - When RBSVS initiates the cross connect bypass valves close, the RBSVS cooling coil temperature control valves open fully and all chilled water pumps start. The chillers and condensing water pumps will start when chilled water return temperature exceeds 48°F if all the chiller interlocks are met. The anti recycle timer is bypassed.

II MALFUNCTIONS FIG. 3

A. MAJOR SYSTEM LEAKAGE - Major Leakage will cause a decrease in surge tank levels and possibly pressure in both systems. When a surge tank reaches a low low level. The cross connect bypass valves will shut. The system with the leak will continue to loose surge tank level and the other system's surge tank level should return to normal.

B. MINOR AIR LEAKAGE FROM ONE SURGE TANK - The level in the surge tank with the leak will increase. The other system surge tank level will remain near normal as its level control valve will makeup for water sluiced to the other system.

C. MINOR AIR LEAKAGE INTO ONE SURGE TANK - With minor air leakage into one surge tank, both surge tank pressures will increase.

FIG. 4

D. CHILLER TRIP OR FAILURE TO START DUE TO LOW CHILLED WATER RETURN TEMPERATURE - With a low chilled water return temperature and a chiller run signal present an RBSVS SYS A/B CHILL WTR DEGRADED ANNUNCIATOR will alarm. If the chilled water supply temperature indicates less than 45°F the return temperature is probably low.

FIG. 5

E. CHILLED WATER PUMP TRIP - If a chilled water pump trips, the associated chiller will trip but the condensing water pump will remain running.

FIG. 6

F. MALFUNCTIONING WATER CHILLER - A high chilled water temperature with normal chiller amps would indicate a possible malfunctioning chiller.

FIG. 7

G. CHILLED WATER SYSTEMS CROSS-CONNECTED - If both RBSVS SYS. A&B CHILL WTR crossover VV open annunciators alarm and all four crossover valves indicate not fully shut, the chilled water systems are cross-connected. The cross-connect valves do not automatically shut during accident conditions.

FIG. 8

H. CHILLER OVERLOAD DUE TO HIGH HEAT LOAD - An Excessive Heat Load would be indicated by high compressor amps and a high chilled water supply temperature.

J. IMPROPER SYSTEM INTERRELATIONS OPERATION - The Control Room Air Conditioning, Relay Room, Emergency Switchgear and Computer Room Air Conditioning units of the same loop as the operating CRAC chilled water chiller must be in operation for proper cooling.

III PRECAUTIONS, CAUTIONS, LIMITATIONS AND ACTIONS

A. The condensers of idle water chillers should be flushed and layed up with demineralized water to prevent tube corrosion.

- o Control Room Indications - N/A

B. The current limiting selector on the water chillers should always be set to 100 percent capacity.

- o Control Room Indications - N/A

C. Components which have been shutdown during accident condition operation must be manually restarted if the need arises for them to operate.

- o Control Room Indications - The white manual override lights on VC-2 indicate the component has been manually shutdown during accident operation.

D. When shifting from operation of one chilled water system (A or B) to the other, the supplied CRAC and relay, emergency switchgear and computer room components must also be shifted to the corresponding system, as per SP 23.411.01.

- o Control Room Indications - The equipment operating status can be verified on VC-1 and VC-2.

E. The RBSVS and CRAC system A/B Cross Connect Bypass Valves (*AOV-068A/B and *AOV-069 A/B) must always remain open when only one chilled water system (A or B) is operating. This will ensure that the water in the non-operating system remains at operating temperature to provide immediate cooling in the event of automatic system initiation. This is also required to ensure that all reactor building MCC area and MG Room Unit Coolers (1T46*UC-Ø2ØA, B and Ø21A, B and Ø22A, B and Ø23) are provided with chilled water during normal operation.

- o Control Room Indications - Cross connect bypass position indication lights on VC-2.

F. Automatic interlocks prevent starting any water chiller unless at least one half hour has passed since that water chiller was previously started. This interlock is bypassed during accident conditions.

- o Control Room Indications - N/A

IV ACCIDENT OPERATION FIG. 2

A. VERIFICATION OF AUTOMATIC INITIATION - On VC-2 verify that all chilled water pumps are running and that the cross connect bypass valves are shut. The chillers and condensing water pumps will start on a high chilled water return temperature.

FIG. 9

B. MANUAL INITIATION - To start a Standby chiller the VC-2 control switch is placed in NORMAL-AFTER-START. Verify that the chilled water, condensing water and lube oil pumps start. The chiller will start after a time delay to allow the lube oil pump to establish oil pressure.

C. REQUIREMENTS FOR SHUTTING DOWN THE SYSTEM AFTER A VALID INITIATION SIGNAL - The system should be allowed to run for thirty minutes after initiation to allow conditions to stabilize. If two chillers are running in each loop and both redundant sets of emergency core cooling systems are not running, one chiller in each system may be shutdown. The system may be returned to normal operation only after the RBSVS initiation is reset and the Reactor Building Ventilation has been returned to normal.

V ANNUNCIATORS

ANNUNCIATOR	ARP #	CONTROL ROOM VERIFICATION
1. RBSVS SYS A/B CHLR MTR OVLD	3013/3014	1. Chiller Amps
2. RBSVS SYS A/B CHILL WTR DEGRADED	3017/3018	2.a. Chiller in Pull-To-Lock b. Loss of Chiller Control Power (Status Lights Out) c. Chilled water pump in OFF d. Loss of Chilled Water Pump Control Power (Status Lights Out) e. Chilled water Pump Motor Overload (Green Status Light On) f. Lube Oil Pump Trouble (Same as chilled water pump) g. MOV Overload or loss of control power h. Cross-Tie bypass valves loss of power (valves will close) i. Chiller Breaker open with run signal present j. Local Problems
3. RBSVS SYS A/B CHILL WTR SPLY TEMP. HI	3112/3052	3. Chilled water supply Temp. greater than setpoint
4. RBSVS CHLR DEMIN PURGE FLOW HI	3091	4. LOCAL
5. RBSVS CHLR DEMIN PURGE CNDCT HI		5. LOCAL

ANNUNCIATOR	ARP #	CONTROL ROOM VERIFICATION
6. RBSVS SYS A/B CHILL WTR SPLY/RTN VV CLOSED	3102/3103	6. MOV-Ø31A/B or MOV-Ø32A/B position
7. RBSVS SYS A/B CHILL WTR CROSSOVER VV OPEN	3104/3105	7. MOV-Ø33A/B or Ø34A/B position
8. RBSVS CHILL WTR SURGE TK A/B TROUBLE	3110/3111	8. LOCAL
9. RBSVS SYS A/B CHILL WTR INOP	3019/3020	9.a. Normal/Inop Switch b. Service Water Inop c. Both chillers in Pull-To-Lock d. Loss of control power to both chillers e. Loss of control power or motor overload on pumps for both chillers f. MOV-Ø31A/B or Ø32A/B overload or loss of control power and not full open. g. LOCAL

VI TECH SPECS

A. 3.7.9 The temperature of each area in table 3.7.9-1 shall be maintained with the limits indicated.

APPLICABILITY: Whenever the equipment in an effected area is required to be operable.

NOTE: Table 3.7.9-1 includes areas served by CRAC chilled water

B. 3.6.5.3 Two independent reactor building standby ventilation systems (RBSVS) shall be operable.

APPLICABILITY: Operational Conditions 1, 2, 3 and *

* When irradiated fuel is being handled in the secondary containment and during core alterations and operations with a potential for draining the reactor vessel.

ACTION: With both RBSVS inoperable in condition * suspend handling of irradiated fuel in the secondary containment, core alterations or operations with a potential for draining the reactor vessel.

C. 3.7.2 Two independent control room air conditioning systems shall be operable.

APPLICABILITY: All Operational Conditions and *

* When irradiated fuel is being handled in th- secondary containment.

ACTION: In Operational Condition 4, 5 or * with both Control Room air conditioning systems inoperable, suspend core alterations, handling of irradiated fuel in the secondary containment and operations with a potential for draining the reactor vessel.

VII NORMAL CRAC CHILLED WATER PARAMETERS

A. Chilled Water Supply Temperature 45° - 50°F

B. Chiller Amps 38 Amps

C. Chilled Water differential pressure 50 psid

VIII The loss of one chilled water loop will require the reduction of heat loads in the MCC and MG rooms that have lost cooling. The following example shows the heat producing loads on MCC's cooled by 1T46*UC-020A/B. The operator is not required to memorize these loads but given control room reference material determine these loads.

A. From FM 1C-15

1. 1T46*UC-020A Cools:

a. 1R24*MCC1118

b. 1R24*MCC1113

c. 1R24*MCC111X

d. 1R24*MCC1112

e. 1R24*MCC-0A2

2. 1T46*UC-020B Cools:

a. 1R24*MCC1128

b. 1R24*MCC1123

c. 1R24*MCC112Y

d. 1R24*MCC1122

e. 1R24*MCC-0B2

B. From ESK or the Control Room Load List the major (heat producing) loads on the above MCC's are:

1. MCC 1118

a. RBSVS Unit Coolers UC-Ø2ØA, ØØ2A, ØØ3A

2. MCC 1113

a. SBLC Pump A

b. RBSVS Filter Train Heating Coil A

c. H_2 Recombiner A

3. MCC 1112

a. RBSVS Unit Coolers UC-ØØ4A, ØØ5A

b. RBCLCW CIRC. PUMP A

c. Reactor Building Exhaust Booster Fan A

4. MCC OA2

a. Remote Shutdown Panel

b. RCIC Condenser Condensate Pump

c. RCIC Condenser Vacuum Pump

5. MCC 1128

a. RBSVS Unit Coolers VC-Ø23, ØØ2B, ØØ3B, Ø2ØB

6. MCC 1123

   a. SBLC Pump B

   b. MSIV LCS Inboard Heater

   c. H_2 Recombiner B

   d. RBSVS Filter Train Heating Coil B

7. MCC 1122

   a. MSIV LCS Inboard Heater

   b. RBSVS Unit Coolers UC-ØØ4B/ØØ5B

   c. Reactor Building Exhaust Booster Fan B

   d. RBCLCW Circ. Pump B

8. MCC OB2

   a. Remote Shutdown Panel

	1	2	3	4	5	6	7	8	9	10
A	[illegible] PURGE P HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	3013 RBSVS SYS A CHLR MTR OVLD	3014 RBSVS SYS B CHLR MTR OVLD	3090 PASF SYS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
B	CNTMT PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS SYS A CHILL WTR INOP	3020 RBSVS SYS B CHILL WTR INOP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	3091 RBSVS CHLR DEMIN PURGE FLOW HI	3095 DRYWELL UNIT CLR DIFF P HI
C	3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3052 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	3092 RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI
	1	2	3	6	5	6	7	8	9	10

PNL - VC2

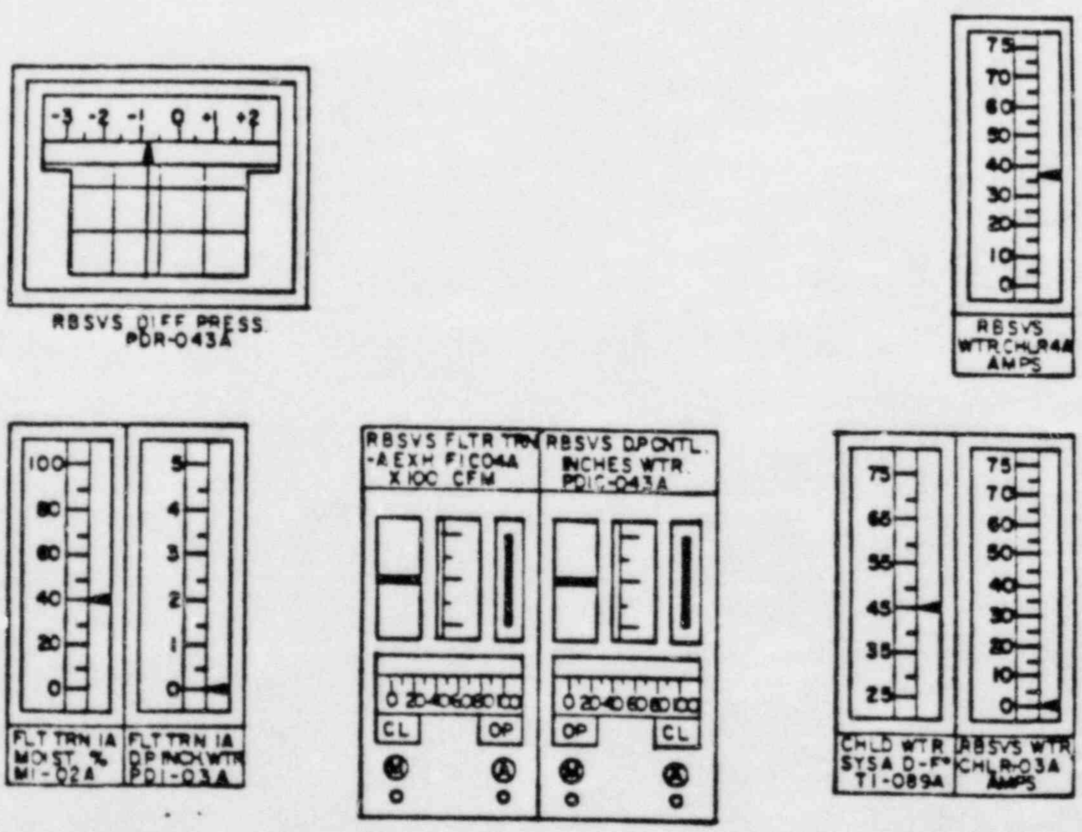


FIG. 1

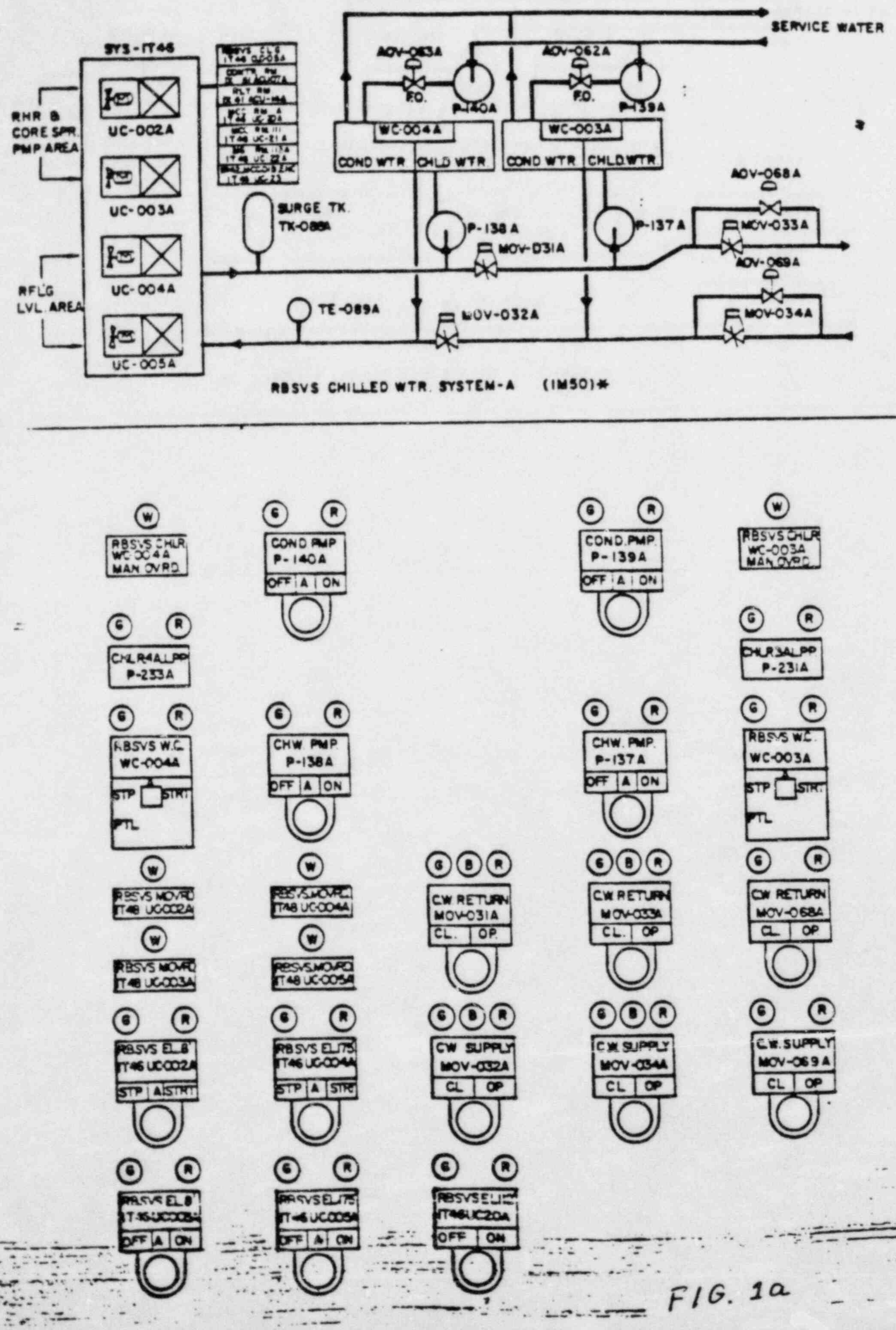

SERVICE WATER
SYS-IT46
RHR & CORE SPR. PMP AREA
RFLG LVL. AREA
UC-002A
UC-003A
UC-004A
UC-005A
AOV-063A
AOV-062A
F.O.
P-140A
P-139A
WC-004A
WC-003A
COND WTR
CHLD WTR
AOV-068A
MOV-033A
SURGE TK. TK-088A
P-138A
P-137A
MOV-031A
AOV-069A
MOV-034A
TE-089A
MOV-032A
RBSVS CHILLED WTR. SYSTEM-A (IM50)*
RBSVS CHLR WC-004A MAN OVRD.
COND PMP P-140A
OFF A ON
COND.PMP. P-139A
RBSVS CHLR WC-003A MAN OVRD.
CHLR4ALPP P-233A
CHLR3ALPP P-231A
RBSVS W.C. WC-004A
STP STRT PTL
CHW. PMP. P-138A
CHW. PMP. P-137A
RBSVS W.C. WC-003A
RBSVS MOVRD IT48 UC002A
RBSVS MOVRD IT48 UC-004A
C.W. RETURN MOV-031A
CL. OP.
C.W. RETURN MOV-033A
C.W. RETURN MOV-068A
RBSVS MOVRD IT48 UC-003A
RBSVS MOVRD IT48 UC-005A
RBSVS EL.8' IT46 UC-002A
STP A STRT
RBSVS EL.175' IT46 UC-004A
CW SUPPLY MOV-032A
CL OP
C.W. SUPPLY MOV-034A
C.W. SUPPLY MOV-069 A
RBSVS EL.8' IT46 UC005A
RBSVS EL.175' IT46 UC005A
RBSVS EL.1 IT46UC20A
OFF ON

FIG. 1a

A	3082 [illegible] PURGE [illegible] HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	3013 RBSVS SYS A CHLR MTR OVLD	3014 RBSVS SYS B CHLR MTR OVLD	3090 PASP SYS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
B	CNTMT PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS SYS A CHILL WTR INOP	3020 RBSVS SYS B CHILL WTR INOP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	3091 RBSVS CHLR DEMIN PURGE FLOW HI	3095 DRYWELL UNIT CLR DIFF P HI
C	3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3052 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	3092 RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI
	1	2	3	4	5	6	7	8	9	10

PNL - VC2

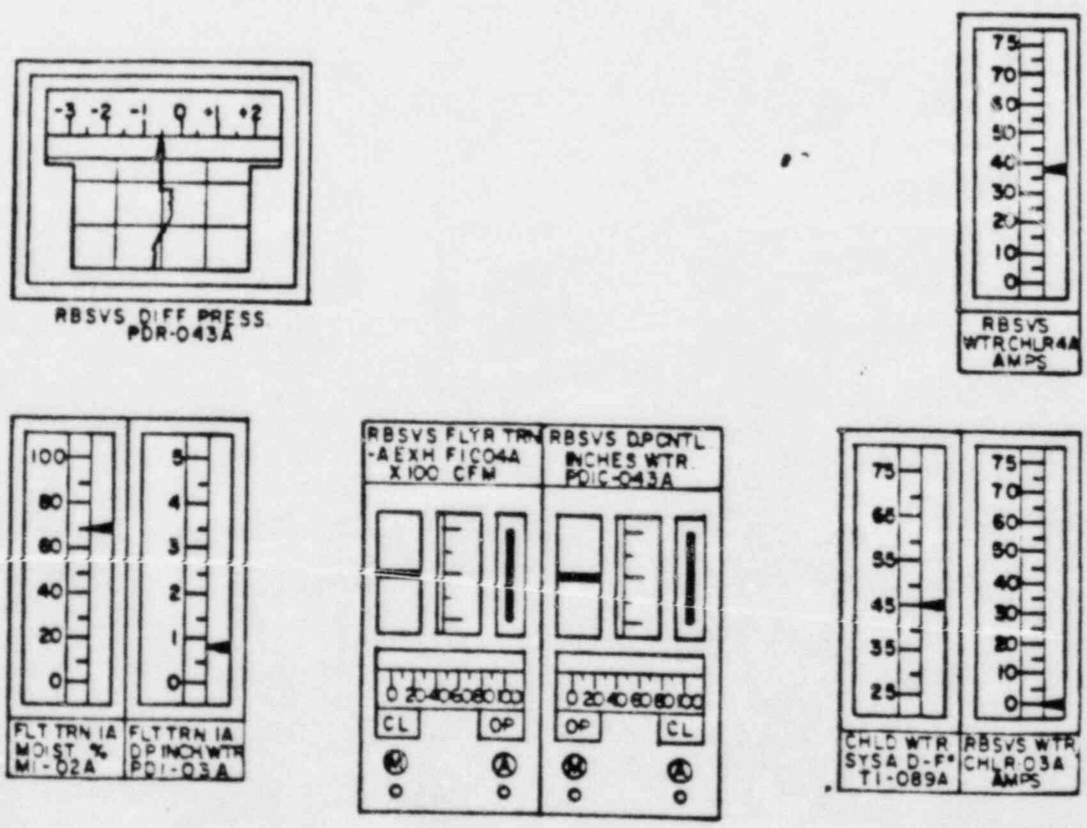
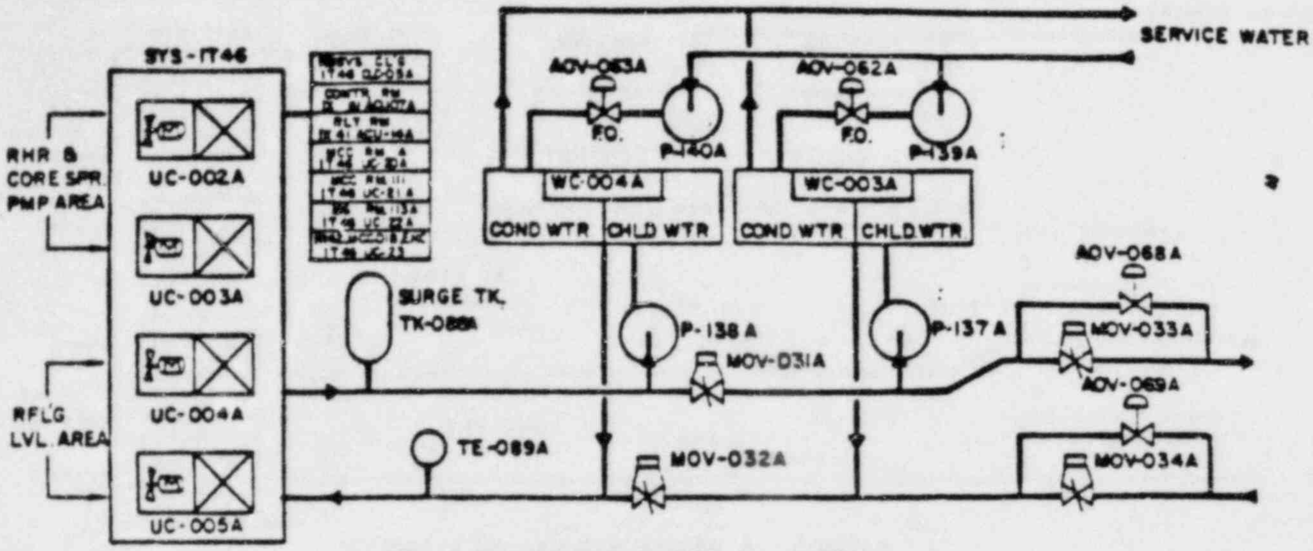


FIG. 2



RBSVS CHILLED WTR. SYSTEM-A (1M50)*

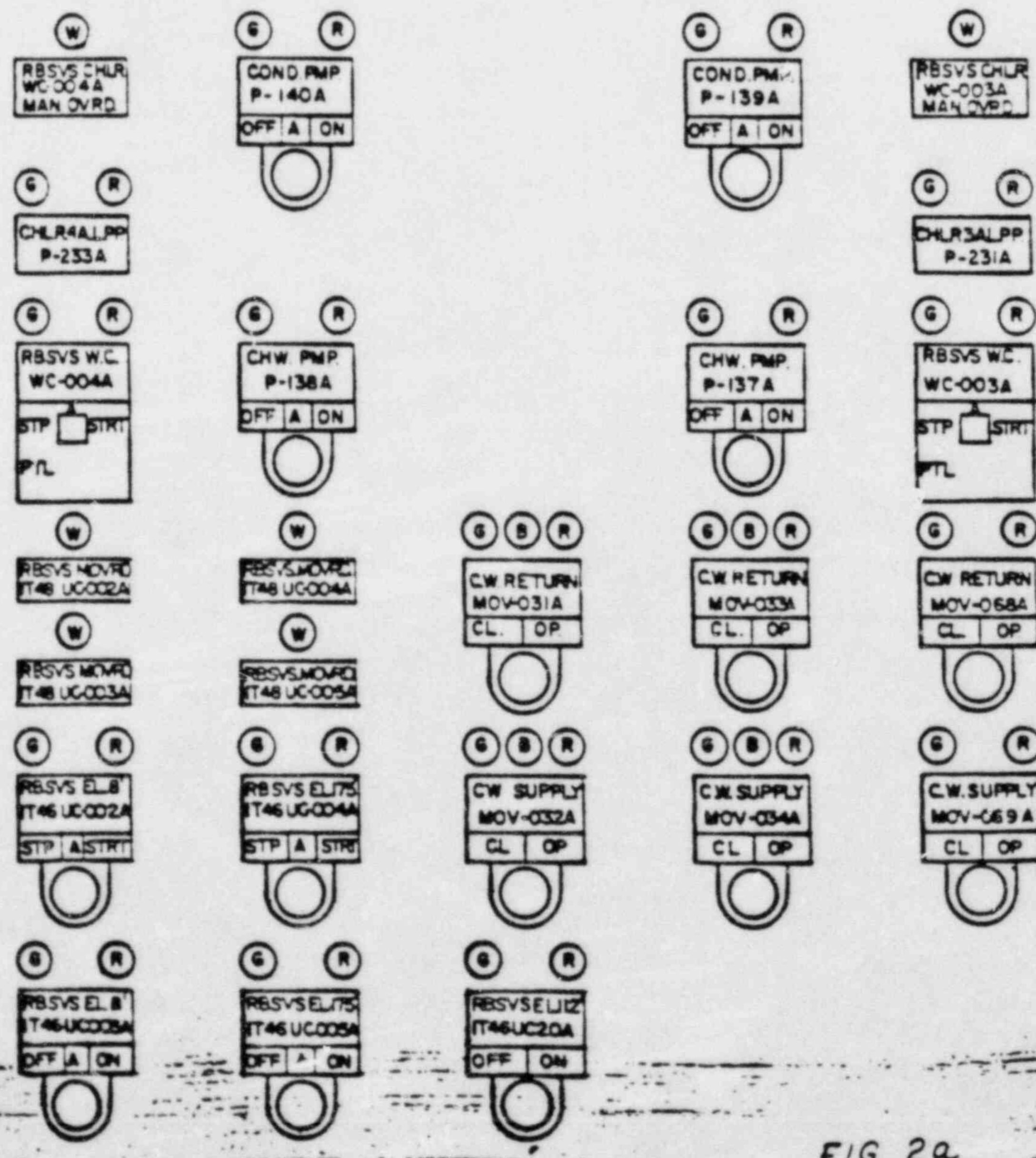


FIG. 2a

3082 CNTMT PURGE FLT D/F P HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	3013 RBSVS SYS A CHLR MTR OVLD	3014 RBSVS SYS B CHLR MTR OVLD	3090 PASF SYS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
6 CNTMT PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS SYS A CHILL WTR INOP	3020 RBSVS SYS B CHILL WTR INOP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	3091 RBSVS CHLR DEMIN PURGE FLOW HI	3093 DRYWELL UNIT CLR DIFF P HI
3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3052 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	3092 RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI
1	2	3	4	5	6	7	8	9	10

PNL - VC2

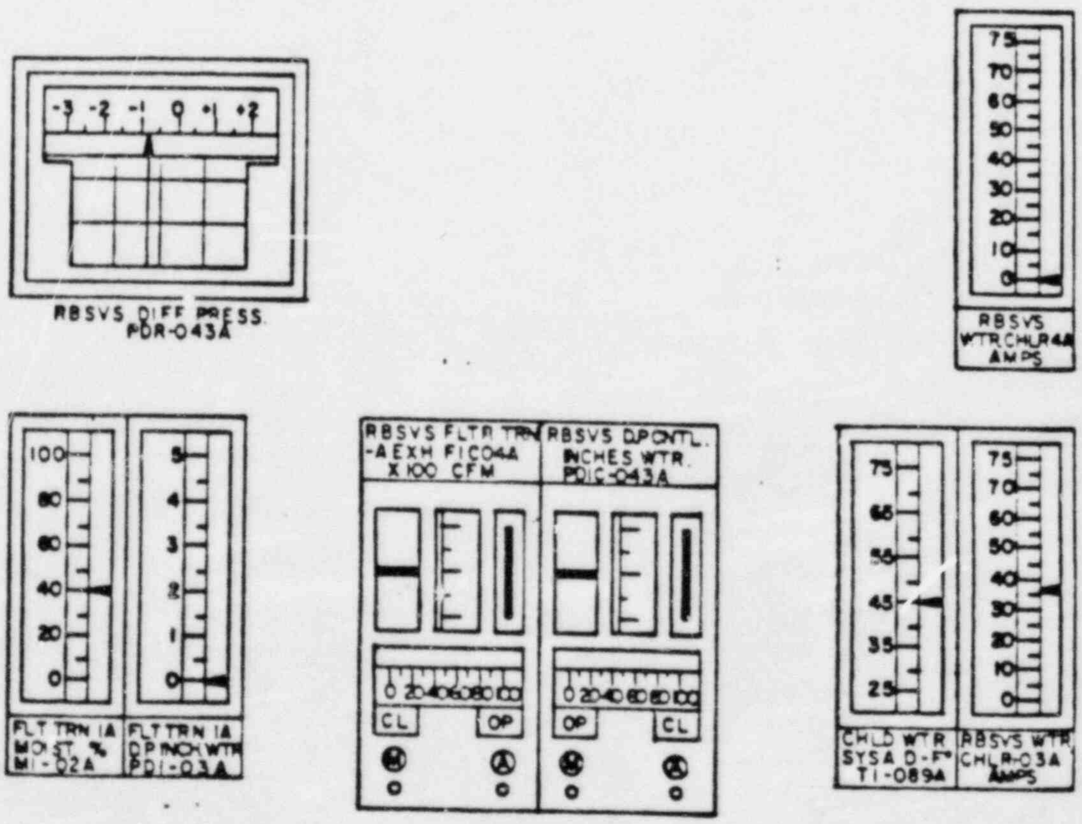
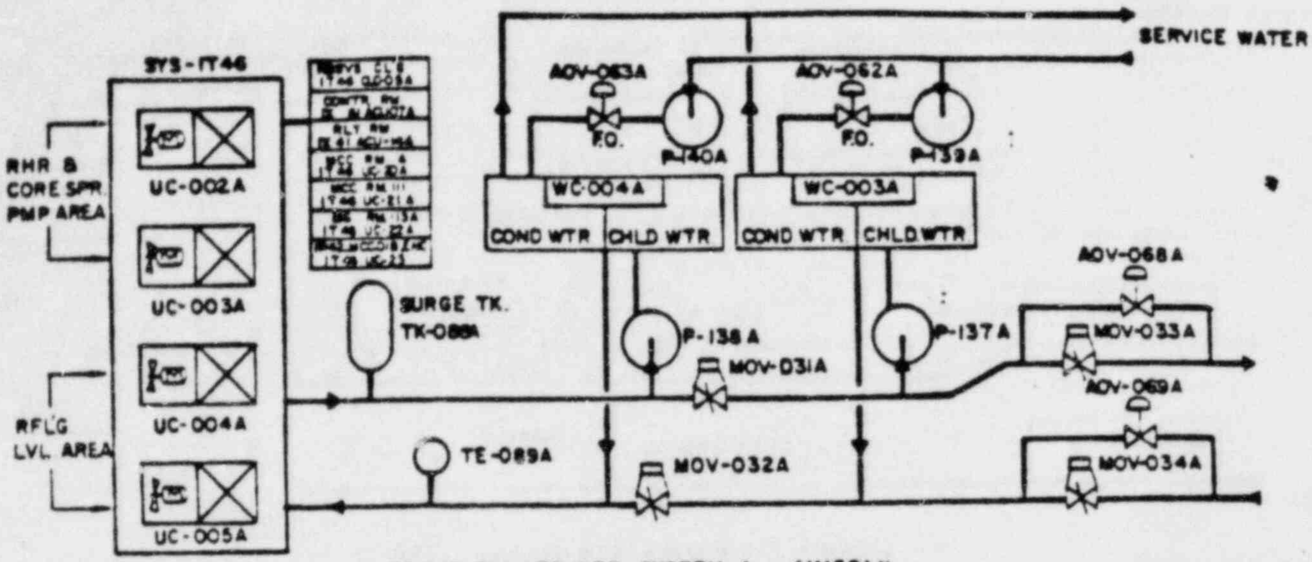


FIG. 3



RBSVS CHILLED WTR. SYSTEM-A (IM50)*

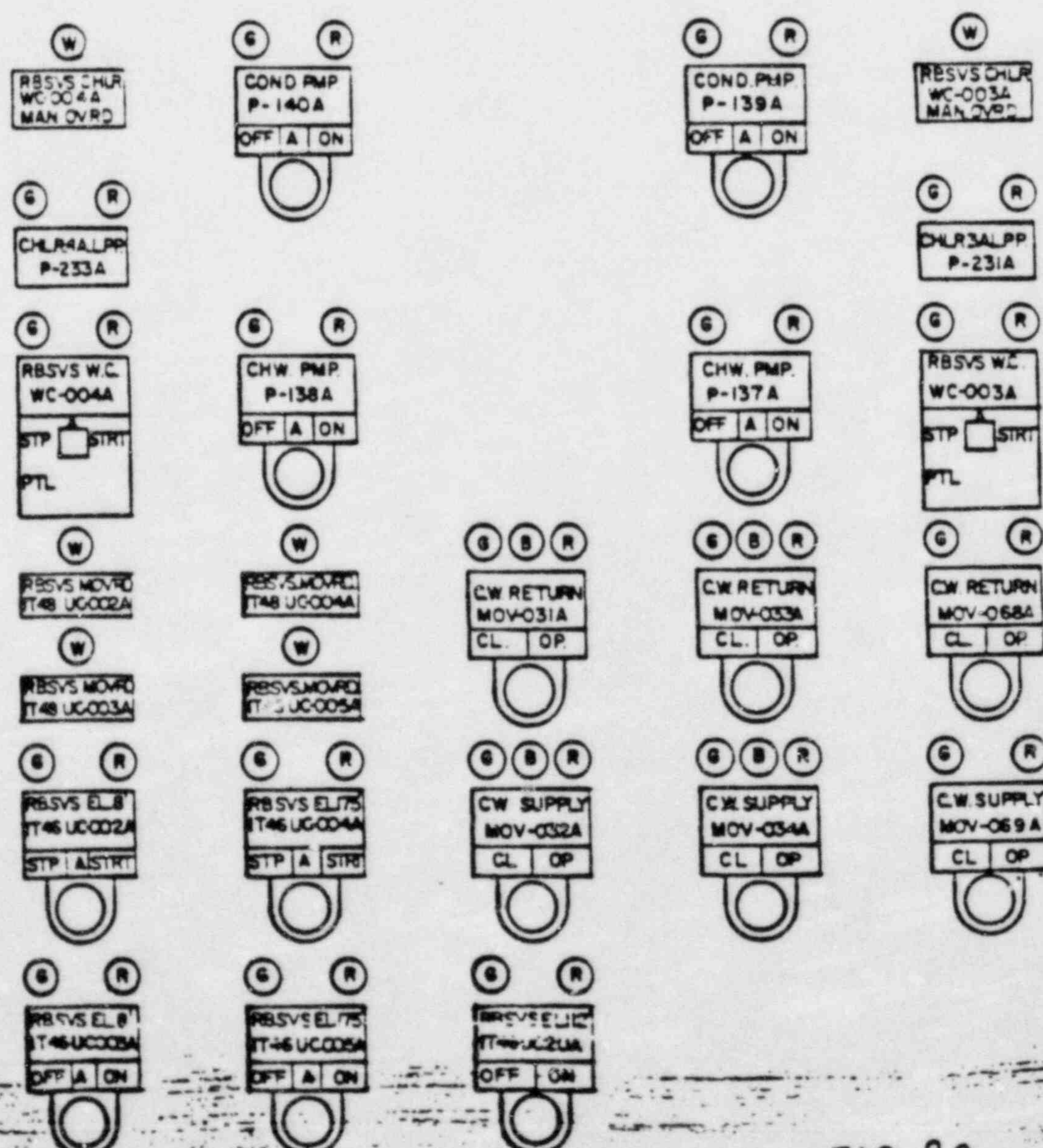


FIG. 3a

	1	2	3	4	5	6	7	8	9	10
A	3082 [illegible] PURGE [illegible] P HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	3013 RBSVS SYS A CHLR MTR OVLD	3014 RBSVS SYS B CHLR MTR OVLD	3090 PASP SYS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
B	CNTMT PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS SYS A CHILL WTR INOP	3020 RBSVS SYS B CHILL WTR INOP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	3091 RBSVS CHLR DEMIN PURGE FLOW HI	3095 DRYWELL UNIT CLR DIFF P HI
C	3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3052 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	3092 RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI
	1	2	3	4	5	6	7	8	9	10

PNL - VC2

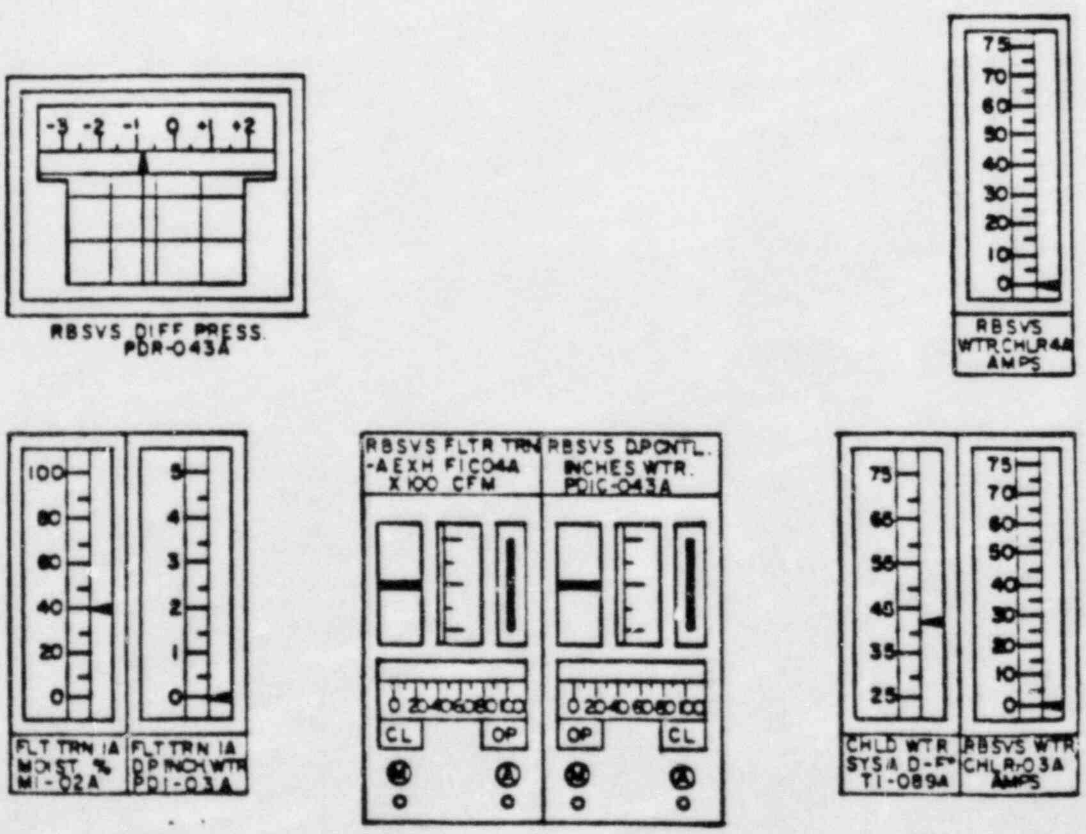
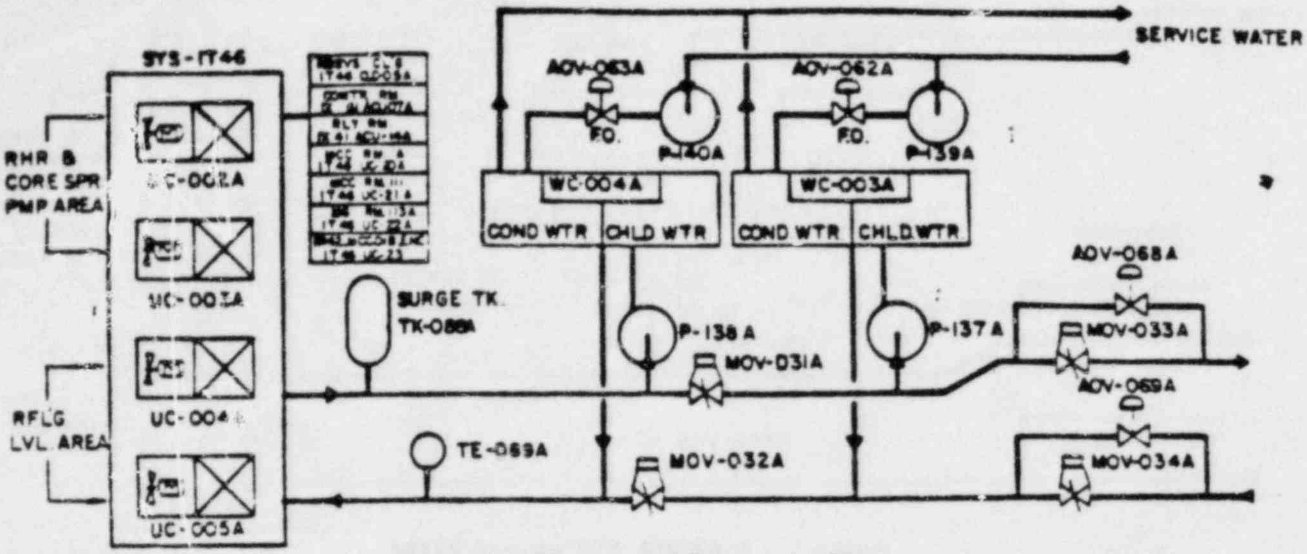


FIG. 4



RBSVS CHILLED WTR. SYSTEM-A (IM50)*

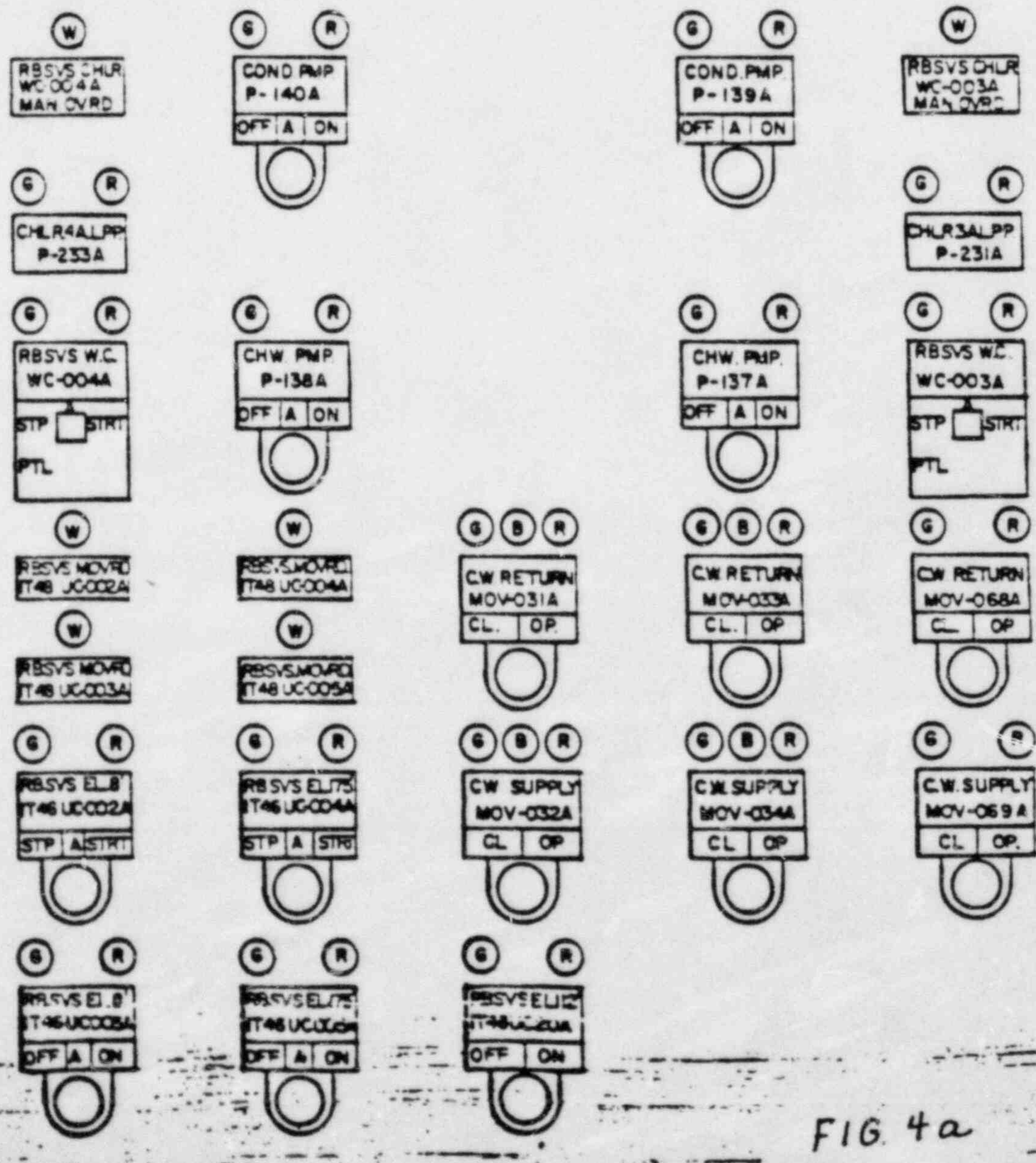


FIG 4a

	1	2	3	4	5	6	7	8	9	10
A	3082 [illegible] PURGE [illegible] P HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	3013 RBSVS SYS A CHLR MTR OVLD	3014 RBSVS SYS B CHLR MTR OVLD	3090 PASP SYS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
B	CNTMT PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS SYS A CHILL WTR INOP	3020 RBSVS SYS B CHILL WTR INOP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	3091 RBSVS CHLR DEMIN PURGE FLOW HI	3095 DRYWELL UNIT CLR DIFF P HI
C	3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3052 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	3092 RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI

PNL - VC2

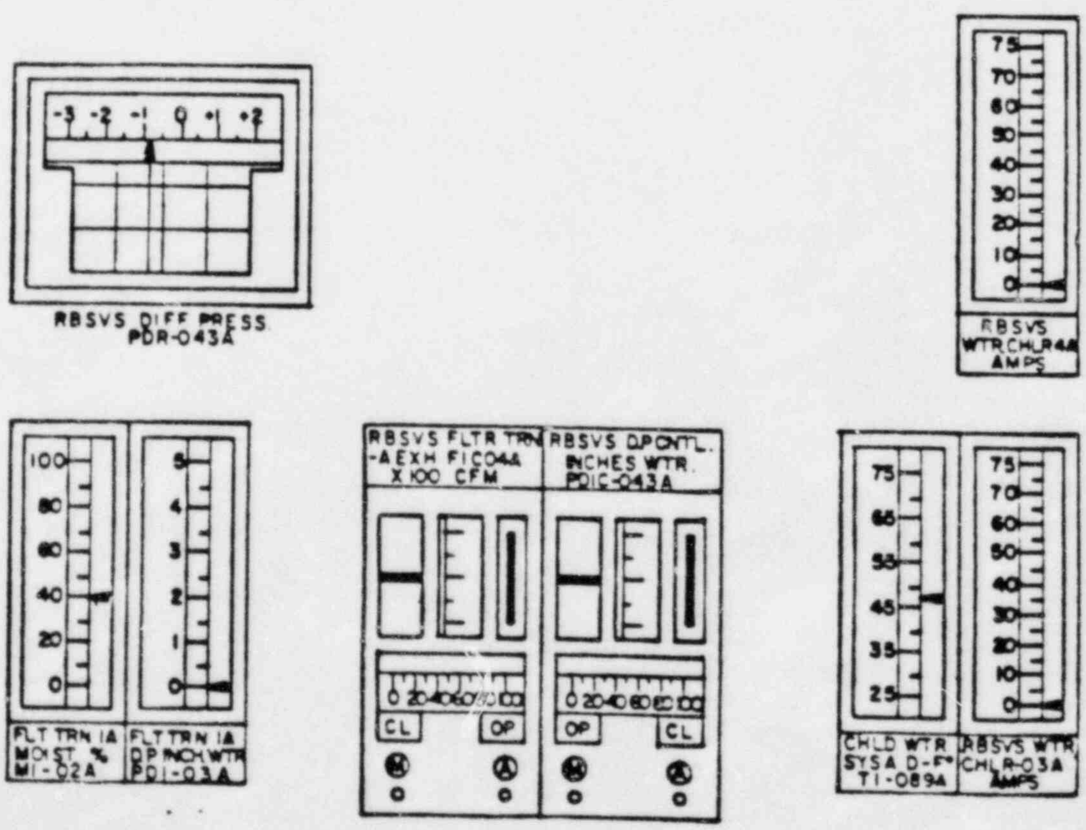
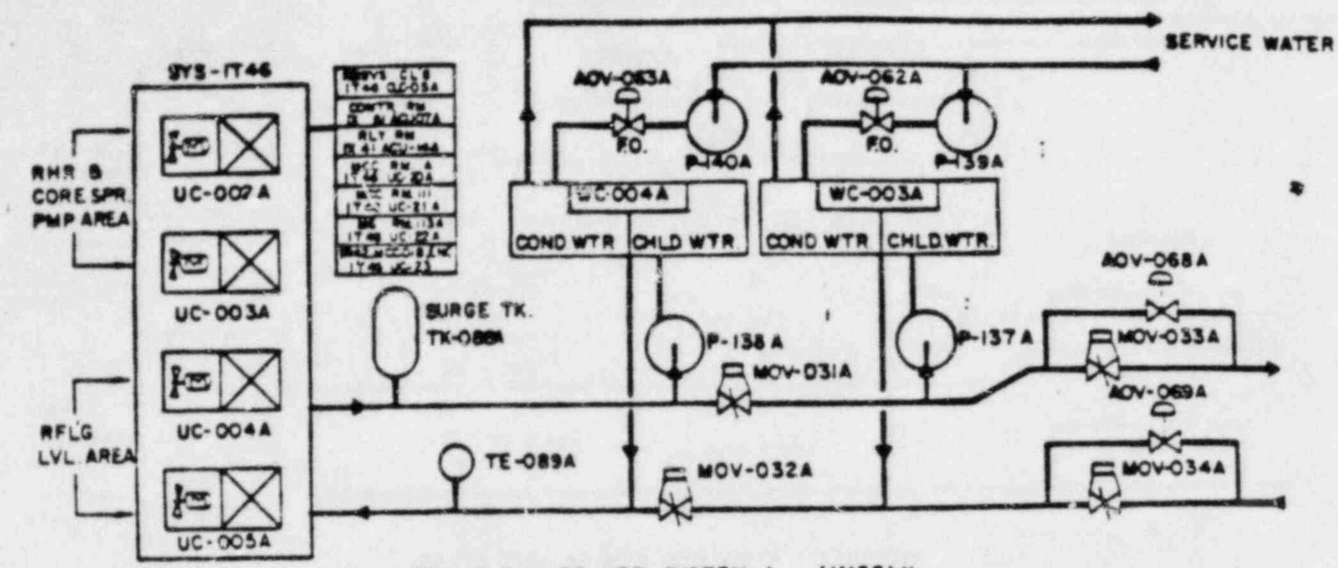


FIG. 5



RBSVS CHILLED WTR. SYSTEM-A (1M50)*

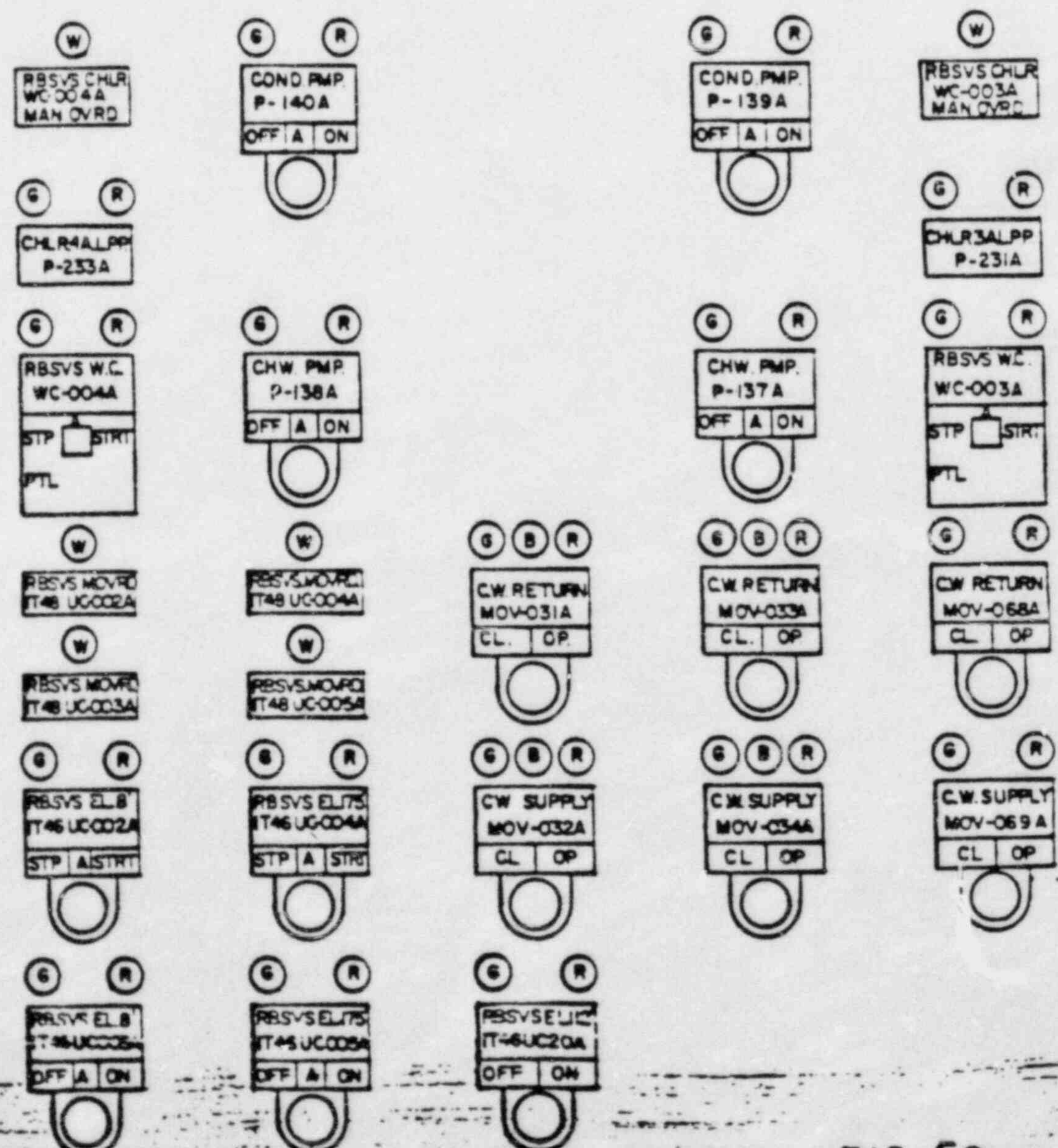


FIG. 5a

A	[illegible] PURGE P HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS STS A CHILL WTR DEGRADED	3018 RBSVS STS B CHILL WTR DEGRADED	3013 RBSVS STS A CHLR MTR OVLD	3014 RBSVS STS B CHLR MTR OVLD	3090 PASF STS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
B	CNTMT PURGE STS A VV LCTL	3077 CNTMT PURGE STS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS STS A CHILL WTR INOP	3020 RBSVS STS B CHILL WTR INOP	3102 RBSVS STS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS STS B CHILL WTR SPLY/RTN VV CLSD	3091 RBSVS CHLR DEMIN PURGE FLOW HI	3093 DRYWELL UNIT CLR DIFF P HI
C	3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS STS A CHILL WTR SPLY TEMP HI	3052 RBSVS STS B CHILL WTR SPLY TEMP HI	3104 RBSVS STS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS STS B CHILL WTR CROSSOVER VV OPEN	3092 RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI
	1	2	3	4	5	6	7	8	9	10

PNL - VC2

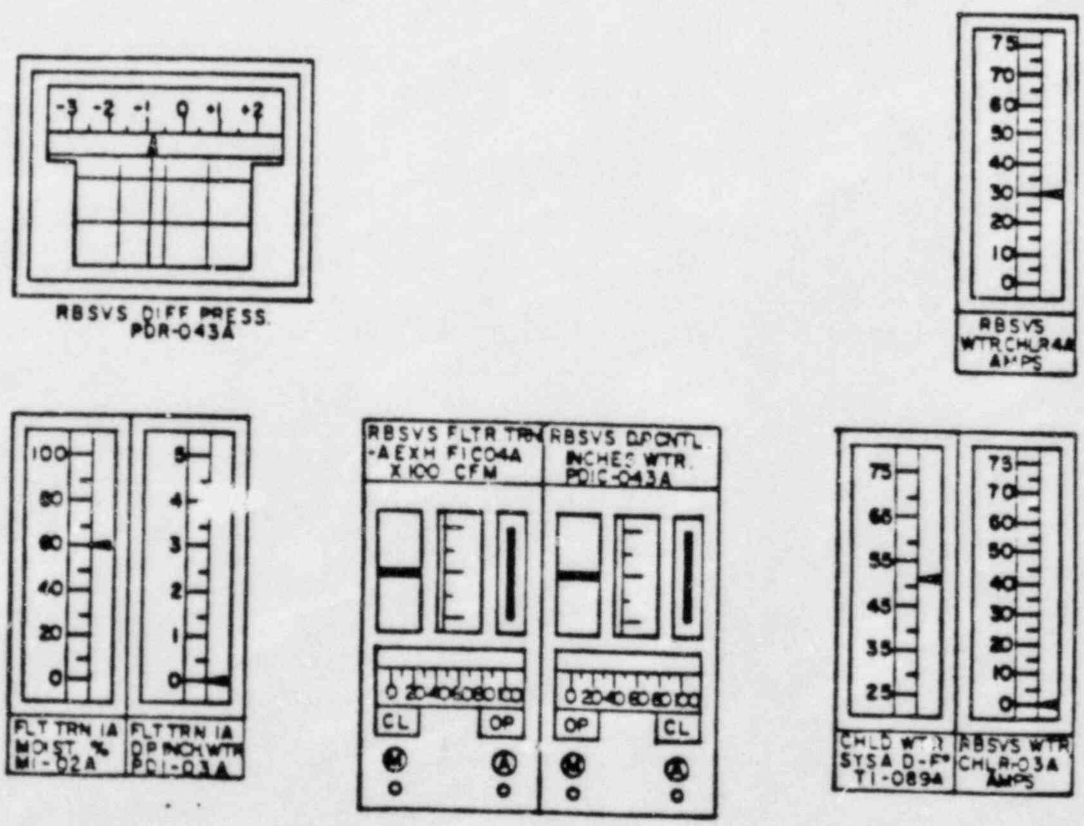
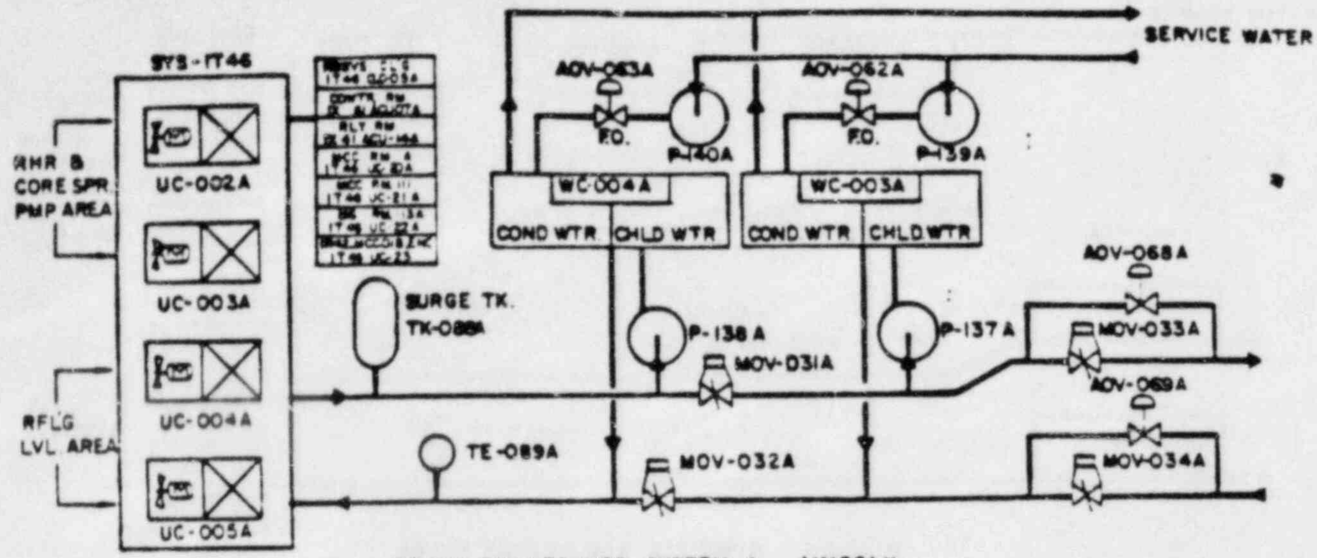


FIG. 6



RBSVS CHILLED WTR. SYSTEM-A (1M50)*

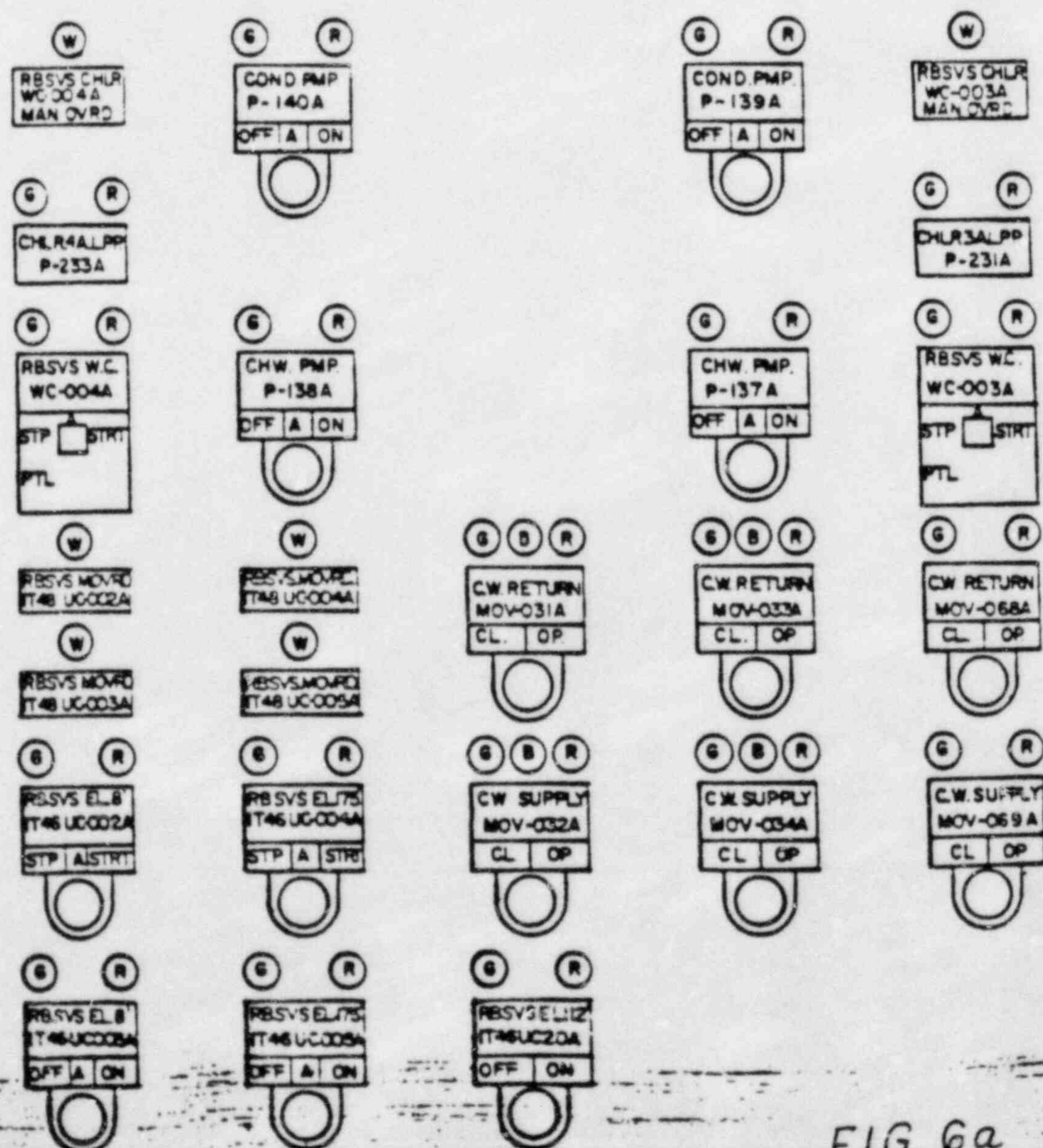


FIG. 6a

	1	2	3	4	5	6	7	8	9	10
A	[illegible] PURGE P HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	3015 RBSVS SYS A CHLR MTR OVLD	3016 RBSVS SYS B CHLR MTR OVLD	3090 PASP SYS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
B	CNTMT PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS SYS A CHILL WTR INOP	3020 RBSVS SYS B CHILL WTR INOP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	3091 RBSVS CHLR DEMIN PURGE FLOW HI	3093 DRYWELL UNIT CLR DIFF P HI
C	3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3052 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	3092 RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI

PNL - VC2

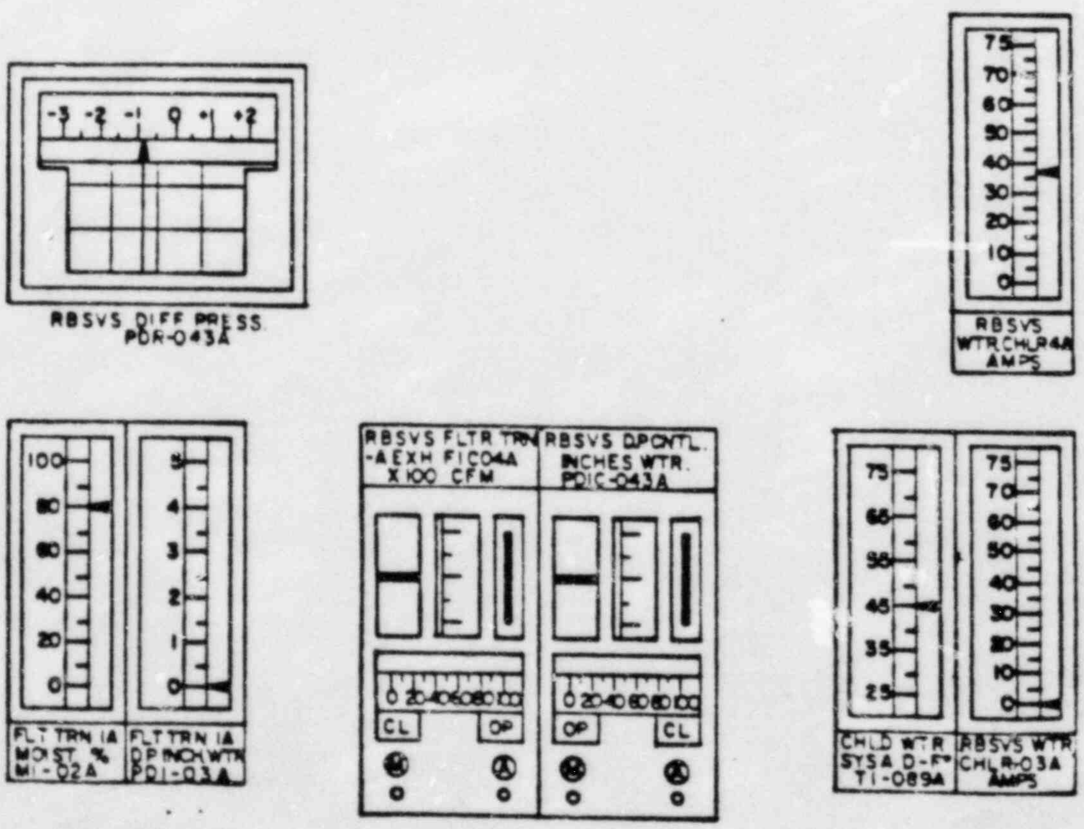
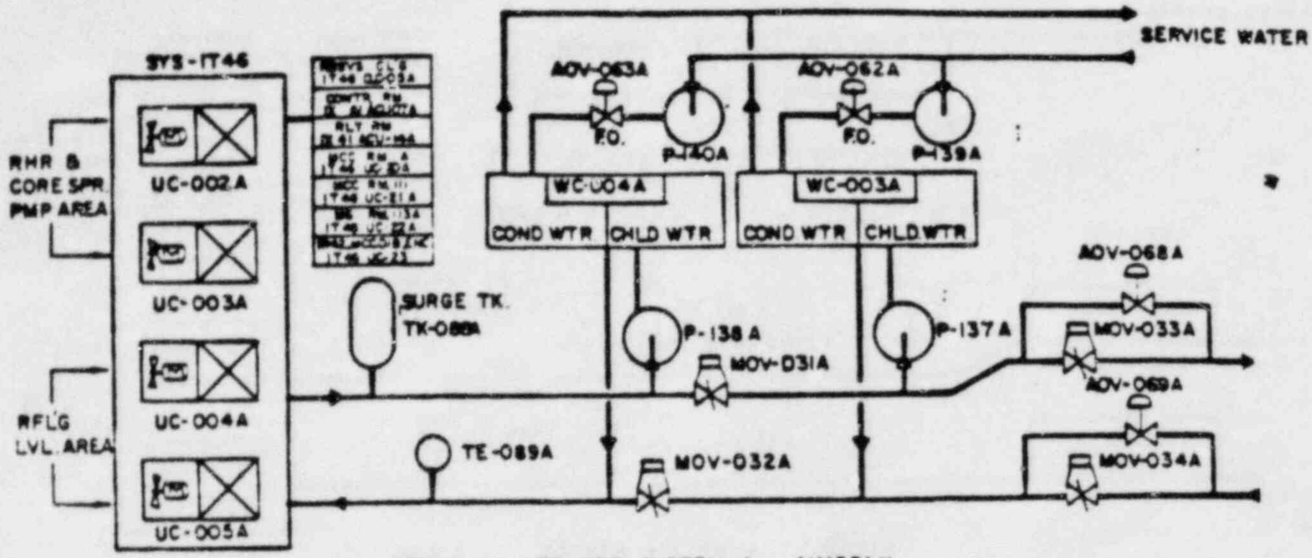


FIG. 7.



RBSVS CHILLED WTR. SYSTEM-A (1M50)*

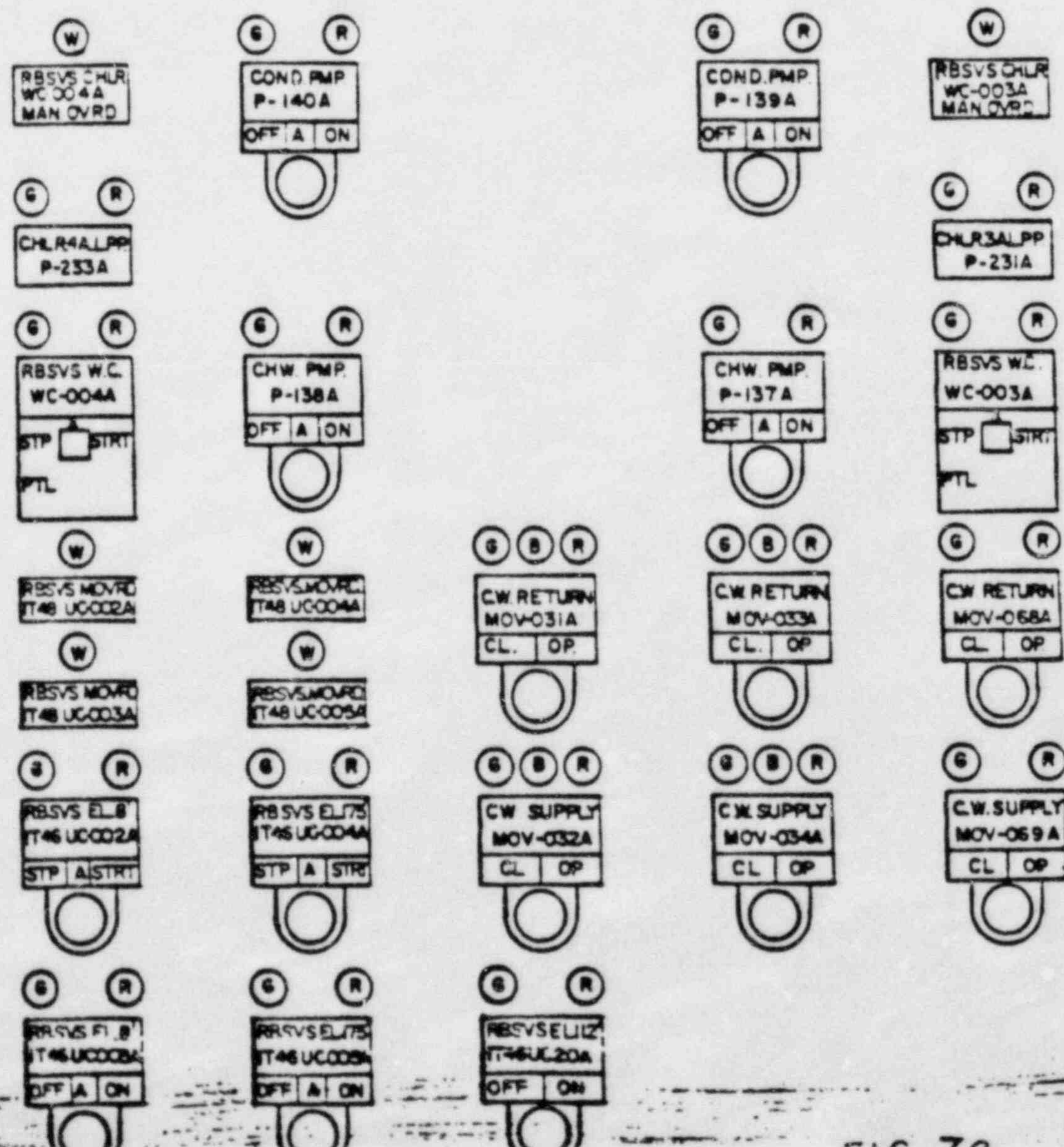


FIG. 7a

3082 C[illegible]URGE F[illegible] [illegible] HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	3013 RBSVS SYS A CHLR MTR OVLD	3014 RBSVS SYS B CHLR MTR OVLD	3090 PASP SYS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
CNTMT PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS SYS A CHILL WTR INOP	3020 RBSVS SYS B CHILL WTR INOP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	3091 RBSVS CHLR DEMIN PURGE FLOW HI	3093 DRYWELL UNIT CLR DIFF P HI
3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3052 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	3092 RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI
1	2	3	4	5	6	7	8	9	10

PNL - VC2

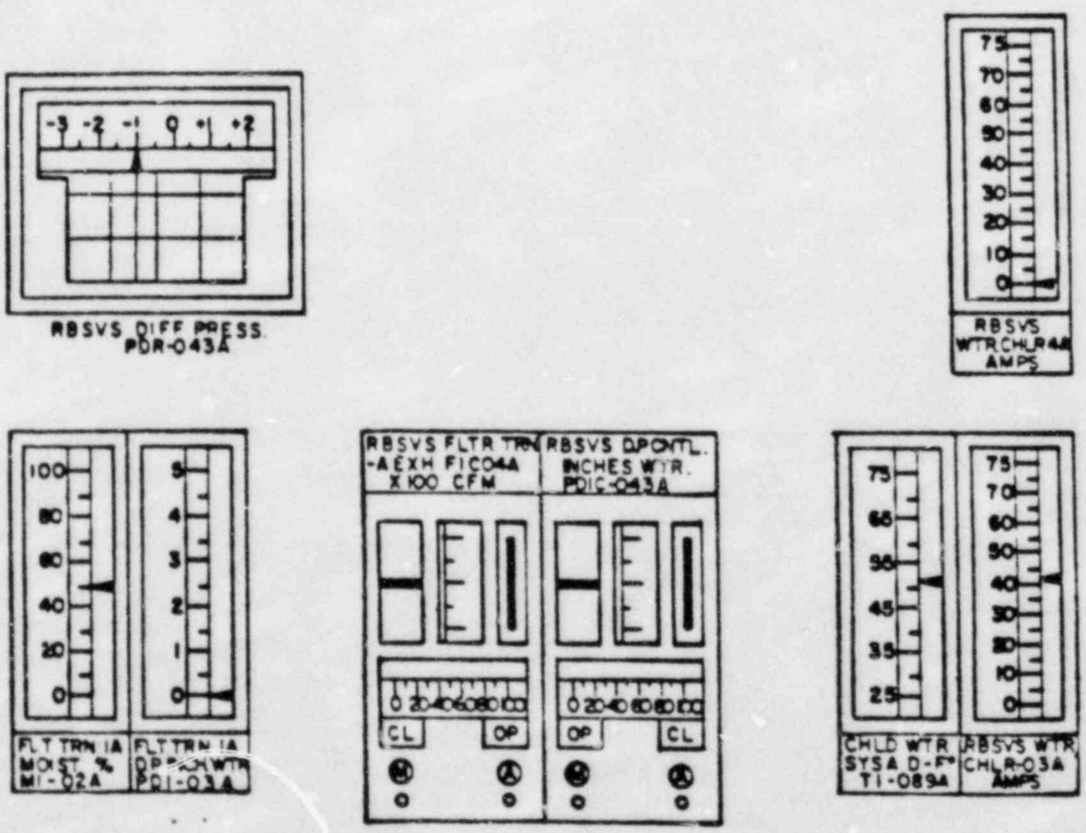
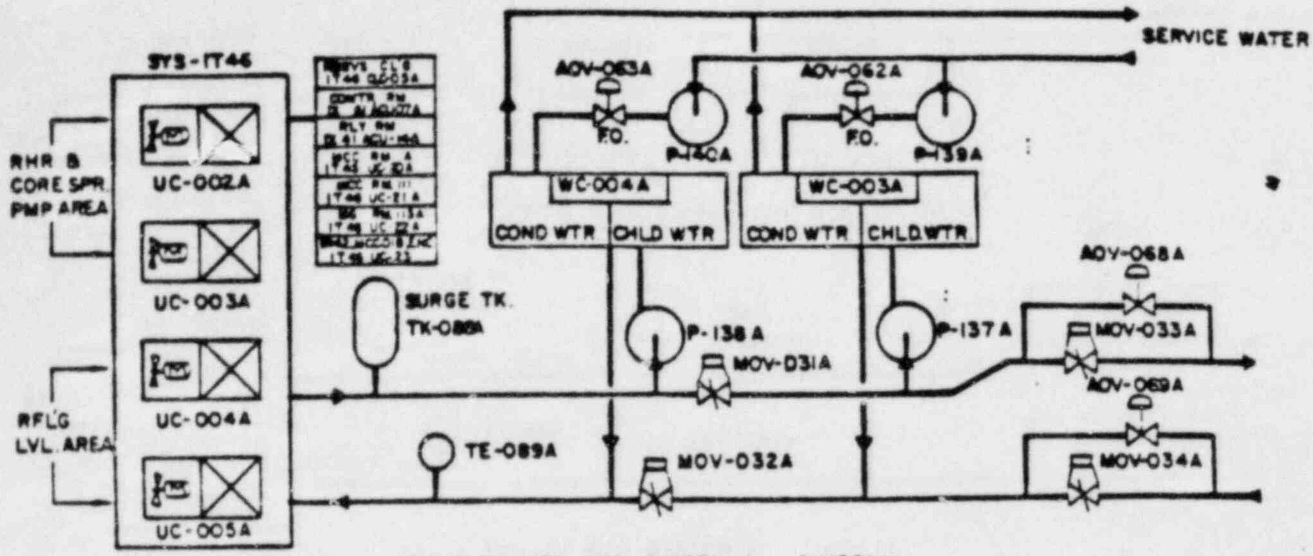


FIG. 8



RBSVS CHILLED WTR. SYSTEM-A (IM50)*

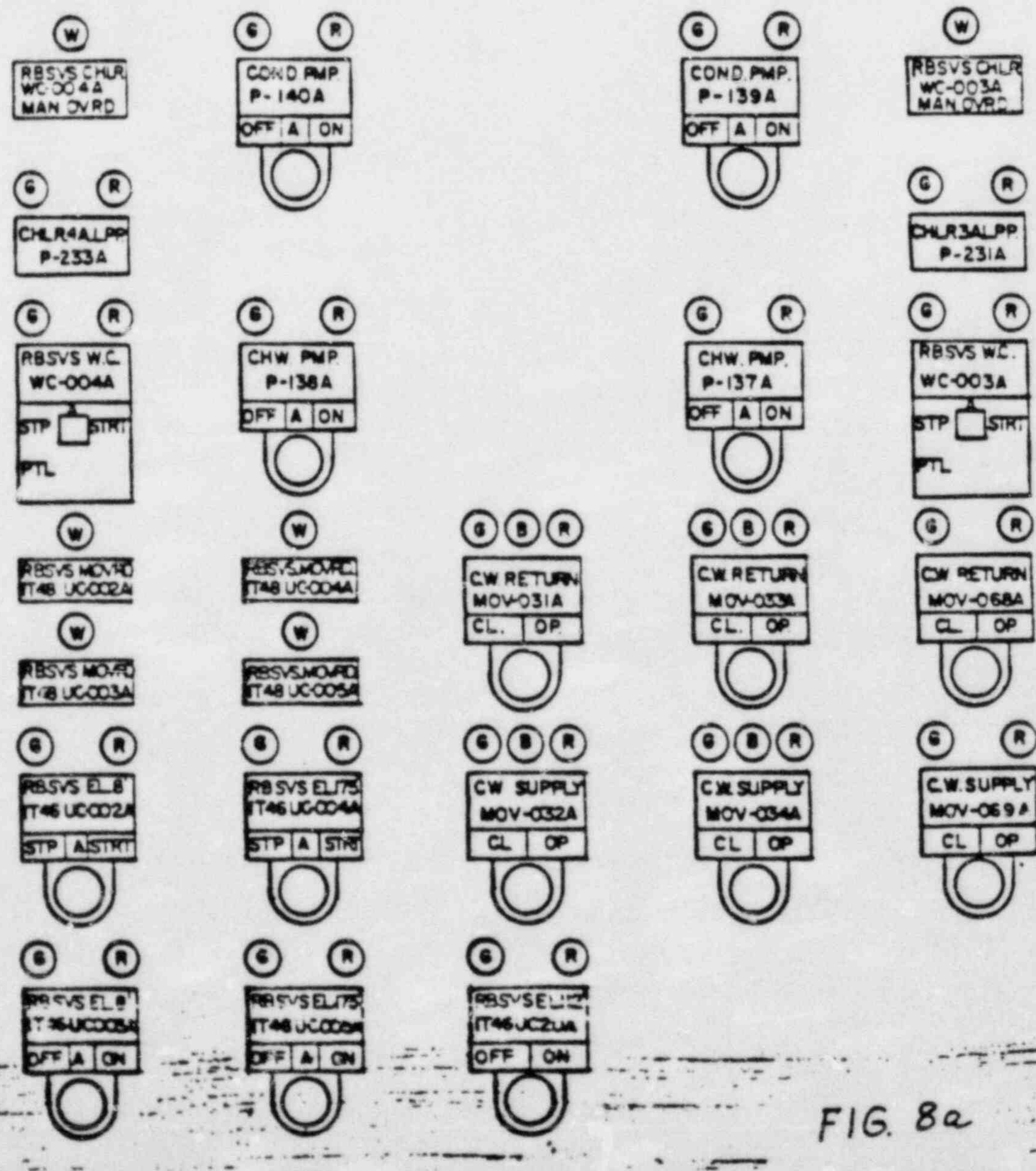


FIG. 8a

30[illegible] [illegible] PURGE [illegible] HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB MCC RM A TEMP HI/LO	3107 RB MCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	3013 RBSVS SYS A CHLR MTR OVLD	3014 RBSVS SYS B CHLR MTR OVLD	3090 PASP SYS TROUBLE	3059 DRYWELL UNIT CLR FAN TROUBLE
3[illegible] CNTMT PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB MCC RM A VENT INOP	3109 RB MCC RM B VENT INOP	3019 RBSVS SYS A CHILL WTR INOP	3020 RBSVS SYS B CHILL WTR INOP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	3091 RBSVS CHLR DEMIN PURGE FLOW HI	3093 DRYWELL UNIT CLR DIFF P HI
3055 DRYWELL UNIT CLR-17A FLOW HI	3056 DRYWELL UNIT CLR-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3052 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	3092 RBSVS CHLR DEMIN PURGE CNDCT HI	3096 DRYWELL AREA TEMP HI
1	2	3	4	5	6	7	8	9	10

PNL - VC2

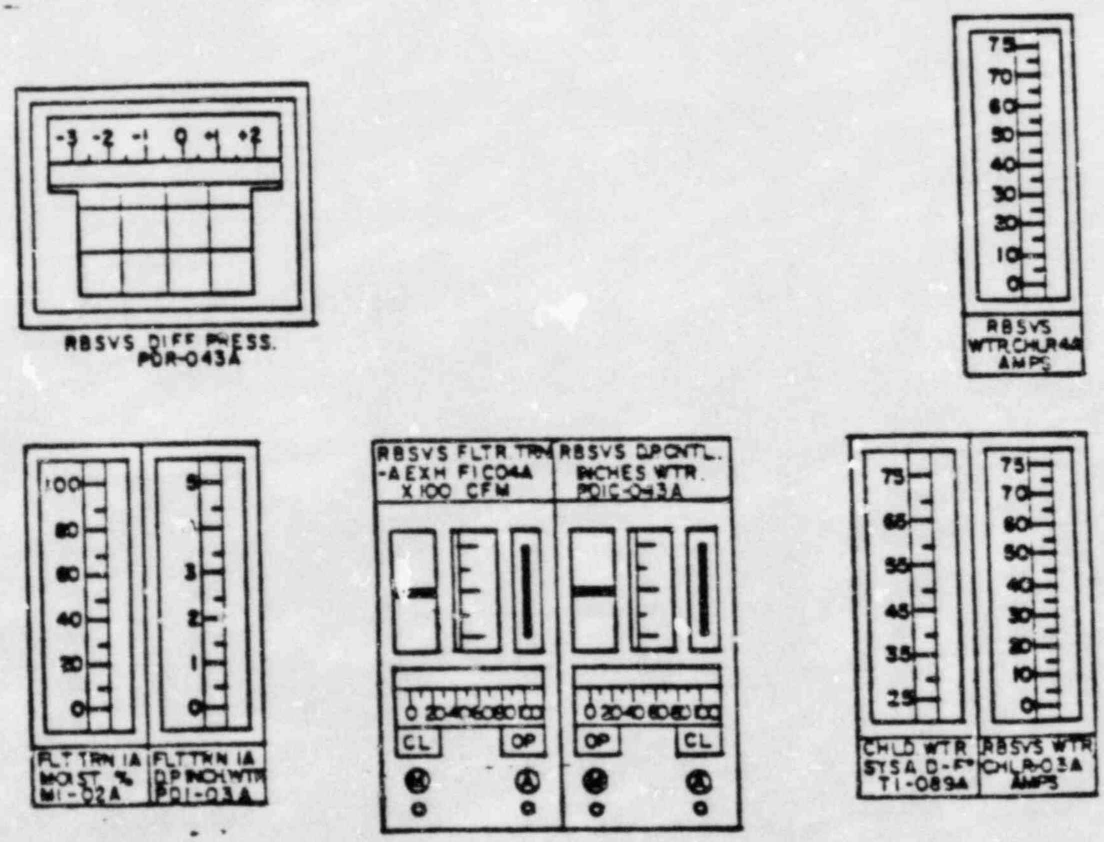
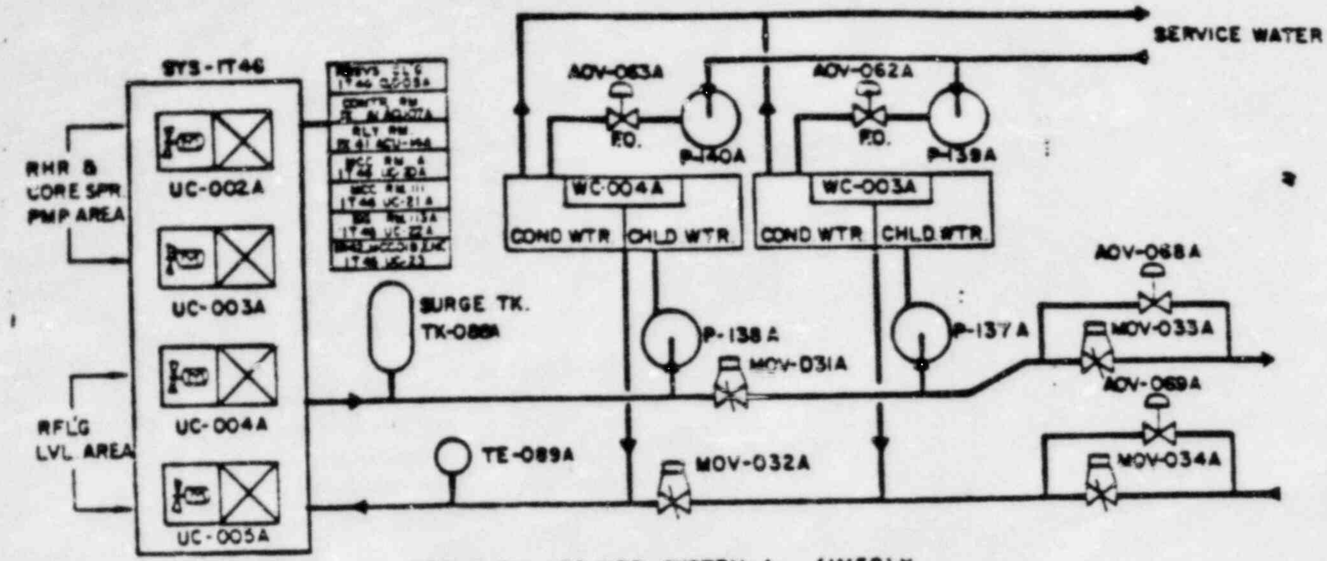


FIG. 9



RBSVS CHILLED WTR. SYSTEM-A (1M50)*

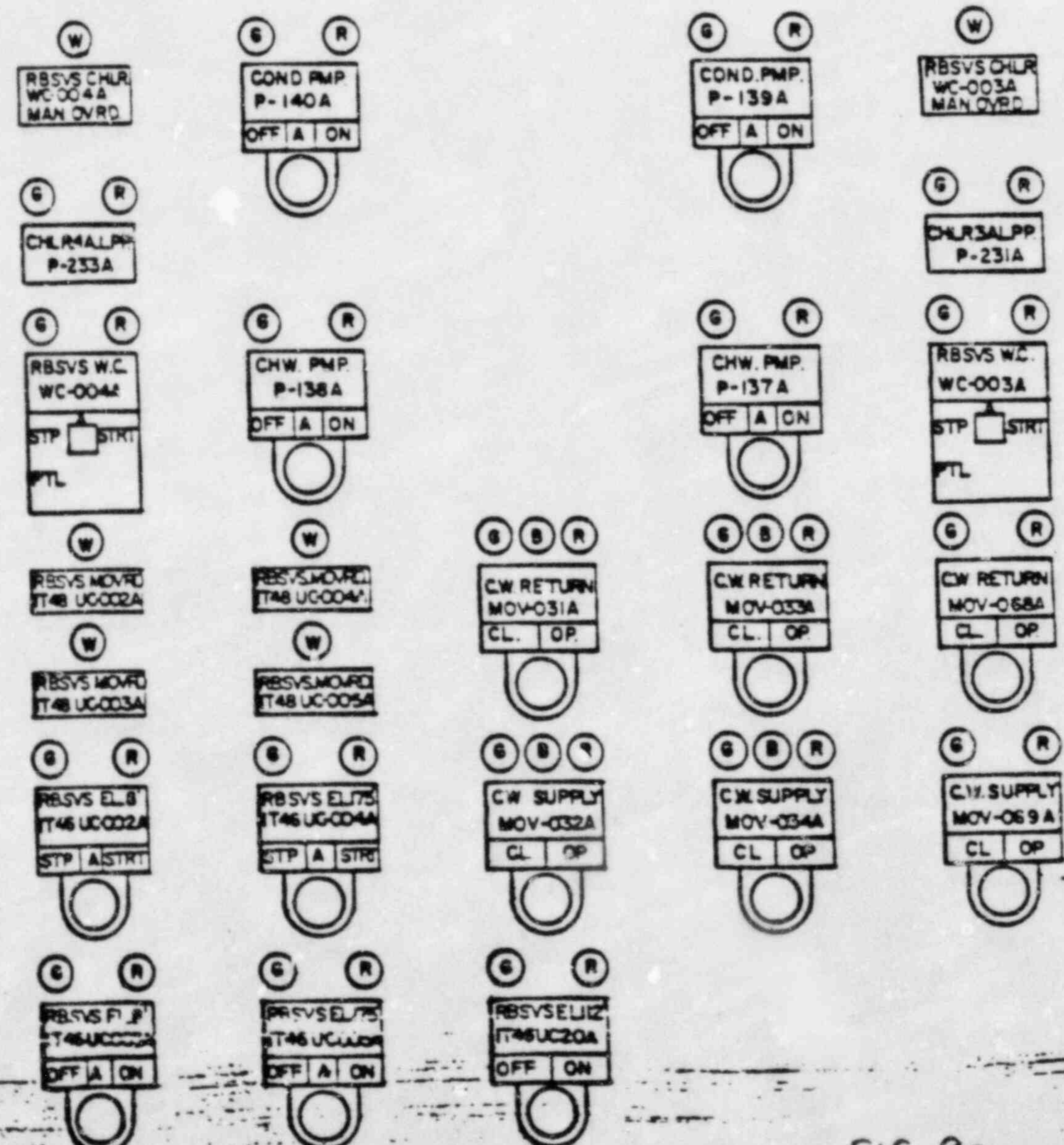


FIG. 9a

ROD WORTH MINIMIZER/ROD SEQUENCE CONTROL SYSTEM
STUDENT HANDOUT FOR SHIFT (SRO)
ADVISOR TRAINING PROGRAM

DATE: 05/10/84

PREPARED BY: L. T. Pilis 5/10/84
Training Instructor / Date

REVIEWED BY: 5/10/84
Operations Training Specialist / Date

REVISION NUMBER: 0

APPROVED BY: 5/10/84
Training Supervisor / Date

I OBJECTIVES

The student should be able to:

7.1 State the purpose of the RWM/RSCS systems as given in the Student handout.

7.2 From control room indications identify the following RWM conditions:

- a) Normal Operation
- * b) Single insert error
- * c) Withdraw block caused by 3 insert errors
- * d) 3 insert errors & non-error rod selected
- * e) Withdraw block caused by a single withdraw error
- f) Select error
- g) RWM Program Inop
- h) RWM auto. bypass
- i) RWM manual bypass

In addition for each of the * conditions identify control rods that you are able to reposition.

7.3 From control room indications identify the following RSCS conditions:

- a) All rods that are full in
- b) Rods that are bypassed in RSCS
- c) All rods in a given RSCS group
- d) Free rods in a RSCS group
- e) Insert block
- f) Withdraw block

I PURPOSE

A. The purpose of the Rod Worth Minimizer (RWM) is to reinforce procedural controls when operating at low power conditions to limit the reactivity worth of the control rods to reduce the severity of a rod drop accident.

B. The purpose of the Rod Sequence Control System (RSCS) is to enforce adherence of control rod movements to a predetermined sequence during startup and low power operation to limit the reactivity worth of the control rods to reduce the severity of a rod drop accident.

III SYSTEM DESIGN

A. GENERAL DESCRIPTION Refer to figure 1

1. The rod worth minimizer is a monitoring system which ensures that the plant operator adheres to a predetermined sequence of control rod withdrawals or insertions when the reactor is operating at low power levels. The rod withdrawal and insert sequence (insertions are made in a reverse order of withdrawals) is designed to limit the worth, or reactivity effect that movement of any single control rod can have on the overall core flux distribution. Operation with low rod worths leads to more economical utilization of the nuclear fuel and also minimizes the effect of an accident such as a rod drop, thereby lessening the chances that such an accident would cause damage to the fuel or to the primary coolant system.

2. The Rod Sequence Control system receives information from the Rod Position Information system and sends it to a logic circuit which monitors rod group, position, and direction of movement. The logic circuit permits any selected rod within the currently Latched group to be moved within its insert and withdrawal limits, if limits are exceeded a rod block is generated. Refer to figure 2.

B. COMPONENT DESCRIPTION

1. Rod Worth Minimizer Components

a. Process computer system

1) Stores two withdrawal sequences and is programmed by the reactor engineering group

2) Sequence can only be modified when the RWM is bypassed.

b. Operator panel on 1H11*PNL-603

1) Contains controls and indications required for operation of the RWM system

a) MANUAL BYPASS
b) SYSTEM INITIATION
c) DIAGNOSTIC PROGRAM REQUEST
d) SELECTION OF SINGLE ROD TEST MODE
e) RWM/COMP PROG RESET

2. Rod Sequence Control System Components

a. Rod pattern controller

1) Contains the logic portion of RSCS that determine the rod limits and patterns.

2) The switches on the face of the RPC are only used for testing and are not normally used by the reactor operator.

3) The keylock switch is normally in the on line position.

b. Operator panel on 1H11*PNL-603

1) Contains controls and indications required for operation of the RSCS system

a) ALL RODS DISPLAY SELECT
b) FREE RODS DISPLAY SELECT
c) RODS FULL IN DISPLAY
d) BYPASS RODS DISPLAY
e) SEQUENCE A or B SHEET
f) INSERT/WITHDRAW DIRECTION SELECT
g) SELECT SUBSTITUTION
h) ROD BLOCK
i) ABOVE LPSP INDICATION

IV CONTROLS AND INSTRUMENTS

A. The following RWM system controls and indications are located on PNL-603 in the control room. Refer to Figure 1.

1. INSERT ERROR Digital Display Windows.

These two four-digit displays are used to identify control rods responsible for causing insert errors. The X coordinates of the error rod are displayed in the two leftmost positions of each display, and the Y coordinates are shown in the two rightmost positions. The rod which causes the first insert error encountered by the program is identified in the upper of the two INSERT ERROR displays. If a second insert error occurs before the first error has been corrected, the second error rod is identified in the lower display window. If there are no insert errors or if the RWM is bypassed, these windows are blanked (manual auto bypass).

2. WITHDRAW ERROR Digital Display Window

This four-digit display is used to identify a control rod responsible for a withdraw error. The WITHDRAW ERROR display is blanked if there is no withdraw error or if the RWM is bypassed (manual or auto bypass).

3. ROD GROUP Digital Display Window.

The two-digit window is used to display the group number of the rod group that is currently latched. The window is blanked whenever the RWM is bypassed or when no sequence, and consequently no rod group, is latched.

4. SELECTED ERROR Indicator Light.

This indicator lights amber whenever a control rod is selected which is not contained in the currently latched rod group or which is not an error responsible for an existing rod block.

5. INSERT BLOCK Indicator Light.

This indicator lights red whenever an insert block is applied by the RWM program.

6. WITHDRAW BLOCK Indicator Light.

This indicator lights red whenever a withdraw block is applied by the program.

7. <u>MANUAL Indicator Light</u>.

This indicator lights red when the RWM is manually bypassed.

8. <u>AUTO Indicator Light</u>.

This indicator lights red when the reactor power level is above the low power alarm point. (indicates auto bypass).

9. <u>NORMAL - BYPASS Keylock Switch</u>.

This switch is used to manually bypass the RWM function.

10. <u>SYSTEM INITIALIZE Pushbutton</u>.

Switch/Indicator. The SYSTEM INITIALIZE switch is depressed to initialize the RWM system. <u>Initialization must performed whenever the RWM has been taken off line, as occurs whenever the RWM program is aborted</u>. Therefore, following any program abort, the SYSTEM INITIALIZE switch must be depressed before the program can again be run. The SYSTEM INITIALIZE portion of the window lights while the switch is held down.

11. <u>ROD TEST</u>

This Pushbutton/Switch Indicator is <u>used to allow withdrawal and reinsertion of any one control rod while all other control rods are fully inserted</u>.

12. <u>OUT OF SEQUENCE Indicator Light</u>.

This indicator light is illuminated when the actual rod pattern is out of sequence while the RWM system is in process of determining which group to latch. This is the case for restarts, power decreasing below LPAP, rod drift and system diagnosis.

13. <u>BELOW LPSP Indicator Light</u>.

This indicator light is illuminated whenever the reactor core power is below the LPSP setting. (20%) Low Power Setpoint

14. <u>BELOW LPAP Indicator Light</u>.

This indicator is illuminated whenever the reactor core power is below LPAP setting. (30%) Low Power Alarm Point

15. SYSTEM DIAGNOSTIC Switch/Indicator.

This switch can be depressed at any time after the system has been initialized to request that the system diagnostic routine be performed. The RWM program will thereupon be initiated and will perform the routine, which consists of applying and then removing in sequence the insert, and withdraw blocks. The operator can verify the operability of the rod block circuits by observing that the INSERT BLOCK, and WITHDRAW BLOCK alarm lights come on and then go off as the blocks are applied and removed. The SYSTEM DIAGNOSTIC indicator lights white when the switch is depressed. It will remain on, and the diagnostic routine will be repeated over and over until the switch is depressed a second time. This halts the routine and extinguishes the indicator light.

16. RWM - COMP - PROGR Pushbutton.

Switch/Indicator. The three segments of this indicator are used to alarm various hardware and software failures within the RWM system. The pushbutton switch is used both to verify that the indicator lights are operative and to reset the lamp driver circuits for these indicators in the output buffer. The PROGR portion of the indicator is lit whenever the RWM program is operative; i.e., whenever the program has been aborted and has not been reinitialized, or when the RWM is manually bypassed, the COMP portion is lit whenever a computer malfunction occurs. The RWM portion is lit concurrently with either the PROGR or COMP quadrants. When the pushbutton is released, the lamp driver circuits for these indicators in the output buffer are reset and, provided none of the failure conditions just described are still present, all three of the indicator lights are extinguished.

B. The operator interface with the RWM system consists of the following control functions:

1. RWM Initialization
2. Functional check of withdrawal capability of any control rod providing that all other control rods fully inserted.
3. RWM Diagnostic Test
4. RWM/COMP/PROGR lamp test
5. RWM/COMP/PROGR alarm reset
6. Interpreting RWM display data to determine and correct rod movement errors

C. The operator is provided indications of the following at the RWM console.

1. Control rods beyond their insert limit
2. Control rods beyond their withdraw limit
3. Currently latched control rod group

4. Control rod selected is not in the currently latched control rod group.
5. Insert Rod Block exists
6. Withdraw Rod Block exists
7. RWM has been manually bypassed
8. RWM has been automatically bypassed
9. Rx power (as measured by Steam flow) is below 20%
10. Rx power (as measured by Steam flow) is below 305
11. RWM program inoperative

D. The above indicators can best be explained by looking at figures 3 through 11 of the RWM console.

1. Normal — Fig 3

   Rx Power < 20%
   Rod in group 1 is selected
   Rod is between its insert and withdraw limits

2. Control rods above their insert limits — Fig 4

   Rx Power < 20%
   Control rods 22-37 & 26-41 are above their insert limits
   NOTE: Insert block does not exist

3. Insert Block caused by at least 3 insert errors — Fig 5

   Rx Power < 20%
   At least 3 control rods are beyond then insert limits
   NOTE: Only 22-37 & 26-41 are shown as insert errors, however as they are corrected rod I.D.'s for other rods with insert errors will appear.

4. Insert and Withdraw Block — Fig 6

   Rx Power < 20%
   At least 3 insert errors and non-error rod selected

5. Withdraw Block caused by a single withdraw error — Fig 7

   Rx Power < 20%
   Control rod 30-19 beyond its withdraw limit

6. Select Error — Fig 8

   Rx Power < 20%
   Rod selected is not in currently latched group

7. <u>RWM Manually Bypassed</u> Fig 9

Rx Power $<$ 20%
RWM manually bypassed

8. <u>RWM Automatically Bypassed</u> Fig 10

Rx Power $>$30%

9. <u>RWM Program Inoperative</u> Fig 11

Rx Power $<$ 20%
<u>NOTE</u>: In addition the Control Rod Block Annunciator (1006) will be lit

ROD SEQUENCE CONTROL SYSTEM

E. The RSCS Operator Display panel has a core map which displays rod position information depending on which pushbutton light is depressed. The core maps lights are light emitting diode (LED) type indicators. A red LED will display either all rods in or all rods that are bypassed depending on which pushbutton is depressed. An amber LED will display all rods in a control group or free rods in a group (Those rods in the control group that can be moved) depending on which pushbutton is depressed. The display panel (light behind pushbutton switch type indicators) are: Sequence select, Direction select, Substitute position select. A more detailed description of these components follows. The following RSCS system controls and indications are located on PNL-603 in the control room refer to Figure 2.

1. RSCS Display Panel Controls (Panel 603)

   a) AMBER DISPLAY CONTROL - Selects either ALL RODS assigned to the group selected or FREE RODS which are permitted movement in an assigned group to energize the amber LED core map.

   b) RED DISPLAY CONTROL - Selects either control RODS F.I. (full in) or control rods BYPASSED to energize the red LED core map.

   c) SELECT - Selects either SEQ A or SEQ B for display.

   d) DIRECTION - Informs the RSCS the direction that the operator is intending to move rods.

   e) SUBSTITUTE POSITION SELECT - Enables operator to accept substitute control rod position data.

2. RSGS Operator Display Panel Lamp Indicators (Panel 603)

a) ALL RODS - Energized when all rods in an assigned group are selected for display by the AMBER LED core map.

b) FREE RODS - Energized when the FREE RODS in an assigned group which are permitted to move are selected for display by the AMBER LED core map.

c) RODS F.I. - Energized when RODS FULL IN are selected for display by the RED LED core map.

d) BYPASS - Energized when RODS BY-PASSED are selected for display by the RED LED core map.

e) INS BLK - Energized when the RSCS applies an insert rod block.

f) WH BLK - Energized when the RSCS applies withdraw rod block.

g) SEQ A - Energized when Sequence A is selected

h) SEQ B - Energized when Sequence B is selected

i) INSERT - Energized when the insert driving direction is selected

j) W/DRAW - Energized when the withdraw driving direction is selected.

k) ABOVE 20% - Energized when the first stage turbine pressure equivalent power level is above 20% (Low Power Set Point).

l) SEL SUB - Energized when substitute control rod position data is selected.

m) SUBSTITUTE POSITION - Displays two digit, substitute rod position data.

n) RED LED (core map) - Energized red LED for each control rod which is full in, or energized red LED for each control rod which is bypassed

o) AMBER LED (core map) - Energized amber LED for each of the controls rods which are assigned to the group selected, or energized amber LED for each of the assigned control rods in the group selected which are permitted movement.

NOTE: Only one amber LED may blink at any one time, i.e., only for the selected control rod.

F. The operator is provided indication of the following at the RSCS Operator Display Panel.

1. All rods full in
2. Rods that are bypassed in RSCS
3. All rods in group selected
4. Free rods in assigned group which are permitted to move
5. Insert block
6. Withdraw block
7. Sequence A or B selected
8. W/DRAW - on when withdraw selected
9. Above 20% - on when first stage turbine pressure is equivalent to 20% reactor power
10. Sel Sub - on when substitute position data selected
11. Substitute Position - display two digit position data

NOTE: The above indications can best be explained by referring the enclosed figures 12 through 16 of the RSCS Operator Display panel.

G. Figures for RSCS Display

1. Normal Shutdown — Fig 12

   All rods FULL IN and FULL IN pushbutton selected.

2. Sequence B Selected — Fig 13

   LEDS are lit for all rods within currently latched groups.

3. Bypass selected and rods 18-51, 18-3, 34-3, 34-51 are bypassed — Fig 14

4. Sequence A latched, Group 5 Free rods selected, withdraw direction selected and an attempt is made to withdraw the wrong rod past its withdraw limit so a W/DRAW block is received. Note insert block is reverse. Fig 15

5. Sequence B latched, Group 1 Free rods selected, withdraw direction selected, and moves but RSCS does not receive position indication, Sel Sub is selected and missing position is displayed in SUBSTITUTE POSITION. Fig 16

H. INTERLOCKS

1. Auto initiation of the RWM/RSCS systems will occur due to the following signals:

Signal	Identification
1. Low Power Alarm Point (LPAP) $\leq$ 30% steam flow. (but > 20% steam flow)	1. RWM/RSCS is activated and provides alarms and indications but does not apply rod blocks. 2. Indicated by LPAP light illuminated on RWM operator console.
2. Above LPAP $\geq$ 30% steam flow.	1. RWM AUTO BYPASS light illuminated and all RWM/RSCS rod blocks are defeated. 2. Indicated by LPAP light off.
3. Low Power Setpoint LPSP $\leq$ 20% steam flow.	1. RWM/RSCS will enforce rod program sequence and provide rod blocks. 2. Indicated by LPSP light illuminated on RWM operator console and RSCS console. 3. $\geq$ 20% steam flow, rod blocks defeated LPSP light out on RWM, on RSCS.

2. Component Interlocks

a. Rod blocks from RWM.

1) If the RWM is not bypassed and power less than 20% rated steam flow then the following RWM signals will cause rod block in the RMCS.

- Withdrawal block if one withdrawal error exists

- Insert block if 2 insertion errors exist and rod movement causes third insertion error

b. Rod blocks from RSCS

1) Selection of a rod which is inconsistent with the established sequence results in a rod withdrawal and insertion block of that rod.

2) Movement of a rod past withdraw or insert limit will result in a rod block and only rod motion in the direction to correct the error is allowed.

I ANNUNCIATORS

- The following parameters are annunciated in the Main Control Room.

Annunciator	ARP#	Control Room Verification
1. RSCS INOP	1429	1. Insert/withdraw permissive light not lit on the operator display console. 2. Check RSCS panel 659 for a) Self test fail indication b) Loss of power c) Circuit card removed

SYSTEM PROCEDURES

A. SYSTEM PRECAUTIONS, CAUTIONS AND/OR LIMITATIONS

1. Do not bypass any control rod in the RSCS having a failed "FULL IN" or "FULL OUT" limit switch unless the actual rod position is known.

a) The purpose of this precaution is to prevent crossing tips and ensuring reactor engineering is aware of possible rod in abnormal position for sequence selected.

2. Bypassing an inoperable rod in the RSCS is permissible only if, there are not more than 3 INOP control rods in any RSCS group and the position and bypassing of INOP control rods is verified by a second licensed operator or other Technically qualified member of the unit technical staff.

   a) The purpose of this precaution is to prevent exceeding a technical specification limiting condition for operation (LCO).

3. Removal of HP Turbine first stage pressure transmitters 1C11-PT-112A (B) from service will result in a signal from the process instrumentation to the RSCS that reactor power is below the Low Power Setpoint (LPSP).

   a) At > 20% power this would result in insert and withdraw rod blocks being imposed by the RSCS.

4. The keylock switch on the Rod Pattern Controller shall only be turned to OFF-LINE while performing diagnostic testing.

   a) The purpose of this precaution is to ensure RSCS is operable at all times except for required testing.

B. NORMAL OPERATION

1. With reactor power ≤ 20% the RWM and RSCS systems are in operation and enforce a pre-planned sequence of rod movements.

2. With reactor power ≥ 20% and < 30% of the rod block functions of the RWM and RSCS systems are bypassed but the alarms are active for information.

3. With reactor power ≥ 30% the RWM and RSCS systems are bypassed.

C. ABNORMAL OPERATION

1. RSCS OPERATION WITH INVALID POSITION DATA

NOTES: In the event of a failure in the rod position circuitry resulting in invalid position data presented to the RPC, substitute data may be entered. This will permit movement of this rod to its next valid location.

If position data is invalid at the next location also, no further input of substitute position data will be accepted for that rod until the rod has been located at a position with valid data by bypassing the rod as per section 2 of this procedure.

   a. If valid control rod position data is not available to the RSCS for a rod, enter substitute data.

2. RSCS CONTROL ROD BYPASSING

NOTE: In the event of a failure in the electronics that exceeds the capabilities of the substitute data provisions, such as failure of position switches in both channels of one rod, or in case of mechanical or electronic failure that causes a control rod to be frozen in position, a way has been provided to bypass up to 8 control rods. The bypass switch cards are located in RSCS cabinet 1H11*PNL-659 inside a locked compartments. Each bypass switch card contains 10 two-way toggle switches (S1-S10) so that the 10 digit binary coding X0, X1, X2, X3, X4, and Y4, Y3, Y2, Y1 and Y0) for any particular position probe can be identified. Each bypass switch card also contains an additional switch (S11) which enables the address of the bypass switches to be activated. Placing this switch to the Bypass position will also turn on an LED, indicating that the address set in on the address switches has been bypassed. A bypassed rod is essentially transparent in all logic equations; that is, it will not cause the result of any equation to be either true or false.

CAUTION: With an inoperable control rod(s), OPERABLE control rod movement may continue by bypassing the inoperable control rod(s) in the RSCS provided that: The position and bypassing of inoperable controls rods is verified by a second licensed operator or other technically qualified member of the unit technical staff, and there are not more than 3 inoperable control rods in any RSCS group. See Technical Specification 3.1.4.2.

3. Substitute Control Rod Position

a. If a control rod position indicator fails, the operator has the capability of manually inputting the control rod's position into the computer program if the actual position is known. This can be accomplished in accordance with the applicable section of SP 53.651.02.

VI SYSTEM INTERRELATIONS

A. The following systems have to be operable to support the RWM.

1) The process computer and its uninterruptible power supply.

2) The reactor manual control system, including the rod position information system

3) The feedwater level control system to provide steam flow signal for LPSP and LPAP.

B. The following systems have to be operable to support the RSCS.

1) The reactor manual control system, including the rod position information system.

2) Turbine first stage pressure instruments for LPSP and LPAP.

VII TECHNICAL SPECIFICATIONS

A. The rod worth minimizer (RWM) shall be OPERABLE.

a) APPLICABILITY - Operational Condition 1 and 2, when THERMAL POWER is less than or equal to 20% of RATED THERMAL POWER, the minimizers allowable preset power level.

B. The rod sequence control system (RSCS) shall be OPERABLE.

a) APPLICABILITY - Operational Condition 1 and 2, when THERMAL POWER is less than or equal to 20% of RATED THERMAL POWER, the minimizers allowable preset power level.

VIII SIGNIFICANT INDUSTRY EVENTS

A. Due to misunderstanding the requirements of operability and allowable maneuvers for the RWM/RSCS systems some stations have erroneously defeated/bypassed these systems and possibly increased the severity of a control rod drop accident (CRDA). See items B and C.

B. Unit one at QC was being shut down for maintenance outage. The operators were inserting control rods in what was thought to be an approved sequence provided by the nuclear engineers. In fact, however, the operators where following RWM printout (from the process computer) which had been inadvertently attached to the sequence approval sheet with the approved/correct sequence. The sheets were apparently not plainly marked and the operators unluckily followed the incorrect sequence sheet. The incorrect sheet (and the one following) specified the correct rod groups to be inserted, however, in the reverse order. QC does not have RSCS.

1. The RSCS system at Shoreham would cause an insert block to be applied to prevent this.

2. Shoreham produces required Reactor Engineering to be present during shutdown and they should verify correct sequence.

C. Hatch, Unit 2, was operating at 25% power in a startup when main condenser vacuum began to decrease. It became apparent to operators that vacuum could not be regained in time to save the unit. The operators began to insert rods using the approved rod sequence, but because of the low rod worth of the control rods in the portion of the sequence, power was not being decreased at the desired rate. A decision was made by the licensed operator with the concurrence of the STA to insert rods using the Notch Override Switch and by individually scramming the rods from the scram test panel. There was no approved procedure for this type of shutdown. The resultant control rod pattern had never been analyzed for a control rod drop accident. The method used (individual control rod scram) resulted in a defeat of the RWM and the RSCS.

1. Shoreham does not have a procedure for this type of operation either.

2. It should be noted that the STA is NOT the SRO in charge of the shift. Adherence to procedures would prevent this incident.

NOTE: Although neither event resulted in fuel damage, both situations jeopardized the respective plants' ability to survive a control rod drop accident (a design basis accident). The control rod sequence, the RWM, the RSCS, and the licensed operators acting in accordance with approved procedures are the vital layers of protection against the control rod drop accident. When operators act to defeat the other protective features, the potential for a very serious accident becomes substantially increased. The NCR staff has proposed a substantial fine against Hatch because of the second incident.

APPENDIX - REFERENCES

A. SYSTEMS DESCRIPTION (RWM) 1020.607

B. SNPS PROCEDURE 23.607.01 (RWM)

C. SNPS PROCEDURE 23.609.01 (RSCS)

D. SNPS PROCEDURE 24.607.01 RWM FRONT PANEL TEST

E. SNPS PROCEDURE 24.609.01 RSCS SELF TEST FUNCTION

F. LESSON PLAN 607 RWM

G. LESSON PLAN 609 RSCS

'PENDIX - CONTROL ROD DROP ACCIDENT

1. The RWM backs up the procedural control to limit the worth of individual control rods during startup and low power operation. Rod worth limits are imposed so that in the unlikely event of a control rod drop from the core, the reactivity addition rate would be below a value that would cause damage to the primary coolant system.

2. A control rod drop accident is possible only if the following sequence of events occurs.

   a) A fully inserted control rod blade becomes completely disconnected from its drive at or near the coupling.

   b) The control rod blade sticks in some inserted position until the control rod drive is fully withdrawn.

   c) The control rod blade falls out of the core with the maximum speed limited only be the velocity limiter.

3. Worst case rod drop accident with no RWM:

   a) In startup region where peak to average neutron flux can be high.

   b) Critical central region of the core

      1) multiple operator errors are assumed

   c) Center rod

      1) becomes uncoupled & sticks at the top of the core

      2) The CRD mechanism is completely withdrawn

      3) The rod then is assumed to drop

   d) Results

      1) Fuel enthalpy exceeds 425 cal/gram

      2) Instataneous fragmentation and dispersion of fuel

3) Large rate of vessel pressure rise causes vessel damage

4. RWM system limits control rod worth

   a) worst case assuming a single sequence error

      1) Enthalpy of 280 cal/gram is reached

      2) Design enthalpy limit of 280 cal/gram ensures that primary coolant system integrity will not be lost from RDA (Note: The threshold of fuel clad failure is 170 cal/gram so some fuel could be damaged)

   b) worst case rod drop (no out of sequence errors exists)

      1) Enthalpy of 100 cal/gram

      2) Well below fuel clad failure threshold

   c) Above 20% power

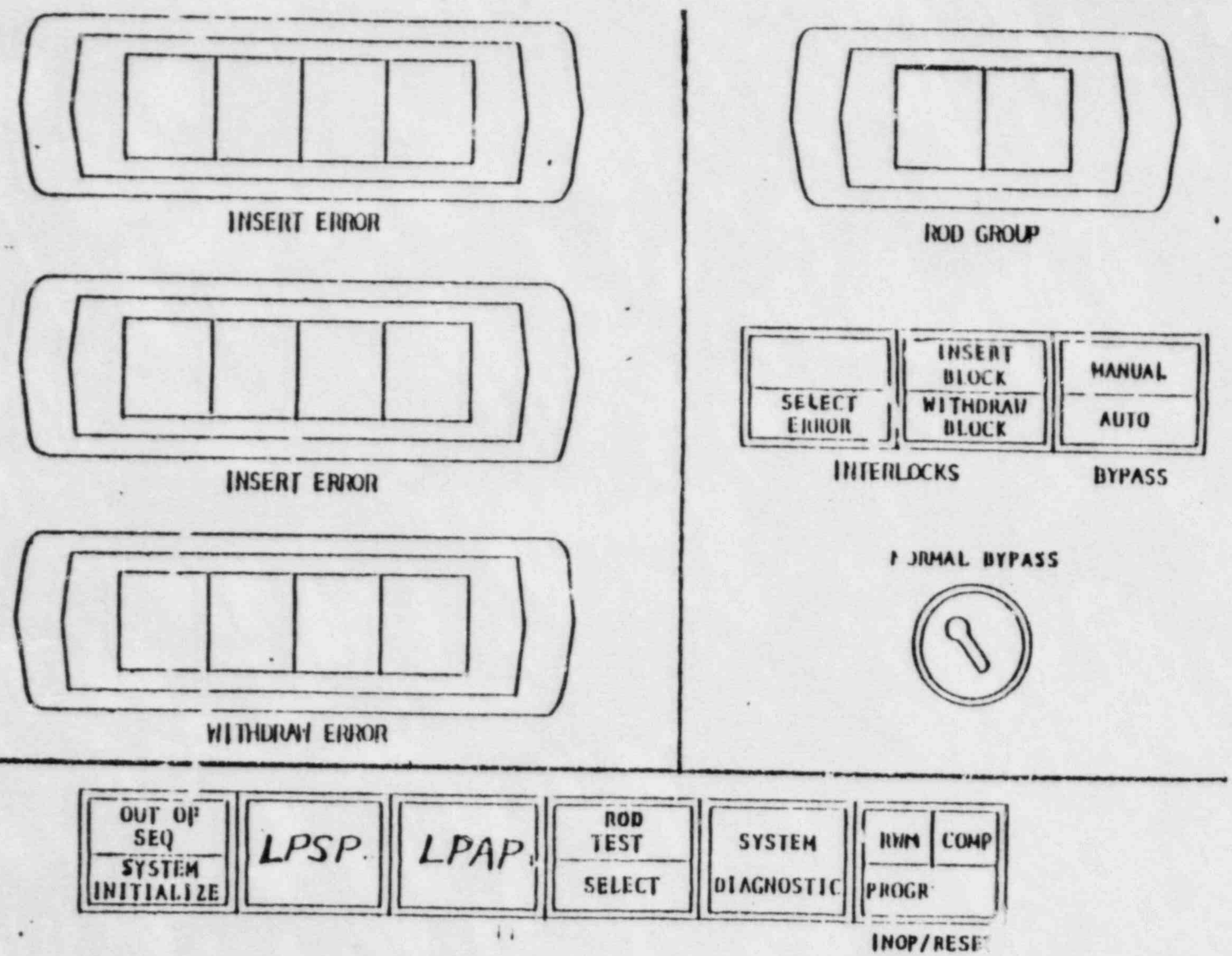
      1) No control rod drop will cause fuel enthalpy of 280 cal/gram - no primary system boundary damage will occur.

5. Relative control rod worth is less during power operation due to:

   a) Increases in power increase voids

   b) Voids flatten peak to average flux profile

   c) Therefore high level rod worths are minimized



RWM OPERATING PANEL

FIGURE

ROD SEQUENCE CONTROL SYSTEM

Operator Display Panel

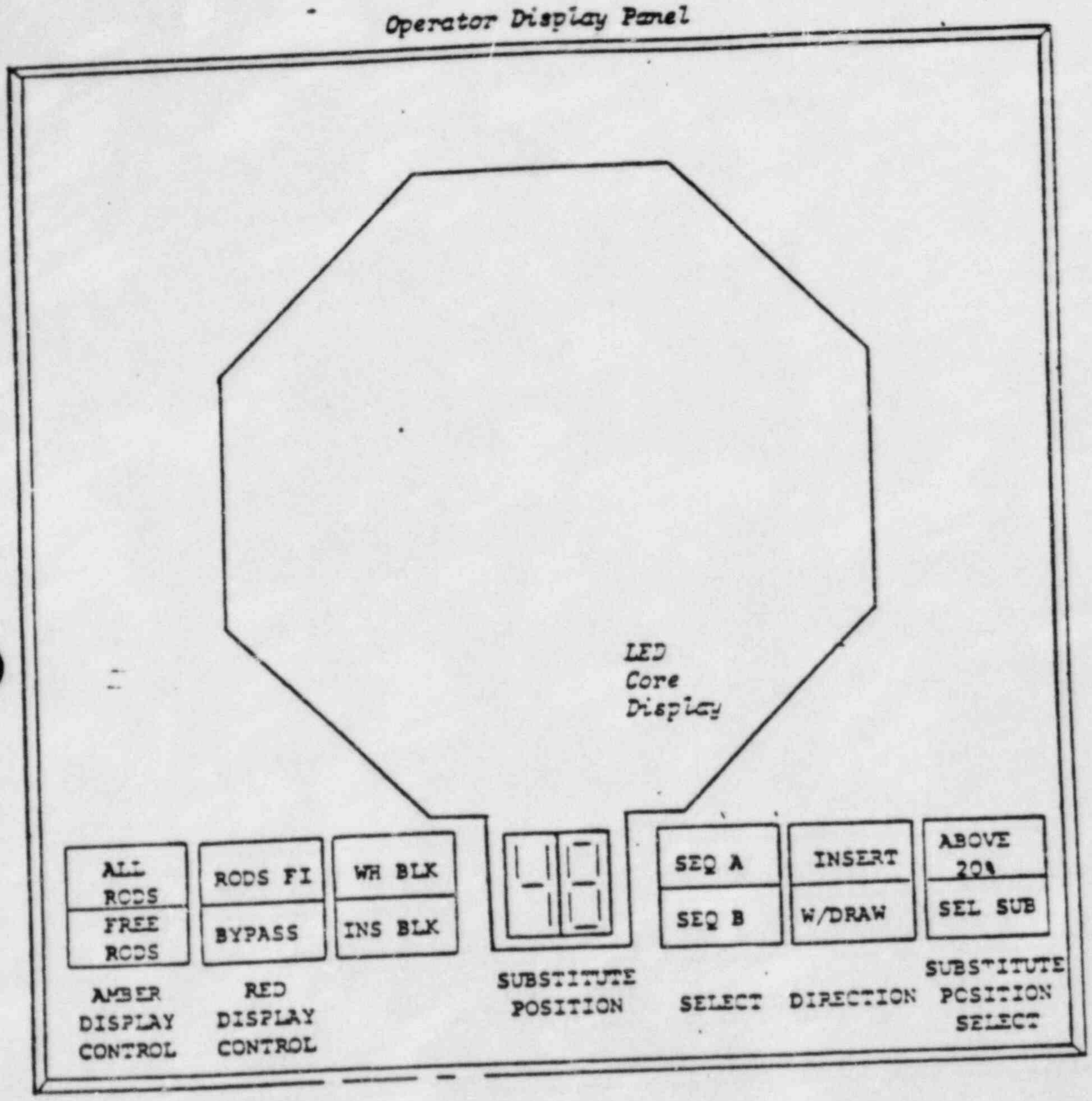
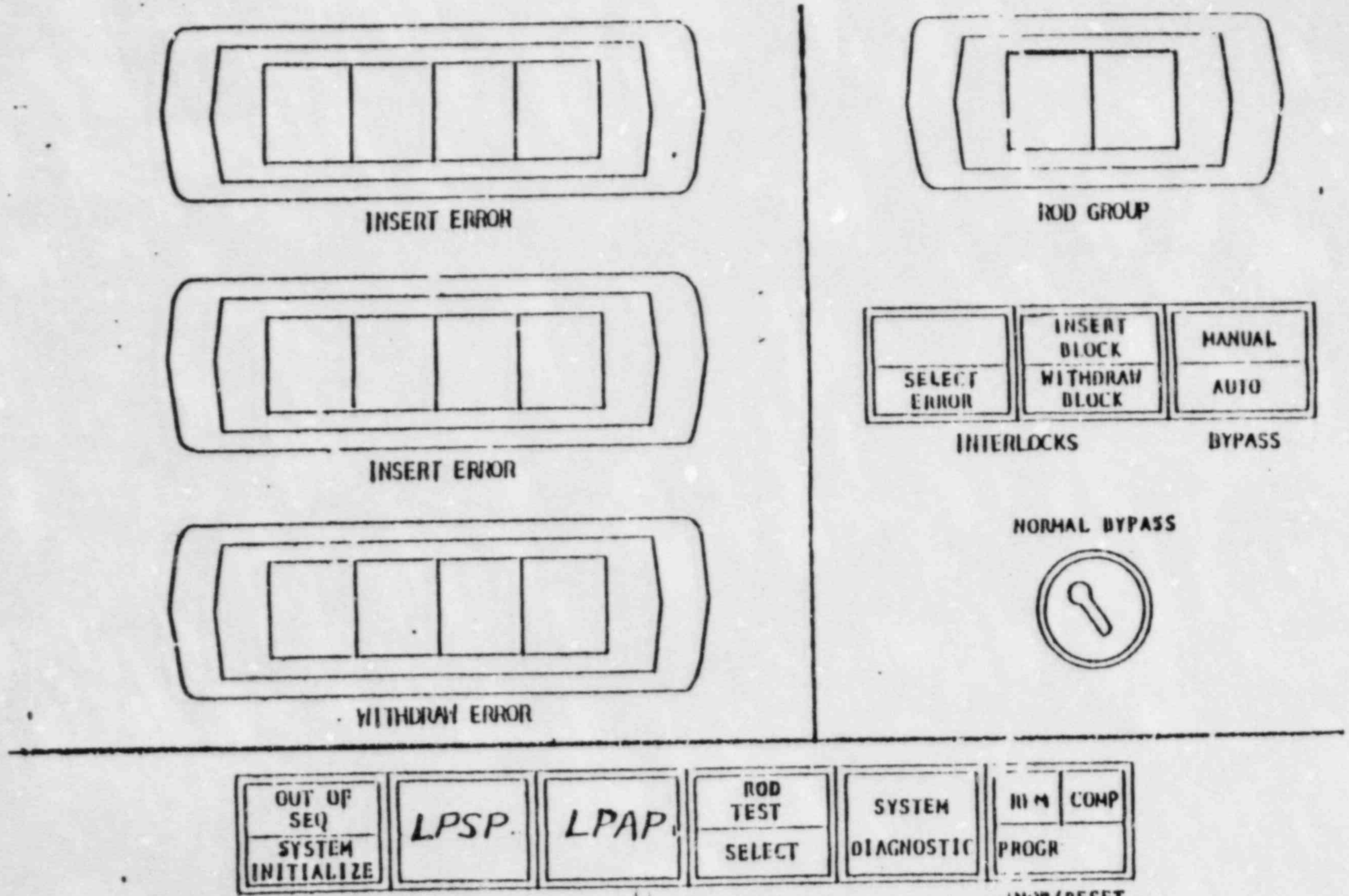
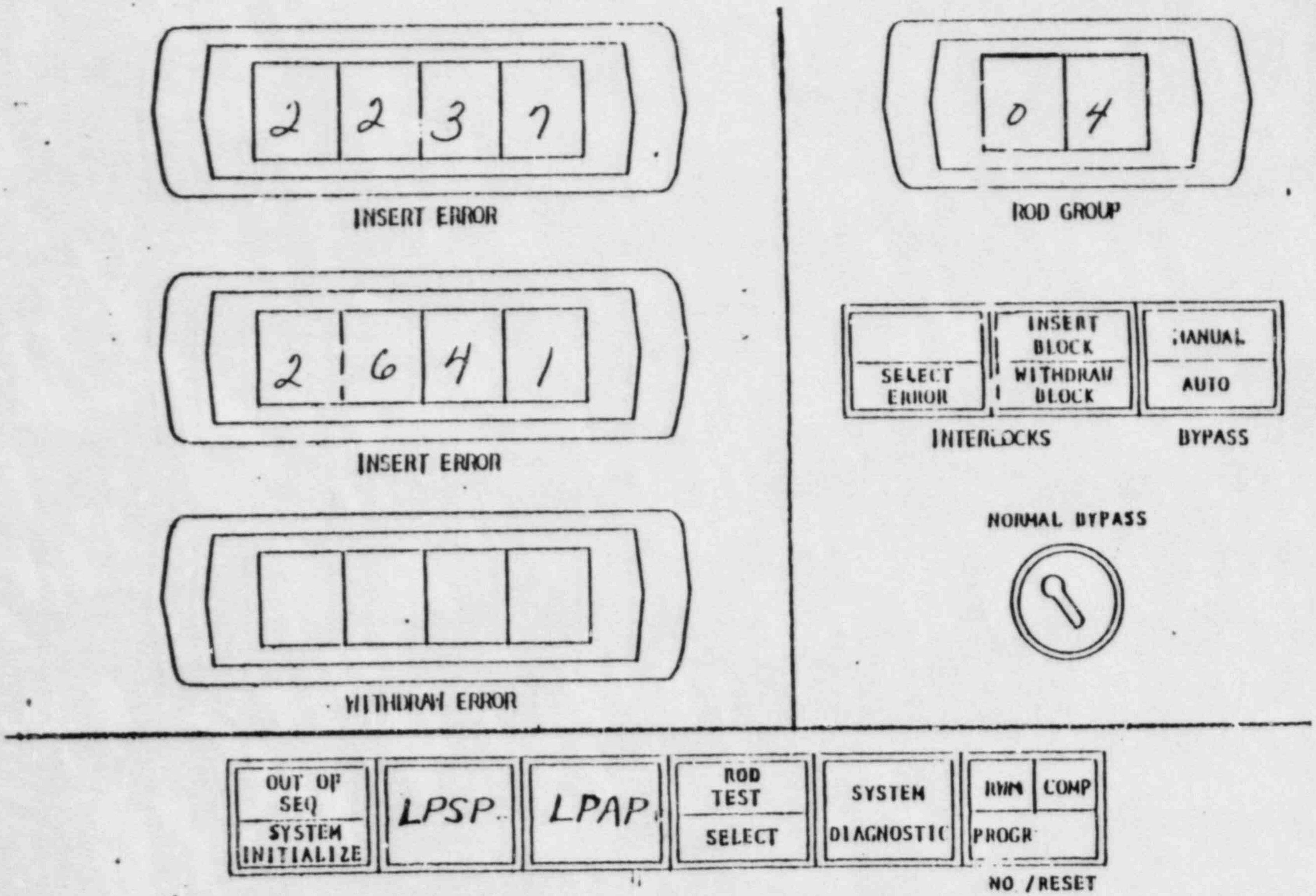


Figure 2



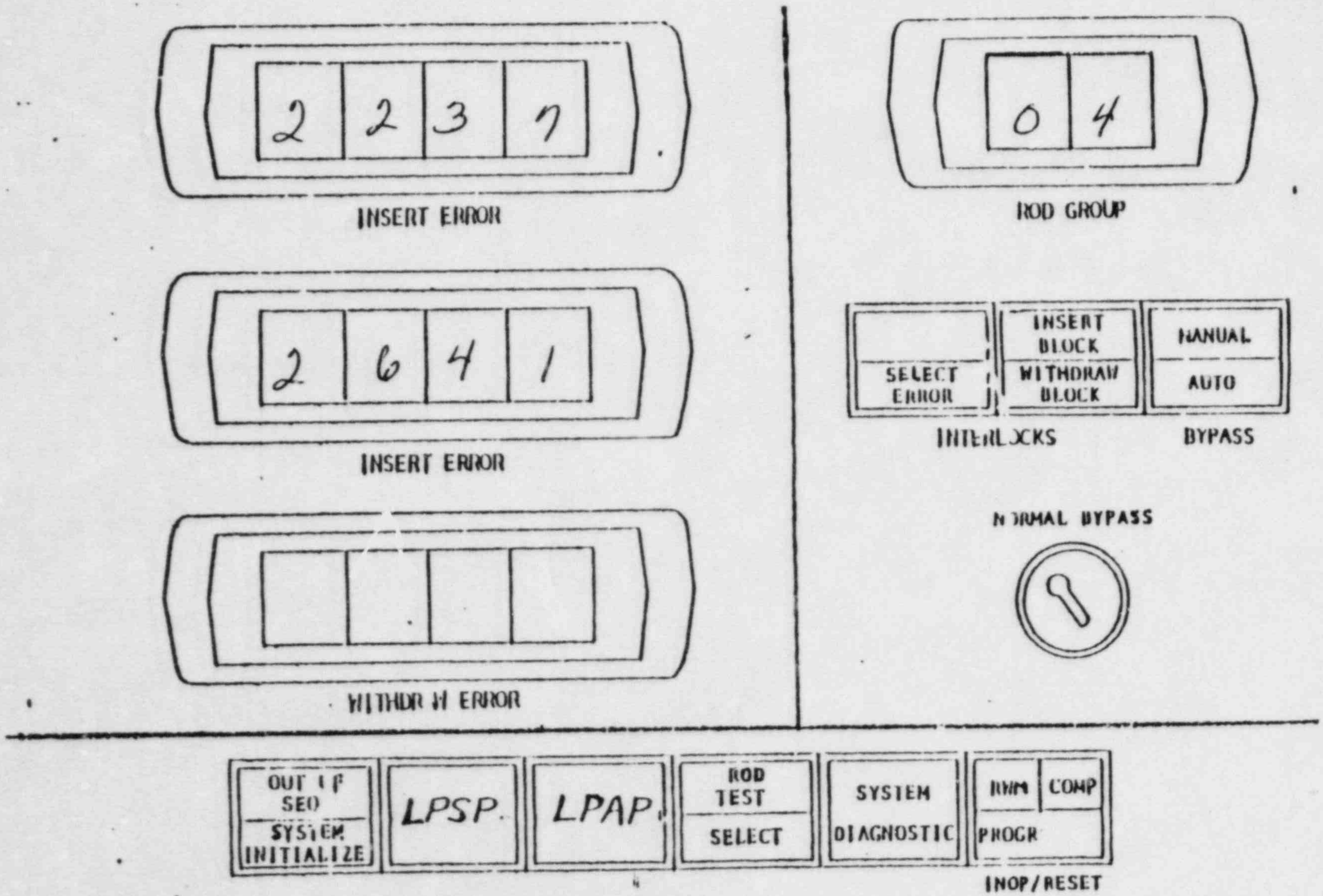
RWM OPERATOR PANEL

FI... 3



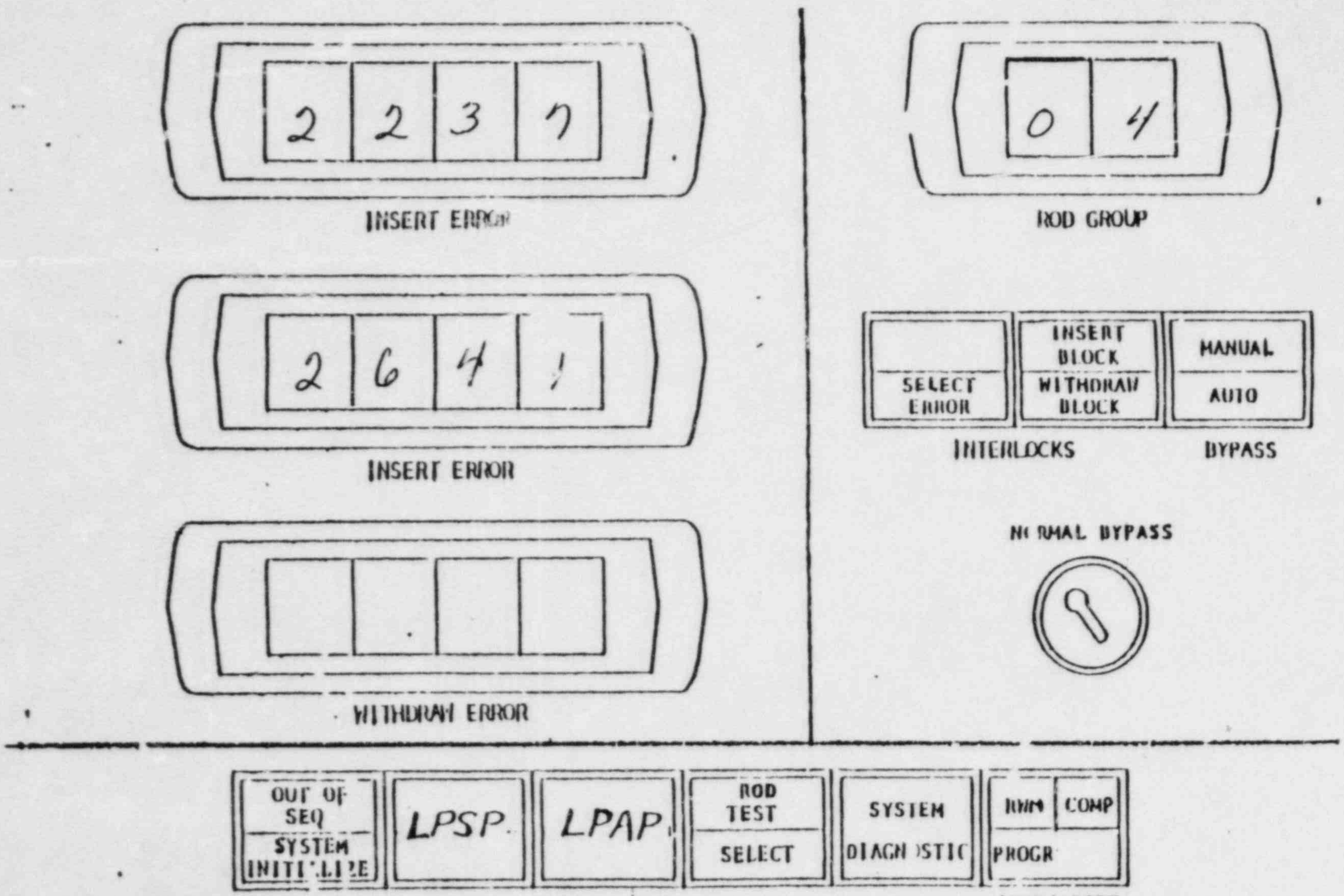
RWM OPERATOR PANEL

FIGURE 4



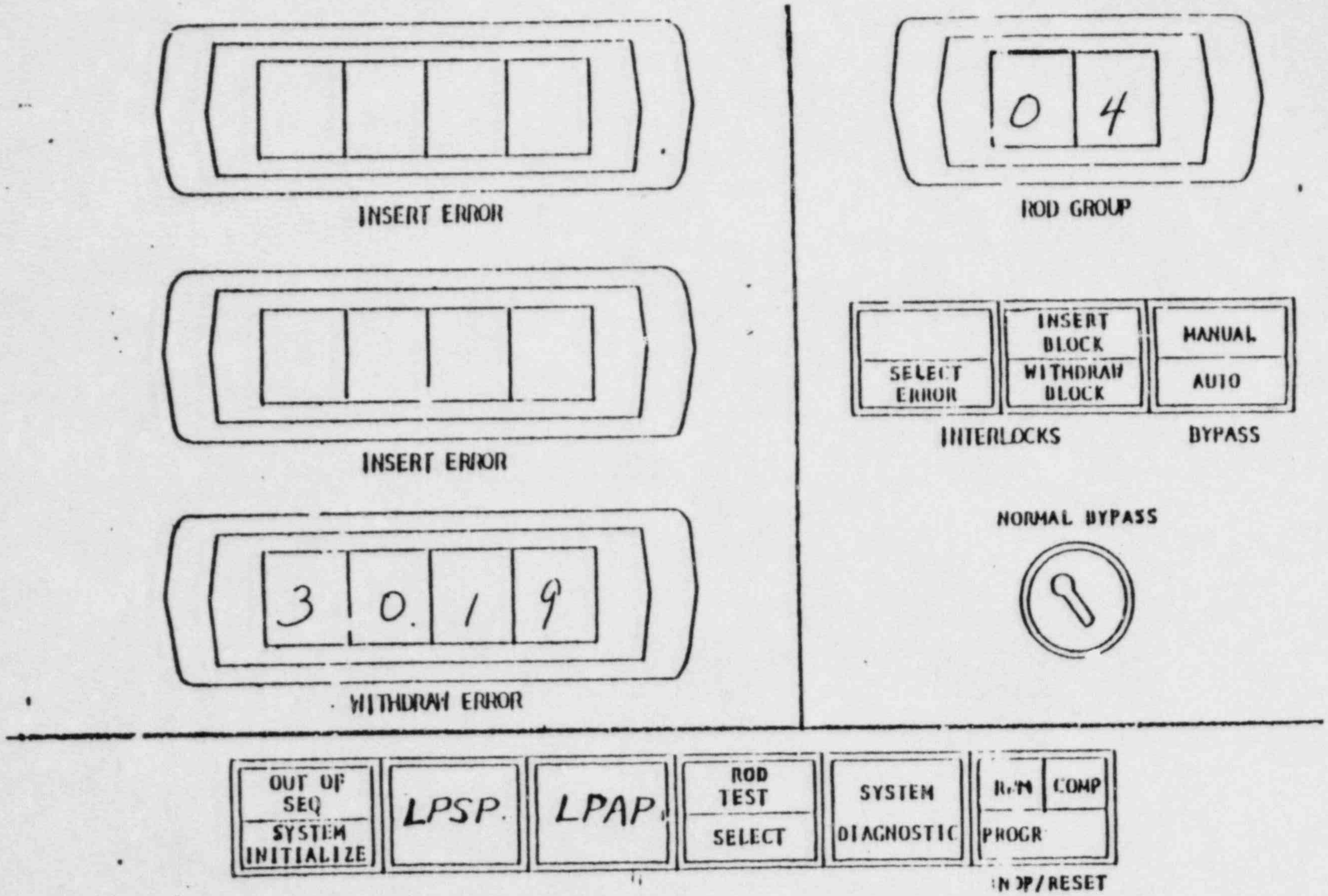
RWM OPERATOR PANEL

FIGURE 5



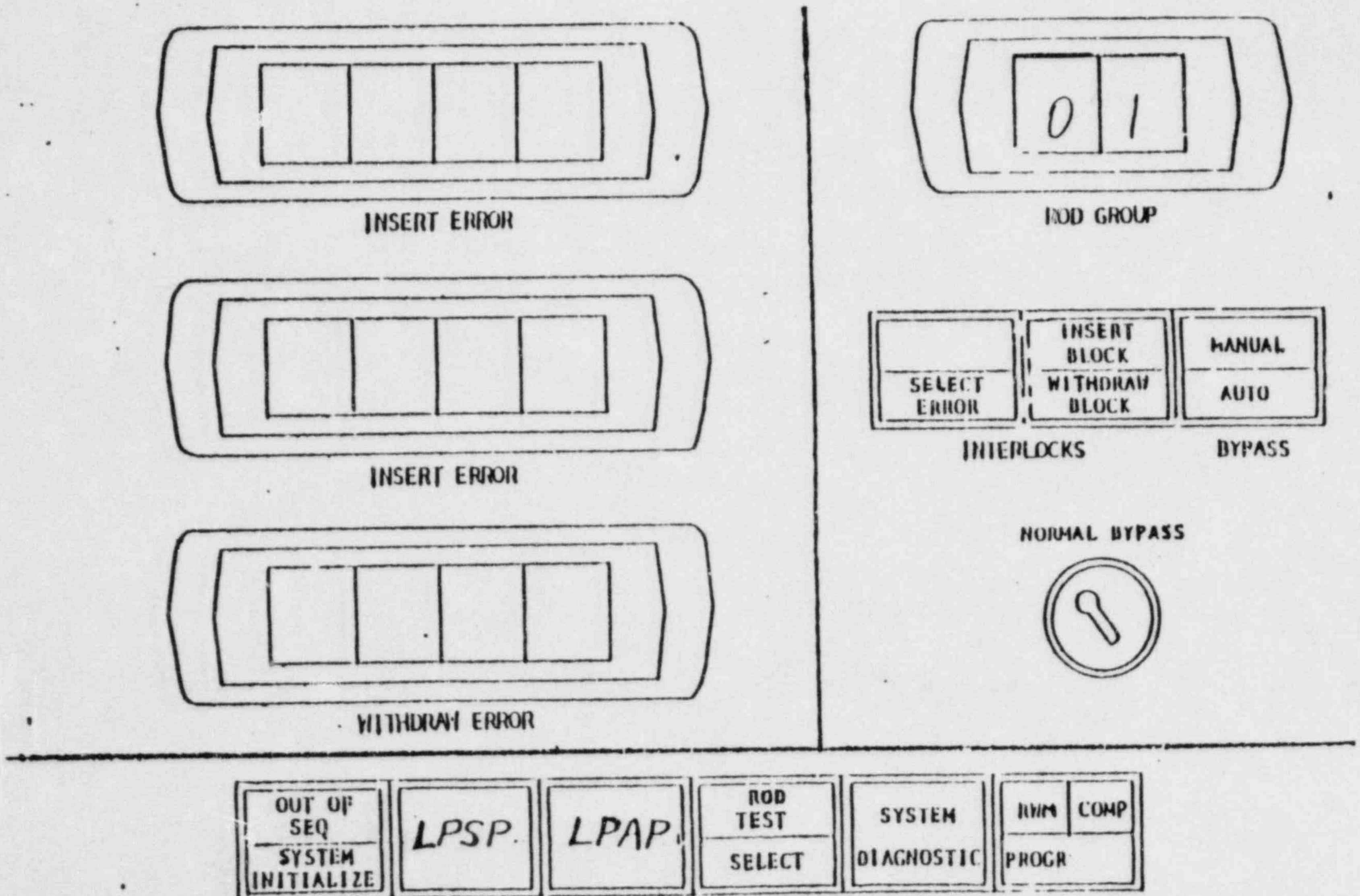
RWM OPERATOR PANEL

FIGURE 6



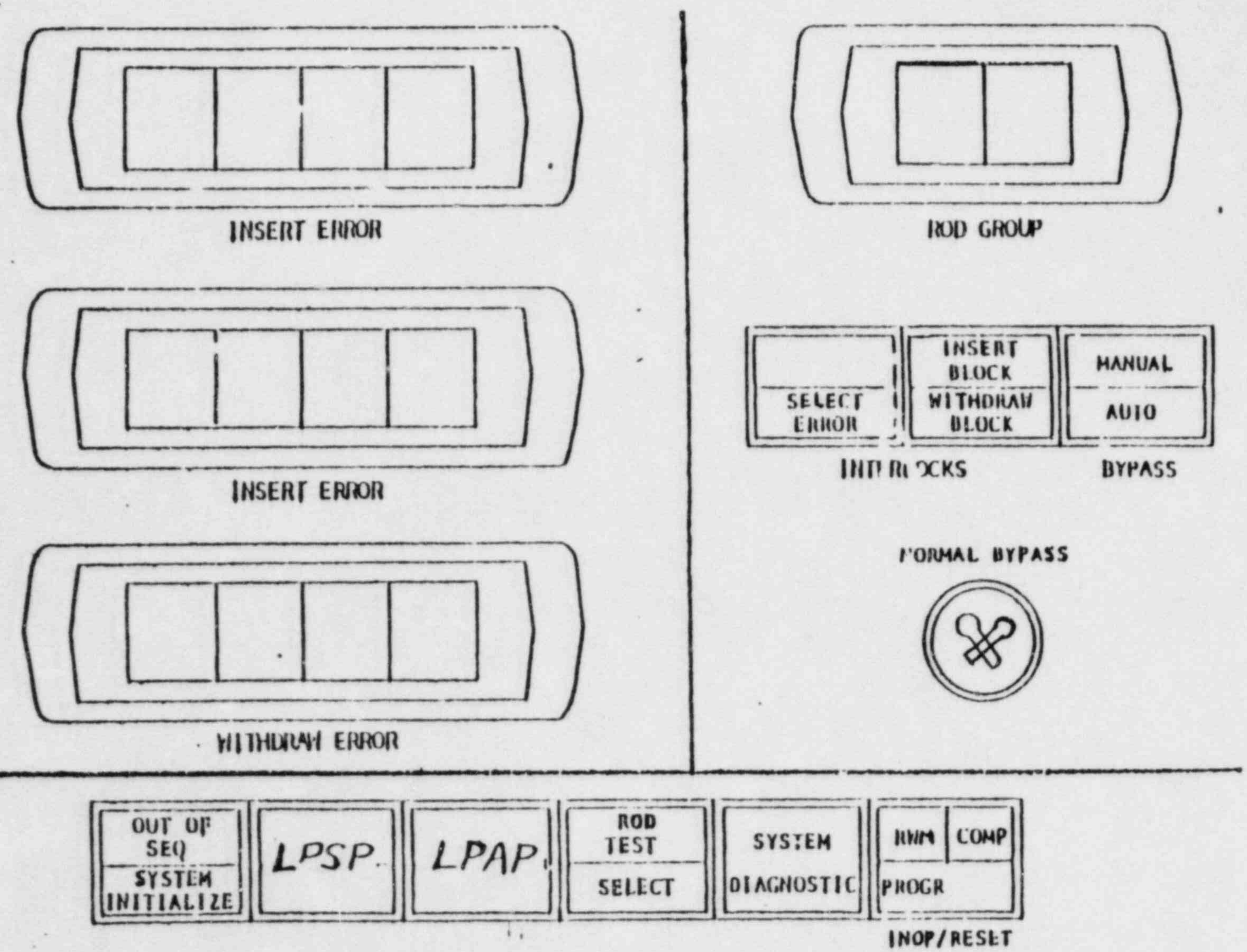
RWM OPERATOR PANEL

FIGURE 7



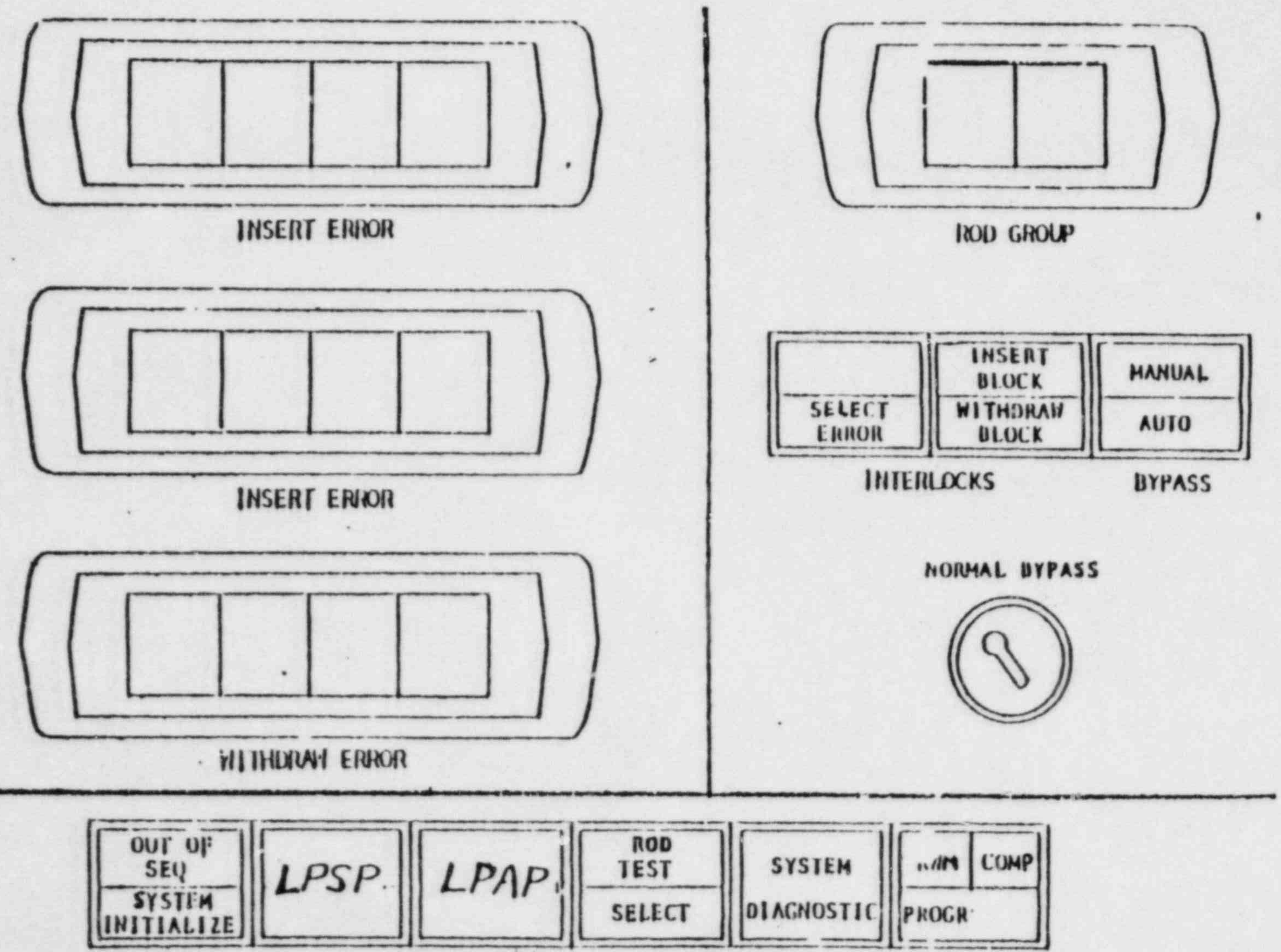
RWM OPERATOR PANEL

FIGURE 8



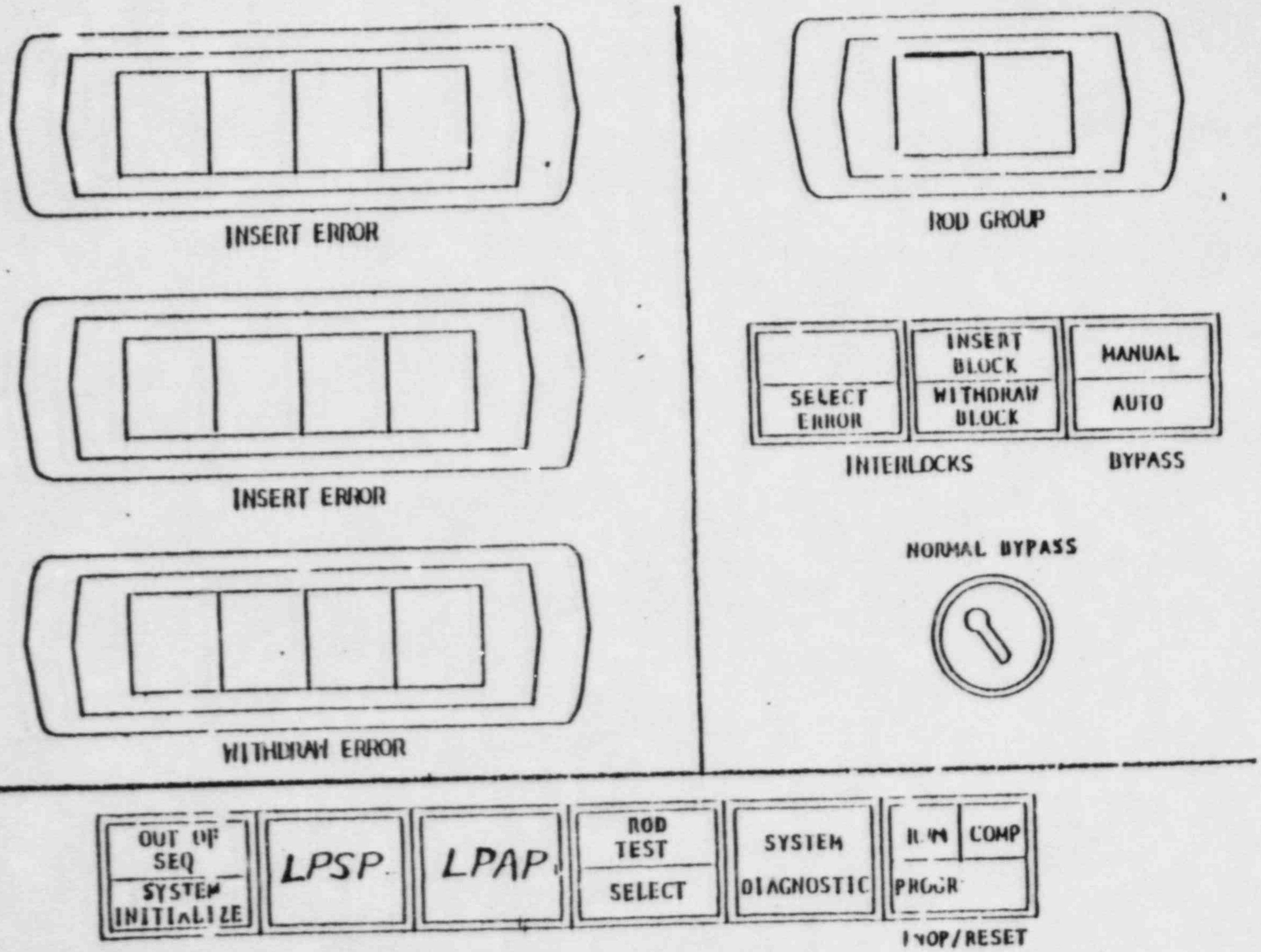
RWM OPERATOR PANEL

FIGURE 9



RWM OPERATOR PANEL

FIGURE 10



RWM OPERATOR PANEL

FIGURE 11

ROD SEQUENCE CONTROL SYSTEM

Operator Display Panel

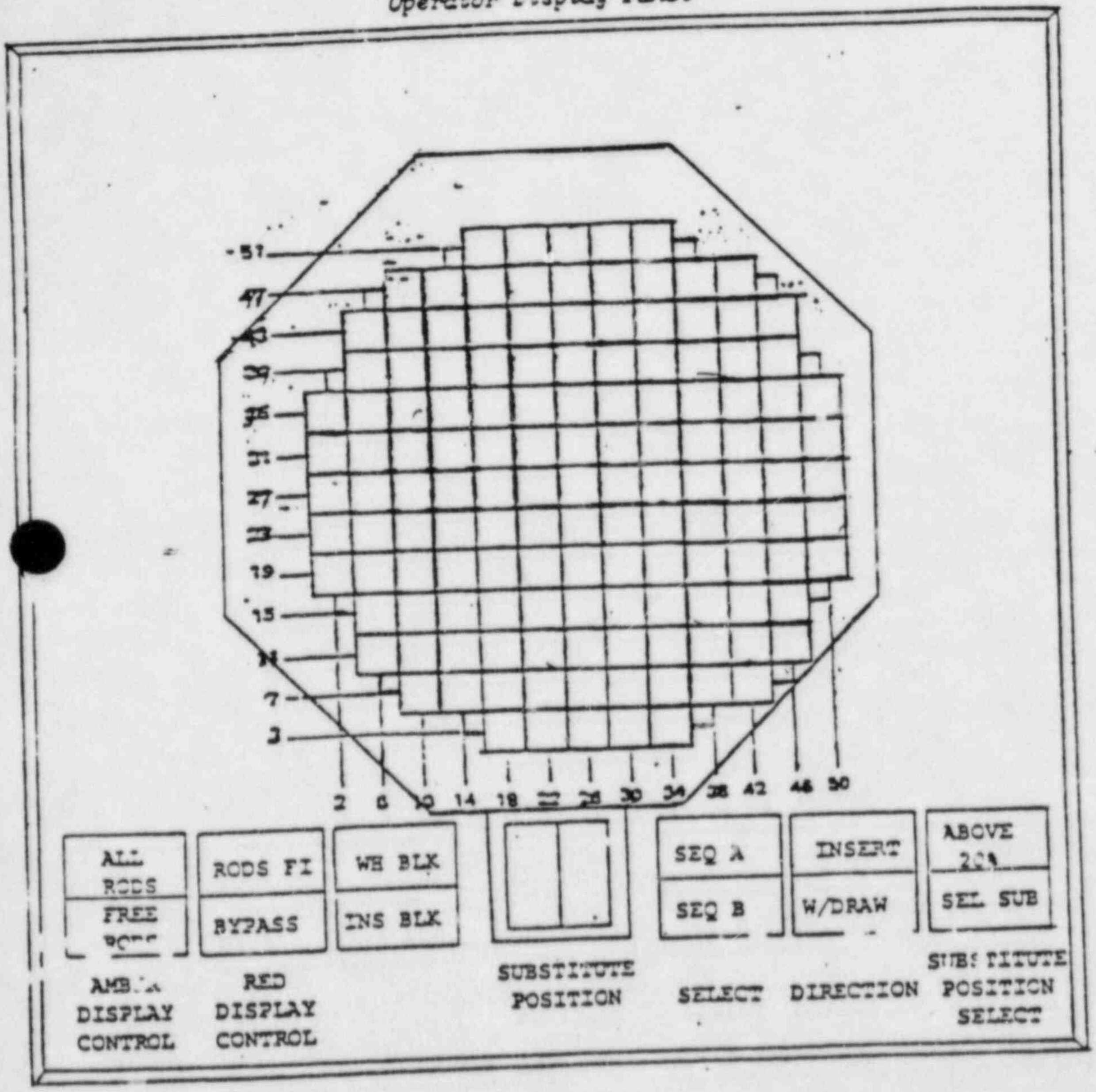
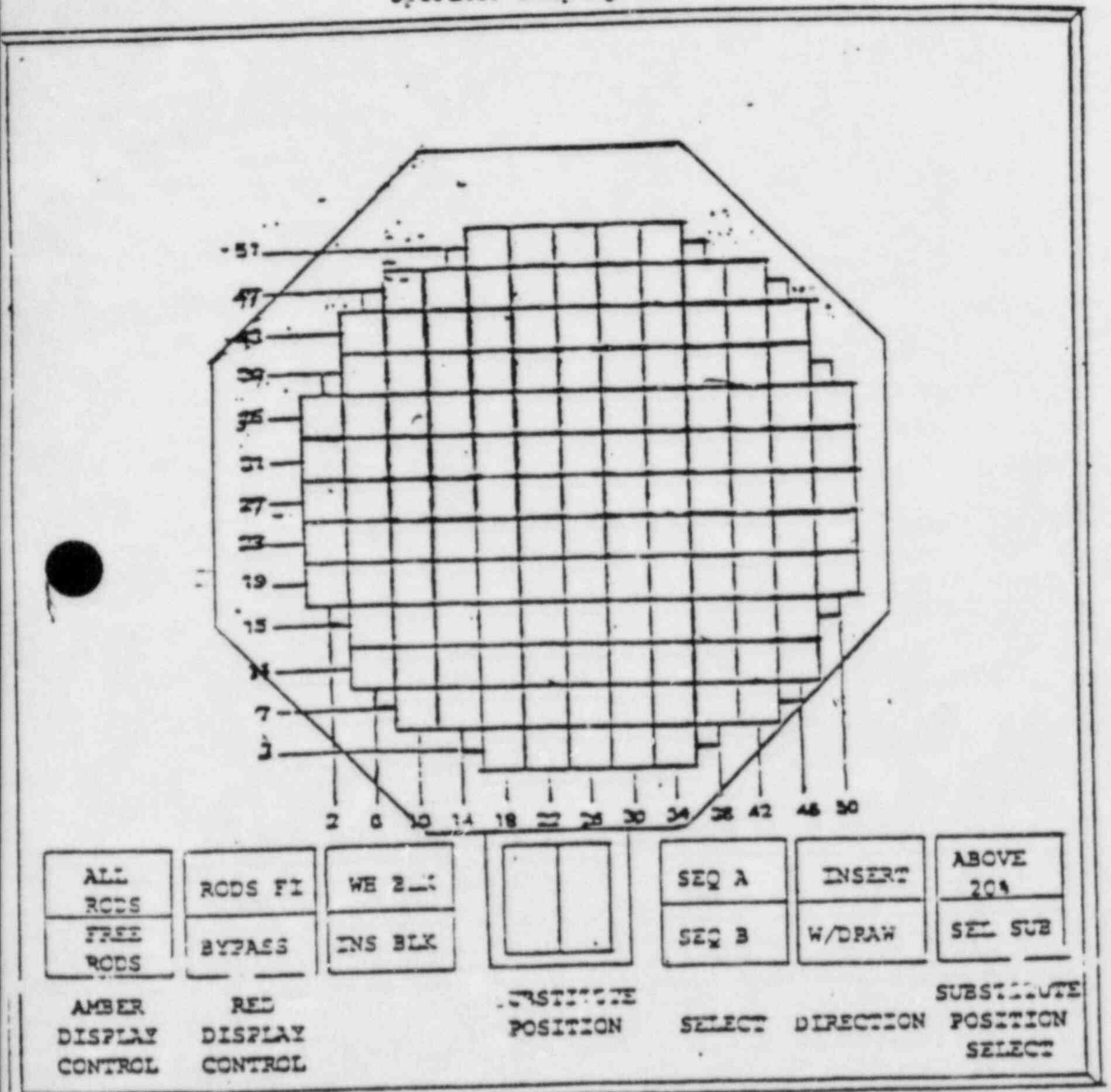


FIGURE 12

ROD SEQUENCE CONTROL SYSTEM

Operator Display Panel



= white lights

FIGURE 13

ROD SEQUENCE CONTROL SYSTEM

Operator Display Panel

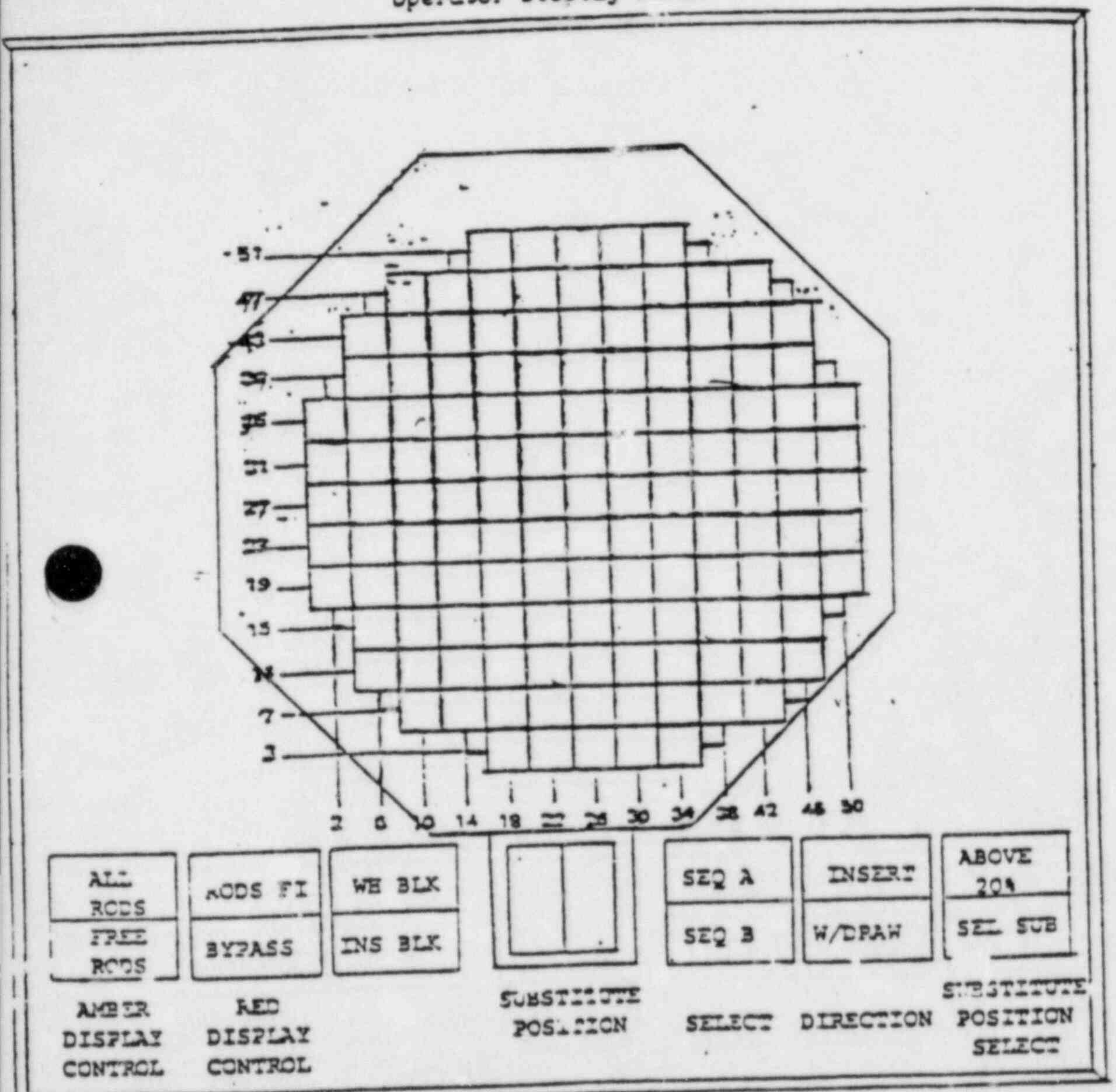


FIGURE 14

ROD SEQUENCE CONTROL SYSTEM

Operator Display Panel

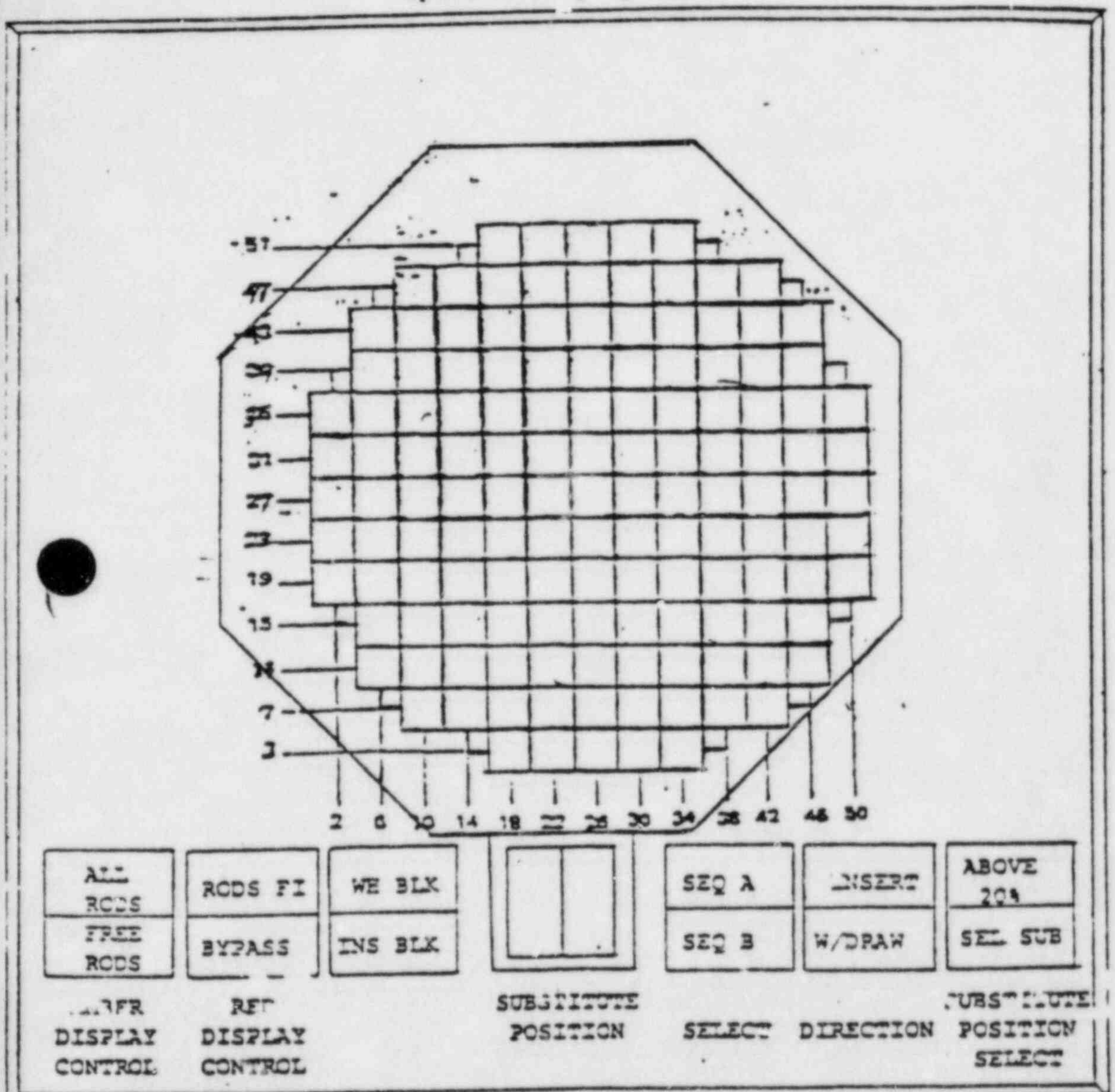


FIGURE 15

ROD SEQUENCE CONTROL SYSTEM

Operator Display Panel

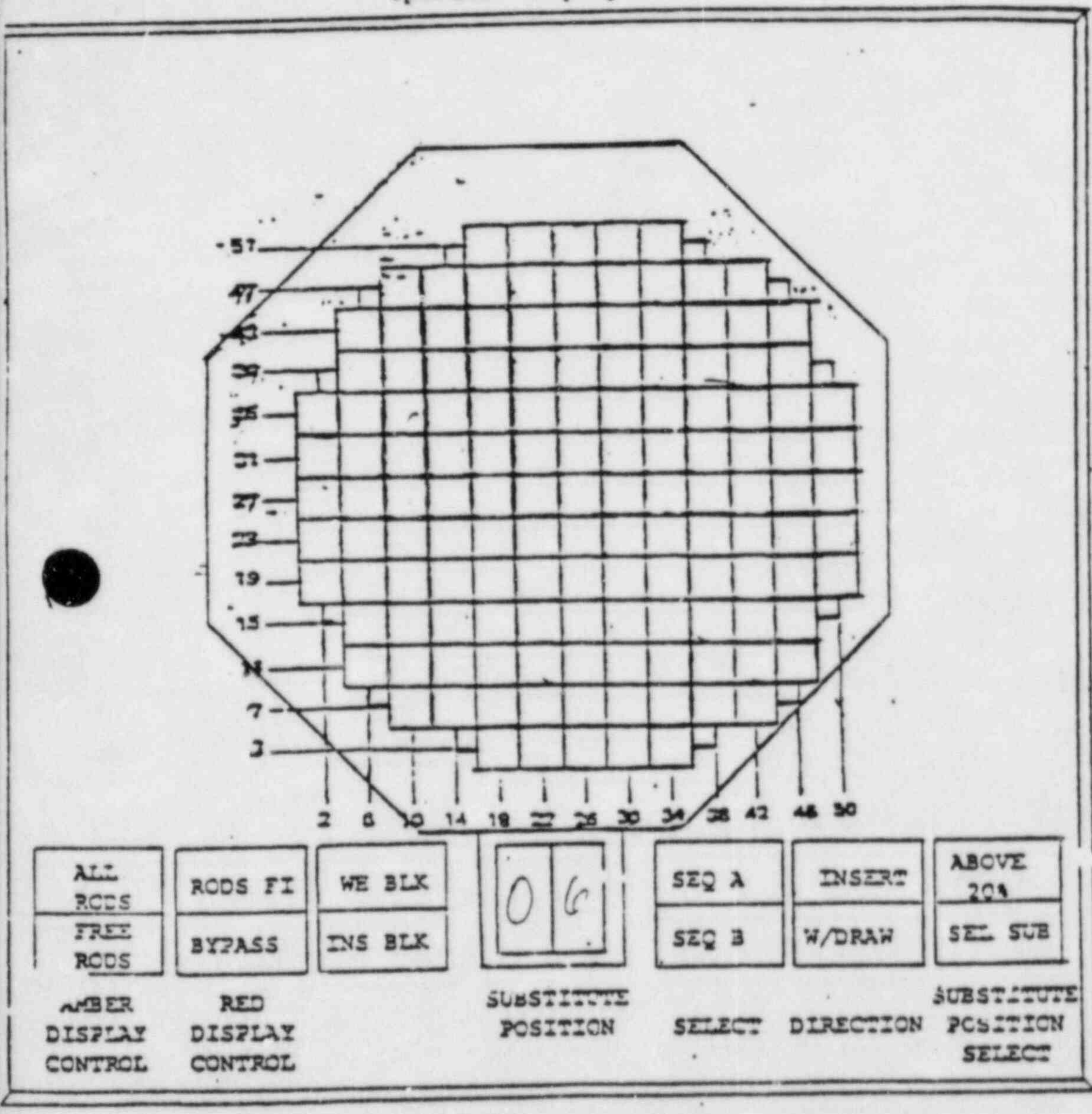
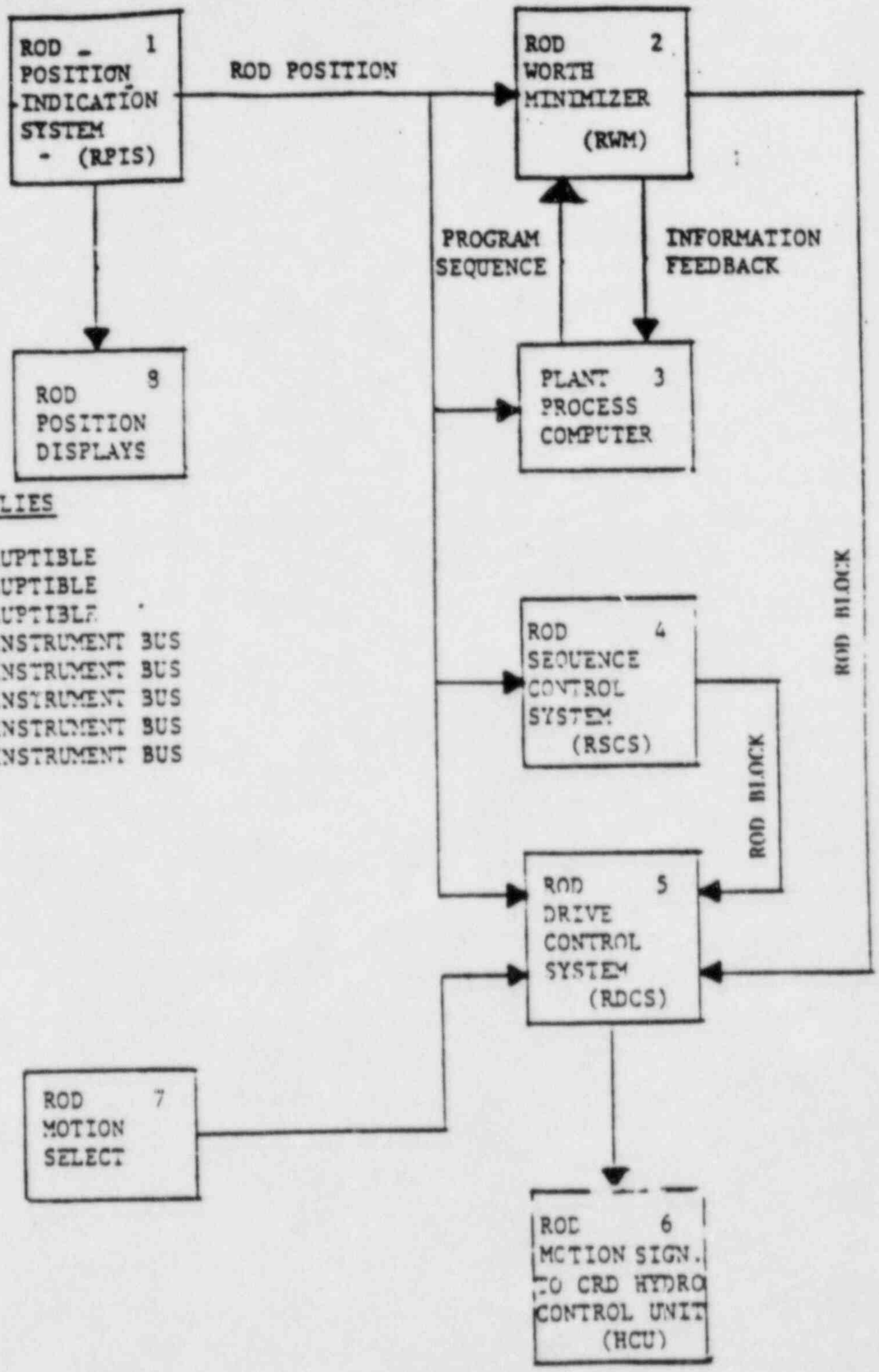


FIGURE 16



POWER SUPPLIES

120 VAC UNINTERRUPTIBLE
120 VAC UNINTERRUPTIBLE
120 VAC UNINTERRUPTIBLE
120 VAC NORMAL INSTRUMENT BUS
120 VAC NORMAL INSTRUMENT BUS
120 VAC NORMAL INSTRUMENT BUS
120 VAC NORMAL INSTRUMENT BUS
120 VAC NORMAL INSTRUMENT BUS

FIGURE 17

RPS SYSTEM

DATA SHEET

1. INITIATION LOGIC SETPOINTS

   a) Reactor water level low (12.5 inches off LT 154 A and C or B and D)

   b) Drywell pressure high (1.69 psig)

   c) Reactor pressure high (1043 psig)

   d) Main steamline high radiation (3x full power background)

   e) Main steam isolation valve closure (6% closed)

   f) Pushbutton

   g) Reactor mode switch in shutdown

   h) Turbine stop valve closure (5% closed from full open)

   i) Turbine control valve fast closure (500 psig TRIP OIL PRESS)

   j) Scram discharge volume level high (40 gallons)

   k) Neutron monitoring Setpoint - VARIOUS

2. ISOLATION LOGIC & SETPOINTS

   N/A

3. TRIP LOGIC & SETPOINTS

   N/A

4. SIGNIFICANT INTERLOCKS

   Bypassed as shown on attached drawing.

5. DESIGN DATA

   N/A

6. MIN FLOW DATA

   N/A

REACTOR PROTECTION SYSTEM AND
MOTOR GENERATOR SETS
STUDENT HANDOUT

Date:

Prepared by: ~~signature~~ 3/19/84
Training Instructor / Date

Lesson Plan # HL312/611

Approved by: ~~signature~~ 3/19/84
Operations Training Specialist/Date

Revision Ø

I OBJECTIVES

The student should be able to:

A. State the purpose of the RPS System

B. Given a schematic diagram of the RPS power supply system label the following components:

1. Motor Generator Supply Breaker
2. Motor Generator Output Breakers
3. Alternate transformer Supply Breakers
4. Alternate transformer Output Breakers
5. Transfer Switch Contacts
6. RPS Bus Distribution Breakers
7. Power Available Lights

C. Given a copy of SNPS Procedure SP 23.312.01 perform or walkthrough an RPS bus A or B transfer to the alternate power supply.

D. List conditions or parameters that initiate a reactor scram and their setpoints.

E. Given any of the precautions or limitations and actions contained in SP 23.312.01 or SP 23.611.01.

1. State its purpose
2. State how the operator can identify from control room indications that the limit is being approached or exceeded (as appropriate)

F. Demonstrate or walkthrough a reactor scram reset.

G. Given any scram initiation signal, state how/when it is bypassed.

H. Given a drawing of the PNL-603 annunciator windows and scram status lights, identify the following:

1. Valid half scram signal due to an instrument surveillance or failure
2. Valid full scram signal
3. Loss of RPS bus A
4. Loss of RPS bus B
5. Trip of a feeder breaker to an RPS logic channel
6. A Full Scram Signal present without an RPS Trip

II PURPOSE

The purpose of the Reactor Protection System (RPS) is to automatically initiate a reactor scram in order to prevent the reactor from exceeding a safety limit.

III SYSTEM DESIGN

A. GENERAL DESCRIPTION

1. Two motor generator sets supply their respective reactor protection distribution busses A and B. There is an alternate supply to either bus from a transformer, it is electrically interlocked so it cannot supply both busses simultaneously.

2. The reactor protection system consists of two completely separate and independent trip systems, each trip system is capable of being tripped or de-energized to allow maintenance or testing on any component in that system. A single component failure will neither cause nor prevent a scram.

3. The method used to meet the above criteria is to use a "one out of two taken twice" logic for the RPS. This logic scheme is set up where a minimum of two out of four RPS Subchannels must fail to cause or prevent a protective action. A simplified diagram of this arrangement is shown on Figure 1. Note the way a scram would be induced is to de-energize the "scram relay". This can be done by de-energizing the circuit or, cause an A or C trip in <u>conjunction</u> with a B or D trip. Notice it will take <u>at least</u> two contacts opening to cause the scram or, conversely, at least two contacts failing shut to prevent a scram. This is basically what "one out of two taken twice" logic consists of.

B. COMPONENT DESCRIPTION

1. <u>RPS MG SETS</u>

   Two motor driven generator sets with an integral flywheel to sustain speed on short power Transients supply power to the RPS busses.

   a) 480V DIV I is power for A MG set

   b) 480V DIV II is power for B MG set

2. <u>ALTERNATE SUPPLY TRANSFORMER</u>

   An alternate supply transformer (1C71-T-001) can be used to supply either RPS bus in the event its MG set is not available. It is electrically interlocked so it cannot supply both busses at the same time or be paralleled with the MG set output.

   a) 480V DIV III is power for the Alternate XFMR

3. <u>EPA BREAKERS</u>

   Electrical protection assemblies are provided to provide undervoltage, underfrequency, and overvoltage protection on the motor generator and alternate power source to the RPS busses. They must be reset manually.

4. RPS DISTRIBUTION PANEL

The RPS distribution panel contains the bus supply contacts A,B, alternate, and the alternate supply output breaker.

5. RPS PANELS 609-611

Panel 609 and 611 contain the relays for A and B RPS logic circuitry. These panels are Main Control Room Back Panels.

6. ANALOG TRIP PANELS

Panels 101 A-D contain the analog trip devices for reactor pressure, reactor level, and drywell pressure instruments. These devices were installed to minimize the occurrence of spurious scram due to sensor surveillance testing.

7. REACTOR MODE SWITCH

Reactor mode switch on panel 603, a four position keylock switch that selects the necessary scram functions and bypasses for the selected operational mode.

8. SCRAM PILOT SOLENOIDS

RPS maintains scram pilot solenoids energized which in turn keeps air pressure on the scram valves. Both pilot valves must de-energized to allow scram valves to open. There are 137 pairs of scram pilot valves, one pair for each HCU.

9. MANUAL SCRAM SWITCHES

Manual scram switches (4) on panel 603 must be armed and pushed (one each channel A and B) to cause a scram.

10. SCRAM RESET SWITCH

Scram reset switch must be used to reset scram and will not function unless initiating signal is cleared.

11. BACK UP SCRAM VALVES

Energized to open and release air from scram valve header.

IV Controls and Instruments

A. CONTROLS

The Operators interfere with the RPS is limited to the following control functions:

1. Selection of Rx operating mode
2. Manual input of scram signal

3. Bypassing the Scram Discharge Valve (SDV) High Level Scram Feature
4. Reset the RPS scram logic
5. Surveillance check of the SDV vent and drain valves
* 6. Transfer of RPS Panel power supply
** 7. Individual control rod scram test switches
*** 8. Loss of power surveillance for the analog trip panels
*** 9. Trip reset for the analog trip panels

All of the above functions are performed on PNL-603 with the exception of those asterisked.

* Control room back panel
** 2 switches at each HCU (total of 274 switches).
*** At analog trip panels

B. INDICATIONS

The following RPS system parameters are monitored in the Main Control Room:

1. Power to scram solenoid valves - monitored via indicating lights on PNL-603. 4 lights per RPS channel (8 lights total). Redundant indicating lights are also provided on RPS Control Room back panels.

2. Scram Discharge Volume Water Level - monitored via 3 annunciators.

3. Instrument air pressure to scram valves - monitored via annunciator and indicating light on PNL-603 for low pressure and high pressure.

4. Power available to RPS Panel. (C71*PNL-001) - monitored via 3 indicating lights on control room back panel. A light being on indicates that power is available from the respective supply i.e.

RPS MG Set A	Alternate XFRMR	RPS MG Set B
0	0	0

Note: Light being on does not means that the bus is energized from the source, the light indicates only that the source is available.

C. INTERLOCKS

1. Auto Initiation

a. Auto initiation (REACTOR SCRAM) will occur due to the below listed signals. Signals must be received in both the RPS A and B trip logic system for an initiation to occur.

Note:

Common identification for valid signals are REACTOR AUTO TRIP CHANNELS A1, A2, B1, B2 on PANEL 603 and the associated computer alarm(s).

Signal	Identification
Reactor water level low Setpoint 12.5 inches	1. Reactor level decreasing 2. Reactor level low alarm 3. Reactor vessel low level trip 4. Post accident sample isolation
Drywell pressure high Setpoint 1.69 psig	1. Primary containment pressure increasing 2. Primary containment high pressure alarm 3. Primary containment high pressure trip Ann. 4. <u>NOTE:</u> This is an ACCIDENT SIGNAL and several other concurrent actions will be taking place
Reactor pressure high Setpoint 1043 psig	1. Reactor pressure increasing 2. Turbine bypass valves open 3. Reactor pressure high alarm 4. Reactor vessel high pressure trip Ann
Main steamline high radiation Setpoint 3x full power background	1. Main steamline radiation levels increasing 2. Main steamline DIV I, DIV II, radiation alert Ann. 3. Main steamline high radiation trip Ann 4. MSIV's closed
Main steam isolation valve closure Setpoint 6% closed (with the Mode Switch in RUN)	1. Closed indication light for MSIV 2. Steam flow decreasing 3. Main steamline flow high 4. Main steamline low pressure 5. Main steamline not full open trip Ann
Pushbutton	1. Reactor manual scram switch armed Ann 2. Reactor manual scram Ann
Reactor mode switch in shutdown	1. Reactor manual scram Ann 2. Mode switch shutdown trip bypass light (after 10 seconds)
Turbine stop valve closure 5% closed from full open (with Power above 25%)	1. Turbine stop valve closure trip A and B Ann 2. Valve position indication

Turbine control valve fast closure 500 psig TRIP OIL PRESS (with Power above 25%)	1. Turbine control valve fast closure trip A and B Ann. 2. Valve position indication
Scram discharge volume level high 40 gallons (with Mode Switch not in Shutdown or Refuel and SDV High Level Scram Switch not in Bypass)	1. Scram discharge volume not drained alarm 2. Valve indication lights for discharge volume vents and drain valves 3. Discharge volume high level trip Ann
Neutron monitoring Setpoint - VARIOUS depending on MODE SWITCH POSITION	SEE BELOW
MODE SWITCH NOT IN RUN IRM HI-HI 120/125 scale IRM INOP APRM HI-HI 15% POWER APRM HI-FLOW BIASED .66W +51% CLAMPED to 113.5% APRM INOP	1. Various SRM, IRM and APRM annunciators for UPSCALE, UPSCALE/INOP, etc. 2. Lights for each NI (e.g. IRM "C", APRM "D", etc.) 3. Neutron Montitoring Trip annunciator 4. Neutron Flux Trend recorders
MODE SWITCH NOT IN RUN AND SHORTING LINKS REMOVED NOTE: NORMALLY IN REFUEL AND ANY SINGLE TRIP WILL CAUSE A FULL SCRAM Setpoint - all of the above plus SRM HI-HI $5X10^5$ CPS	

Signal	Identification
MODE SWITCH NOT IN RUN AND SHORTING LINKS INSTALLED APRM HI-HI 118% POWER APRM FLOW BIASED .66W +51% CLAMPED TO 113.5% APRM INOP APRM DOWNSCALE - ASSOCIATED IRM HI-HI OR INOP	1. Same as above

C. INTERLOCKS

2. Component Interlocks

a. The RPS MG SETS will start when all the following conditions are satisfied:

1) 480 VAC power available
2) Drive motor winding thermaltectors reset
3) Drive motor starter thermal overloads reset
4) Motor ON pushbutton depressed

b. The RPS MG SETS will stop when any of the following conditions occur:

1) Motor OFF pushbutton depressed
2) Drive motor winding thermaltector trip
3) Drive motor starts thermal overload trip
4) Loss of power to associate MCC

c. The generator output breaker will trip on:

1) Manual
2) Underfrequency
3) Overvoltage

d. The electrical protection assembles will trip on:

1) Manual
2) Underfrequency
3) Undervoltage
4) Overvoltage

e. The alternate power supply is electrically interlocked so that it cannot be paralleled with a live bus or supply both RPS busses simultaneously.

f. Scram and isolation conditions are reset with their respective RESET switches after the initiation signal has cleared.

D. ANNUNCIATORS

The following conditions are annunciated in the Main Control Room:

Annunciator		ARP #	Control Room Verification
1. DISCHG VOL HI WTR LEVEL TRIP	A1/B1 A2/B2	1203 1187	1. a) Control rod out block b) Scram discharge vol not drained alarm
2. MSIV NOT FULL OPEN TRIP	A B	1204 1188	2. a) Valve indicating lights b) Decreasing steam flow c) Steam line low pressure alarm
3. PRI CNTMT HI PRESSURE TRIP	A B	1205 1189	3. a) Drywell high pressure alarm, indication and light on analog panel 101A-D b) Containment pressure inst reading
4. RX VESSEL HI PRESSURE TRIP	A B	1206 1190	4. a) Rx press hi alarm b) Rx press instrumentation
5. RX VESSEL LO LEVEL TRIP	A B	1207 1191	5. a) Rx water level Hi/Lo alarm b) Rx level alarm, indication and light on analog panel 101A-D c) Rx level instrumentation

Annunciator		ARP #	Control Room Verification
6. MAIN STM LINE HI RAD TRIP	A B	1208 1192	6. a) Main steam line hi rad alarm b) Main steam line radiation instrumentation
7. TURBINE CONT VV FAST CLOSE TRIP	A B	1209 1192	7. a) Valve position on EHC panel b) Decrease generator output c) Decrease steam flow d) Bypass valves open
8. CONT/STOP VV CLOS TRIP BYPASSED	A B	1210 1194	8. a) Normal annunciator with reactor power 25% or less
9. TURB STOP VLV CLOSURE TRIP	A B	1211 1195	9. a) Valve position on EHC panel b) Decrease generator output c) Decrease steam flow d) Bypass valves open
10. NEUTRON MONITORING TRIP	A B	1212 1196	10. a) IRM or APRM indications, recorders on PNL 603 b) IRM or APRM upscale, trip, inop alarms PNL 603
11. REACTOR AUTO TRIP CH	A1 A2 B1 B2	1197 1213 1198 1214	11. a) Scram solenoid lights out b) Rods in if full scram (A and B) c) Various alarms that attend scram input signals
12. MSIV NOT FULL OPEN TRIP BYP	A B	1217 1199	12. a) Mode switch in any position except RUN

Annunciator		ARP #	Control Room Verification
13. DISCH VOL HI WTR TRIP BYP	A B	1200 1218	13. a) Mode switch in SHUTDOWN or REFUEL b) Keylock switch in BYPASS
14. REACTOR MAN SCRAM SW ARMED		1201 1202	14. a) Any one of four MANUAL SCRAM switch collars in armed position
15. REACTOR MAN SCRAM	A B	1215 1216	15. a) Mode switch in SHUTDOWN b) Neutron monitoring trip if shorting leaks removed c) Manual scram pushbutton armed and depressed
16. MODE SW SHTDN SCRAM BYPASS		1219	16. a) Mode switch in SHUTDOWN for greater than 10 seconds.
17. PRI CNMT PRESS HI/LO		1221	17. a) Containment pressure indications b) Containment valve positions
18. SCRAM DISCH VOL NOT DRAINED		1223	18. a) Reactor scram not reset b) Discharge volume valve position indicating lights
19. RPS SYSTEM INOP	A B	1399 1398	19. a) Switch in INOP position
20. RPS CH A PNL 101 A TROUBLE RPS CH B PNL 101 B TROUBLE RPS CH C PNL 101 C TROUBLE RPS CH D PNL 101 D TROUBLE		1422 1423 1424 1425	20. a) Check analog panel A and B in control room for alarm or pulled card b) Check analog panels C and D in relay room for alarm or pulled card

V SYSTEM PROCEDURES

A. SYSTEM PRECAUTIONS, CAUTIONS AND/OR LIMITATIONS

1. A trip of one RPS Trip System or "½ SCRAM" should be evaluated, and if permissible, reset immediately to reduce the possibility of a spurious "FULL SCRAM" if a trip is received in the other Trip System.

   a. A "½ SCRAM" is recognized by the de-energization of four white scram solenoid lights on PNL 603 and A1 and/or A2 or B1 and/or B2 REACTOR AUTO TRIP annunciators.

2. Caution shall be used when transferring power sources. Failure to correctly transfer power sources could result in a "FULL SCRAM" of the RPS, a "FULL ISOLATION" of the NSSS, and a start of RBSVS.

3. No limitations or actions are directly applicable to the RPS Motor Generator sets. However, removing an MG set from service and placing the alternate feed transformer in service will result in a "½ SCRAM" of the RPS, a "½ ISOLATION" of the NSSSS, and a start of RBSVS. The limitations and actions of the appropriate component operating procedures should be observed.

4. Loss of RPS A or B will cause a loss of Reactor Water Cleanup.

   a. This is recognized by looking at the Primary Containment Mimic and checking 1G33*MOV-033 or (Cleanup system inboard/outboard suction valve) closed and the cleanup pump(s) have tripped. This happens because on loss of RPS bus the NSSSS logic is de-energized.

B. NORMAL OPERATION

1. RPS MG SET STARTUP

   a. Section 8.1.1 of SP 23.312.01 Lists steps necessary to start either RPS MG SET A or B and the alternate power supply. See Figure 2 for reference

   b. Breakers must be closed in order for the MG to the Bus to prevent inadvertent trips due to undervoltage or underfrequency.

2. Energizing the RPA bus loads, See Figure 2 for reference

   a. Step 8.1.1.8 of SP 23.312.01 Lists breakers that must be closed to energize RPS bus A + B loads.

3. When steps for busses A + B are completed, the only requirement during normal operation is to periodically monitor the three white power available lights on 1H11-PNL-610 and the RPS MG Set voltage and amperage on panels 1C71-PNL-S001A(B).

4. A simplified schematic (Figure 3) shows a typical scram contactor circuit and lists all conditions that cause a scram and when they are bypassed.

5. A simplified diagram (Figure 4) shows normal lineup for station air to an HCU with no scram signal present.

6. Resetting a Reactor Scram

   a. Cannot be done until the Scram Signal clears, which is verified by SDV Bypassed and Auto Scram annunciators clear.
   b. Can bypass the SDV High Level Scram with a Control Switch on Panel 603
   c. Reset by placing the Scram Reset Switch in 1/4 then 2/3. After this, verify the 8 white scram lights on Panel 603 are re-energized.

C. ABNORMAL OPERATION

1. Transfer of power from RPS MG SET to alternate feed transformer or vice versa.

   NOTE: Transferring RPS bus A + B to the alternate feed transformer would not be a normal occurrence, except in cases where an RPS MG SET is to be placed out of service for maintenance or a loss of power to one of the RPS MG SETS occur.

   CAUTION:
   Since the RPS MG SET output and the alternate feed transfer output cannot be paralleled all transfers are of the dead bus type, which means one source must be de-energized before the other supply source is closed in. Therefore on all RPS bus transfers a ½ scram, a ½ NSSSS isolation, and an RBSVS initiation will be received. Ensure the transfer switch is placed in the proper position to prevent receipt of a full scram and isolation. Reset ½ SCRAM and ISOLATION immediately after transfer is completed and then restore RBSVS to normal lineup.

2. Procedure steps 8.1.3, 8.1.4, 8.1.5 describe transfer steps for the various combinations.

D. EMERGENCY OPERATION

1. LOSS OF NORMAL POWER

   a) A momentary loss of power less than 2 seconds will not cause any change due to MG flywheel maintaining generator output.

   b) If one RPS MG SET is tripped, investigate and attempt to restore to operation or use alternate feed supply.

c) Loss of power to both RPS busses results in a FULL SCRAM, refer to emergency shutdown procedure SP 29.010.01 for required actions.

d) All alarms associated with the RPS trip system which lost power will illuminate.

VI SYSTEM INTERRELATIONS

The RPS system needs 480 VAC busses MCC 1115, MCC 1125, MCC 1133 for power supply.

VII TECHNICAL SPECIFICATIONS

1. LIMITING OPERATION FOR OPERATION

3.3.1 As a minimum, the reactor protection system instrumentation channels shown in Table 3.3.1-1 shall be OPERABLE with the REACTOR PROTECTION SYSTEM RESPONSE TIME as shown in Table 3.3.1-2.

APPLICABILITY: As shown in Table 3.3.1-1

ACTION:

a. With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels per Trip System requirement for one trip system, place the inoperable channel(s) and/or that trip system in the tripped condition within 1 hour. The provisions of Specification 3.0.4 are not applicable.

b. With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels per Trip System requirement for both trip systems, place at least one trip system** in the tripped condition within 1 hour and take the ACTION required by Table 3.3.1-1.

*An inoperable channel need not be placed in the tripped condition where this would cause the Trip Function to occur. In these cases, the inoperable channel shall be restored to OPERABLE status within 2 hours or the ACTION required by Table 3.3.1-1 for the Trip Function shall be taken.

**If more channels are inoperable in one trip system than in the other, place the trip system with more inoperable channels in the tripped condition, except when this would cause the Trip Function to occur.

VIII SIGNIFICANT INDUSTRY EVENTS

1. None known at this time.

IX CONTROL ROOM SCENARIO

A. Valid half scram signal due to an instrument surveillance or failure.

1. If due to instrument surveillance, this is an everyday occurrence.

2. The only way to distinguish between a surveillance and an instrument failure is to know if I and C is performing the surveillance.

3. Figures 5a and 5b shows a typical half scram indication due to an APRM "A" Surveillance.

B. Valid Full Scram Signal

1. This is the signal necessary to cause a Reactor Scram

2. Figures 6a and 6b show a typical Full Scram. In this case, it is due to a Turbine Trip from 100% Power.

C. Loss of RPS Bus "A" or Bus "B"

1. Either one will cause a half scram on all instruments on its side. Also, it will cause a Half NS^4 isolation, a startup of RBSVS and a loss of RWCU.

2. An "A" RPS Bus Loss is shown on Figures 7a and 7b.

3. A "B" RPS Bus Loss is shown on Figure 8a and 8b.

4. Note from the figures that a loss of either bus causes NS^4 isolation signals on both sides of the boards and all RPS Trip indication on both boards <u>except</u> the AUTO TRIP annunciators. (Only the ones from the associated RPS Bus will illuminate).

D. Trip of Feeder Breaker to an RPS Logic Channel

1. This event will cause a loss of power to an RPS Subchannel, such as shown in Figure 3.

2. Indications of this loss are as shown in Figure 9a and 9b. This is assuming an A1 Logic Channel Loss.

E. Full Scram Signal present without an RPS System Trip .

1. This is an ATWAS condition, i.e., a Full Scram signal is present yet the RPS fails to induce an Automatic Scram.

2. This scenario is as shown in Figures 10a and 10b. In this case, Low Reactor Water Level is the initiating event. Note the absence of the REACTOR AUTO SCRAM A1 (A2, B1 and B2) annunciators. Also, not the solenoids lights are still illuminated.

3. Recall that the REACTOR AUTO SCRAM annunciators do not guarantee the Scram. Check the rod positions with the Process Computer or the RSCS or, the Full Core Display. Finally, check the Sequence of Events Printout on the computer before starting an event or is not an ATWAS.

APPENDIX - **References:**

A. SNPS SYSTEM DESCRIPTION 1020.312, RPS MG SETS

B. SNPS SYSTEM DESCRIPTION 1020.611, REACTOR PROTECTION SYSTEM

C. SNPS OPERATING PROCEDURE SP 23.312.01 120VAC RPS-MG SETS

D. SNPS OPERATING PROCEDURE SP 23.611.01 REACTOR PROTECTION SYSTEM

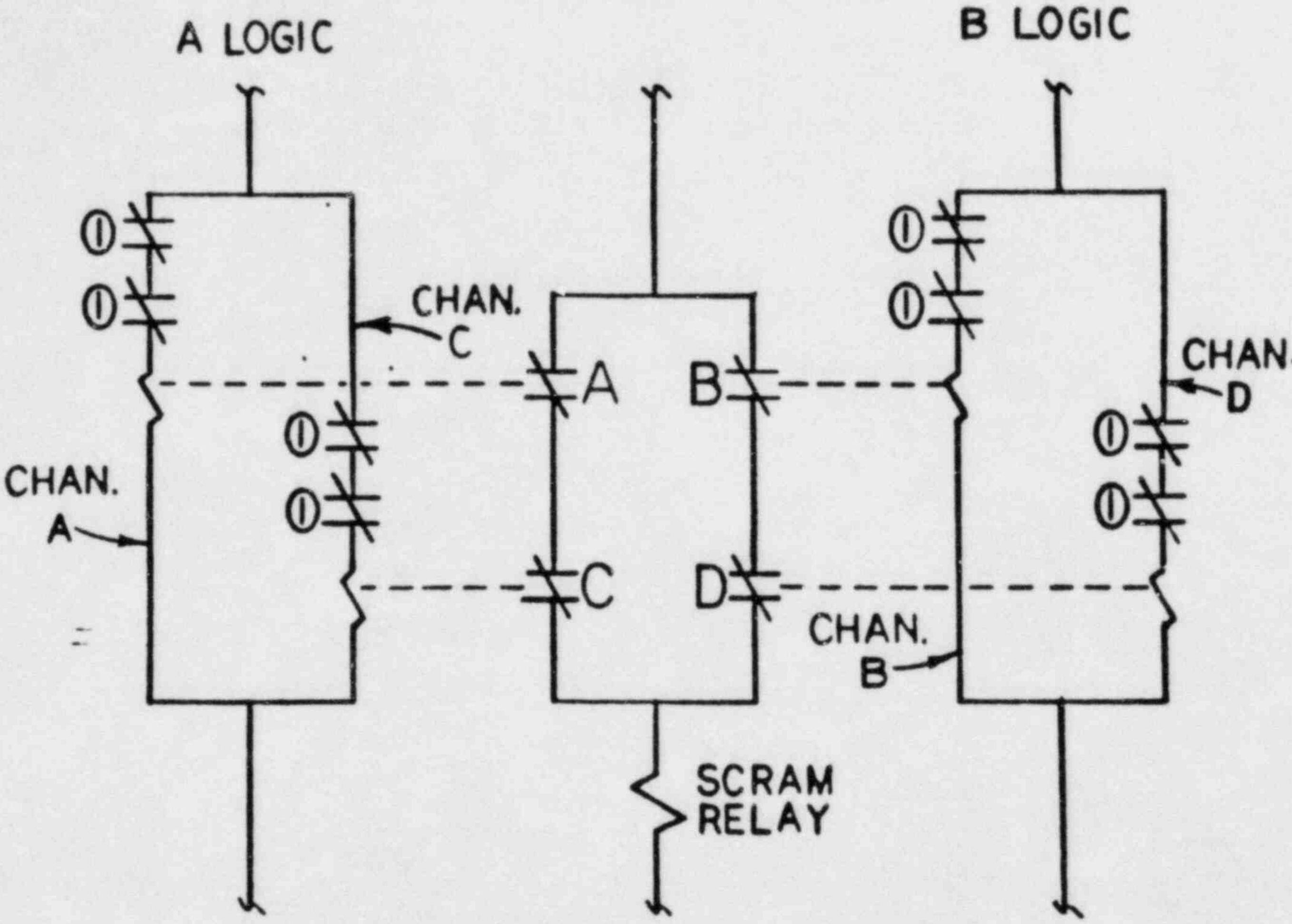
E. SNPS EMERGENCY PROCEDURE SP 29.010.01 EMERGENCY SHUTDOWN

F. 791E414TF Sht 11 SCRAM CIRCUIT LOGIC CONTACTS

G. 115D6002TF Sht 1 RPS MG SET AND BUSSES

H. 731E287BD Sht 13 RECIRC RPT LOGIC

I. SNPS TECHNICAL SPECIFICATIONS



① TYP. SENSOR CONTACTS, e.g. LOW WATER LEV., HIGH DRYWELL PRESS., ETC.

FIGURE 1

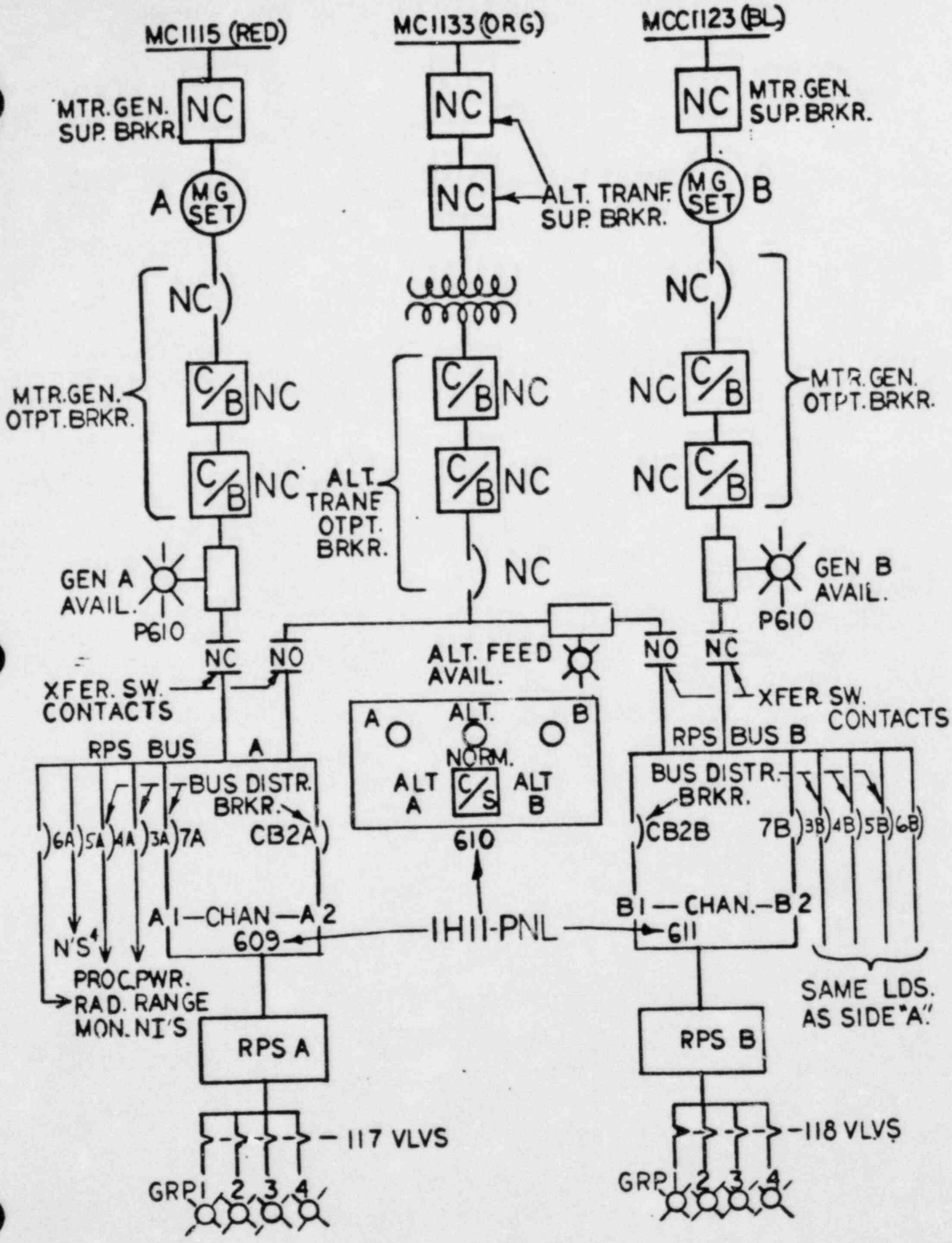

MC1115 (RED)
MC1133 (ORG)
MCC1123 (BL)
MTR.GEN. SUP. BRKR.
NC
A MG SET
B MG SET
ALT. TRANF. SUP. BRKR.
MTR.GEN. OTPT. BRKR.
ALT. TRANF OTPT. BRKR.
C/B
GEN A AVAIL.
GEN B AVAIL.
P610
ALT. FEED AVAIL.
NO
XFER. SW. CONTACTS
RPS BUS A
RPS BUS B
A ALT. B
NORM.
ALT A
ALT B
C/S
610
BUS DISTR. BRKR.
CB2A
CB2B
6A 5A 4A 3A 7A
7B 3B 4B 5B 6B
A1 — CHAN — A2
B1 — CHAN. — B2
609
611
1H11-PNL
N'S
PROC.PWR.
RAD. RANGE MON. NI'S
SAME LDS. AS SIDE "A".
RPS A
RPS B
117 VLVS
118 VLVS
GRP1 2 3 4

FIG. 2

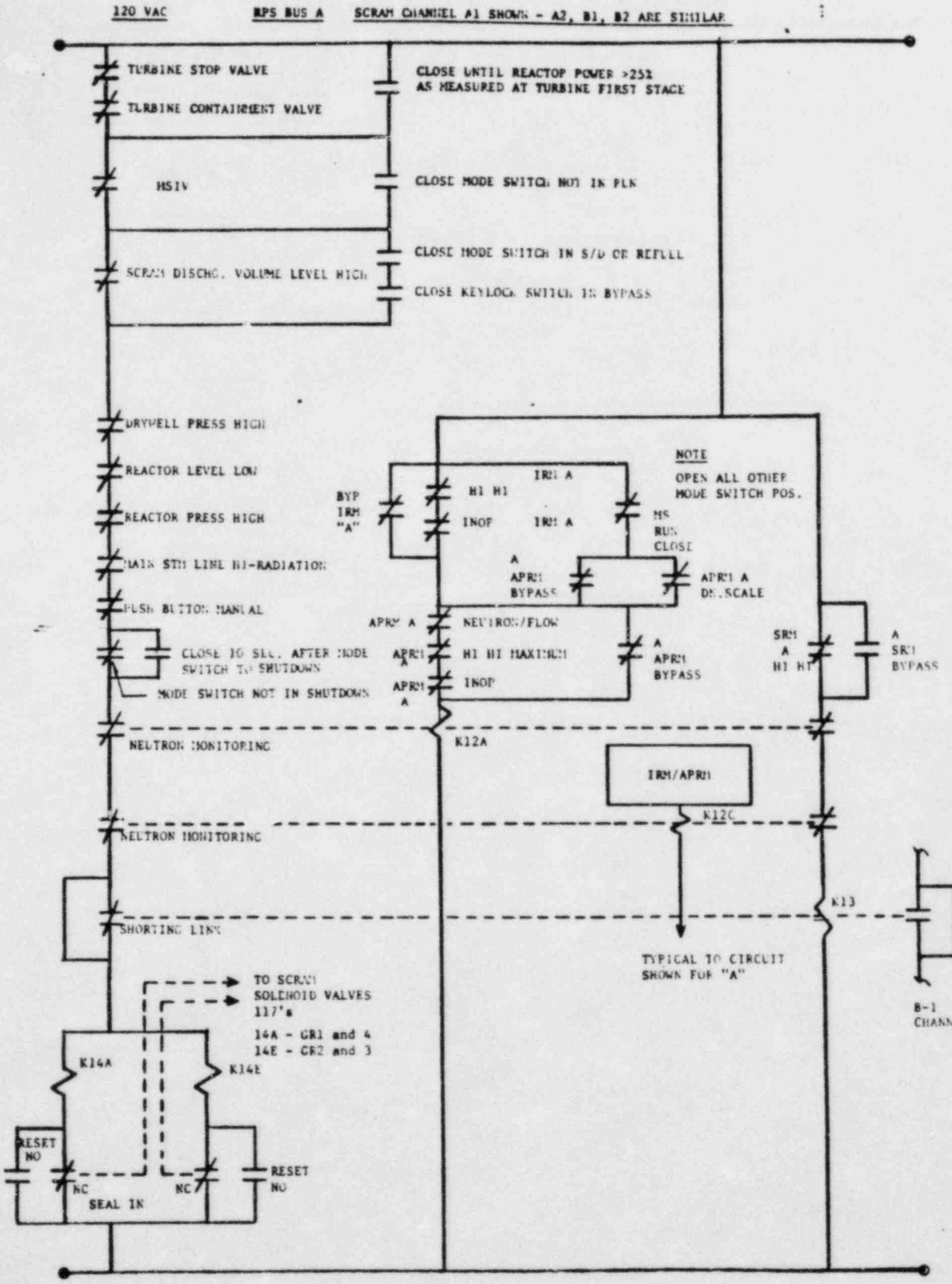
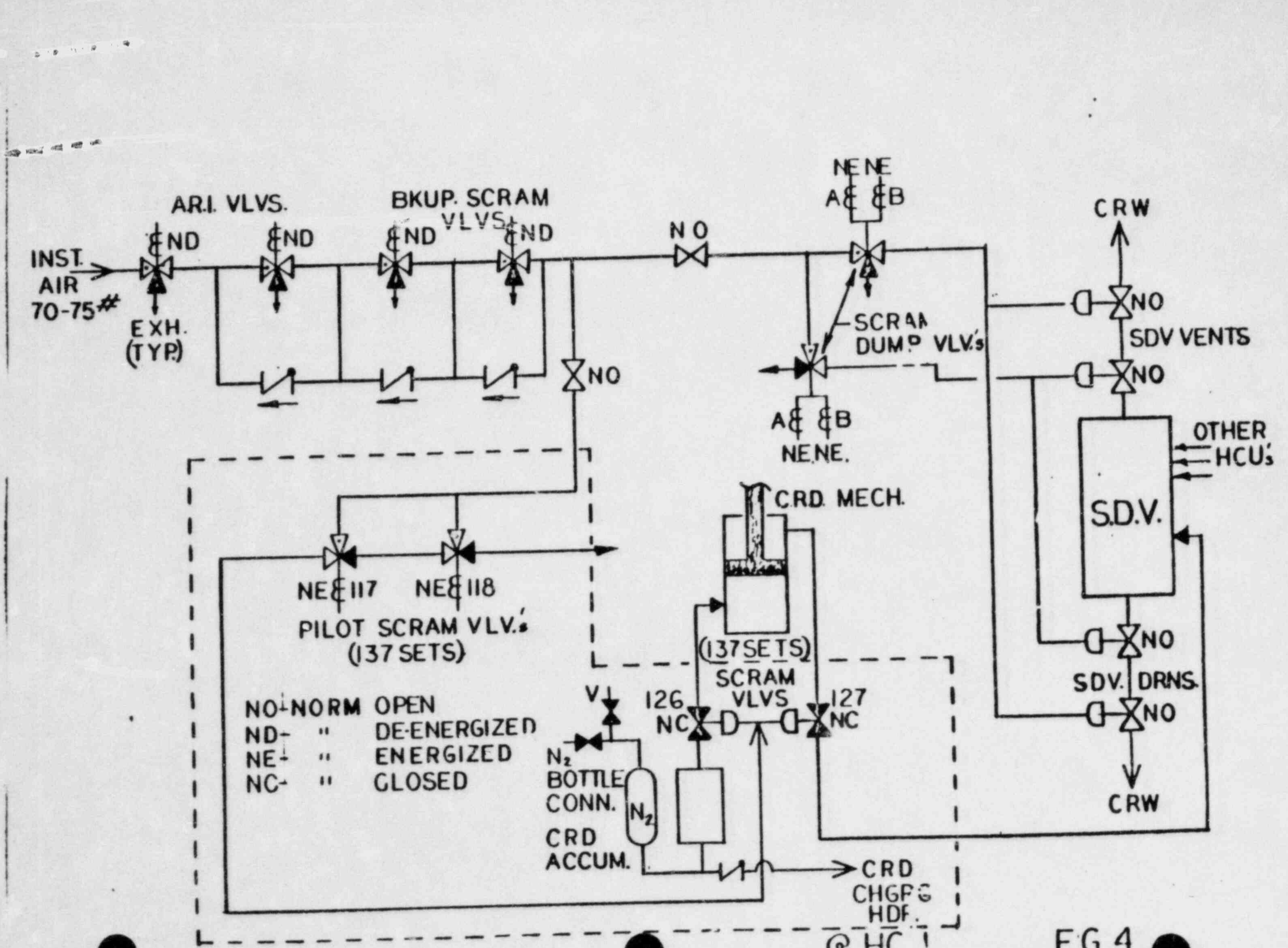


FIG. 3

NORMAL, 100% POWER OPERATION


AR.I. VLVS.
BKUP. SCRAM VLVS.
ND
INST. AIR 70-75#
EXH. (TYP.)
NO
NE NE
A B
SCRAM DUMP VLV.'s
CRW
SDV VENTS
OTHER HCU's
S.D.V.
CRD. MECH.
NE 117
NE 118
PILOT SCRAM VLV.'s (137 SETS)
(137 SETS)
SCRAM VLVS
126 NC
127 NC
SDV. DRNS.
NO - NORM OPEN
ND - " DE-ENERGIZED
NE - " ENERGIZED
NC - " CLOSED
V
N_2 BOTTLE CONN.
N_2
CRD ACCUM.
CRD CHGPG HDF.
FG.4

SNPS Hot License Systems Tour Checklist

System: REACTOR PROTECTION SYSTEM

In the Control Room show the students the following: **Initials**

1)	RPS Scram Solenoid Lights on 603	
2)	RPS Scram Solenoid Lights on 609 and 661	
3)	Scram Reset Switch	
4)	SOV Bypass Switch	
5)	Mode Switch	
6)	RPS Supply available lights	
7)	Analog Trip Panels (RRS A and B)	

In the Relay Room, show the students the following:

8)	RPS MG sets, start/stop buttons and output breakers	
9)	RPS Distribution Panel	
10)	RPS Analog Trip Panels C and D	

In the Emergency Switch Gear Rooms, show the students the following:

11)	RPS MG Supply Brkrs (2)	
12)	ALT XFMR Supply Brkrs (2)	
13)	ALT XFMR EPA's	
14)	Shunt Trip for RPS Standby XFMR override switch	

In the Diesel Hallway, show the students the:

15)	RPS MG EPA's	

The following personnel attended the Hot License System tour on the Reactor Protection system.

SIGNATURE	PRINT NAME	SECTION

Training Instructor/Date

REACTOR VESSEL PROCESS
INSTRUMENTATION STUDENT HANDOUT
FOR SHIFT (SRO) ADVISOR
TRAINING PROGRAM

Date: 5/10/84

Prepared by: L.T. Prelal / 5/10/84
Instructor / Date

Reviewed by: [illegible] / 5/10/84
Training Specialist / Date

Revision #: 0

Approved by: [illegible] / 5/10/84
Training Supervisor / Date

I OBJECTIVES:

The student shall be able to:

7.1 State the purpose of RPV Process Instrumentation system.

7.2 List the five reactor water level measurement systems.

7.3 Given various RPV pressures & temperatures, state which of the following level instruments should be accurate.

1. Narrow Range
2. Wide Range
3. Upset Range
4. Shutdown Range
5. Fuel Zone

7.4 Given a copy of Technical Specifications and a listing of instrumentation in/out of service, be able to determine if an LCO has been exceeded. (SRO-List all required actions).

7.5 Given a diagram of the Rx Vessel Instrumentation system and system parameters available in the control room, identify the following system malfunctions:

1. RPV outer/inner Seal Leak
2. Failed pressure instrument
3. Failed temperature indication

7.6 Given a copy of Technical Specifications, and sample thermocouple temperature readings, determine if any T/S or Admin. limits are being approached or exceeded.

7.7 State the SNPS Heat Up and Cooldown rate Administrative limits.

7.8 Given a drawing of all Control Room Rx level and Rx pressure indicators and recorders, identify the following malfunctions and state actual vessel level:

1) Reference Leg failure (DIV I side)
2) Reference Leg Failure (DIV II side)
3) Narrow Range Variable Leg Failure (DIV I side)
4) Narrow Range Variable Leg Failure (DIV II side)
5) Wide Range Variable Leg Failure (DIV I side)
6) Wide Range Variable Leg Failure (DIV II side)
7) RPS MG Set 'A' Trip
8) RPS MG Set 'B' Trip
9) Loss of Offsite Power
10) Failed Level Transmitter

II PURPOSE

The Reactor Vessel Process Instrumentation System provides for sensing, monitoring, and automatic protective functions for water level, pressure, flow, and temperature of the Reactor Pressure Vessel.

III SYSTEM DESIGN

A. GENERAL DESCRIPTION

1. The Reactor Vessel Water Level system provides: FIG 621-1

   a. Indication to the operator of the water level within the reactor pressure vessel.

   b. Automatic initiation of the Emergency Core Cooling System, Reactor Core Isolation Cooling, and Nuclear Steam Supply Shutoff System when safe operational parameters are exceeded.

   c. Automatic, reliable inputs to the Reactor Protection System to SCRAM the reactor to prevent fuel damage limits from being approached.

   The water level measured is that existing in the reactor vessel downcomer annulus. Five different ranges of instrumentation are provided to monitor the coolant level within and beyond the normal operating level range.

2. The Reactor Vessel Pressure system provides: FIG 621-2

   a. Indication to the operator of the pressure within the reactor vessel.

   b. Automatic, reliable inputs to the Reactor Protection System (RPS) to SCRAM the reactor to prevent both fuel damage limits from being approached and nuclear system overpressurization.

   c. Interlock the High Pressure Coolant Injection (HPCI), Reactor Core Isolation Cooling (RCIC), Nuclear Steam Supply Shutoff System (NSSSS), and the Reactor Recirculation system when operational parameters are exceeded.

   Both narrow and wide range pressure indications are provided to cover normal operation and full range pressure coverage.

FIG 621-4

3. The Reactor Vessel Temperature system measures the temperature of the reactor pressure vessel metal to provide temperature data representative of thick, thin, and transitional sections of the reactor pressure vessel.

FIG 621-20

4. The Reactor Vessel Head Flange Leakage Detection system provides a means for detecting leakage past the reactor vessel head flange inner seal so that integrity of this seal is known to plant operations personnel.

B. COMPONENT DESCRIPTION

1. Vessel Level Instrumentation FIG 621-1

a. Prior to discussing Level Instrumentation, several definitions must be discussed:

1) Reactor Vessel Zero - This is the reference point for all incore components and vessel nozzle taps. Reactor pressure vessel bottom head invert (the top of the bottom head) is Reactor Vessel Zero.

2) Instrument Zero - corresponds to bottom of the dryer skirt 163 inches above Top of Active Fuel (TAF).

b. There are Five Range of Level Indication associated with Vessel Level Instrumentation, which are all referenced to instrument zero.

1) Narrow Range

Uses a 0-60" span covering the normal operating region. It is calibrated for normal operating RPV pressure and 135°F in the drywell.

2) Wide Range

Uses a -150 to +60" span covering the operating range to just above top of active fuel. It is calibrated for normal operating RVP and 135°F in the drywell.

3) Fuel Zone Instrument

Uses a -308 to -108" span covering the active core area and overlapping the lower portion of the wide range. Inst. is calibrated for saturated water steam conditions at Ø psig in the vessel and drywell with no jet pump flow.

a) Intended for use under only accident conditions with reactor at Ø psig and Rx Recirculation pumps tripped.

b) The variable leg taps off the diffuser of jet pump 5 and 15. Flow through the jet pump interferes with the variable leg signal rendering the instrument useless.

c) Fuel Zone Instrumentation provides indication during and after a vessel blowdown accident.

d) With vessel depressurized and LPCI injecting fuel zone instruments will be pegged high even if no level exists in RPV.

4) Upset Range Instrumentation

Uses a 0 to 180" span to monitor abnormal water level increases during transient conditions. It is calibrated for normal RPV pressure and 135°F in the drywell. The instrument is not accurate and is to be used for trending purposes only.

5) Shutdown Range Instrumentation

Uses a Ø to 400" span to monitor Rx water level for flooding of the reactor vessel. It is calibrated at 120°F and Ø psig in the Rx vessel and 80°F drywell temperature.

c. Condensate Chambers

The reactor vessel water level instruments are of the differential pressure type. Reactor vessel water level is detected by comparing the pressure exerted by the actual height of water inside the reactor vessel (variable leg), to the pressure exerted by a constant reference column of water (reference leg). A condensing chamber is installed in each of the three pipes used to provide a reference column of water for water level measurements. The piping to the condensing changers is pitched downward from the chambers to the reactor vessel to allow excess chamber condensate to overflow back to the reactor vessel. Condensate chambers are uninsulated and piping runs are uninsulated and as short as practicable.

1) The Shutdown and Upset instruments share a common condensing chamber.

2) The Narrow Range, Wide Range and Fuel Zone instruments share common condensing chambers.

d. Excess Flow Check Valves

1) Each instrument line that connects to the reactor coolant boundary is equipped with an excess flow check valve (EFV). The valves are used in the instrument lines to limit the flow through the valve in the event of a line break downstream of the valve.

2) The valve will automatically close when the flow through it exceeds 3 to 4 gpm maximum. After excess flow has closed the valve, it will remain closed as long as the balanced forces across it are greater than the force of the spring holding the valve open under normal flow conditions.

3) Each EFV has a position light associated with it on 1H11-PNL-TR in the Control Room.

NOTE: Each instrument line that connects to the reactor coolant pressure boundary is equipped with a restricting orifice (RO) inside the drywell and an excess flow check valve outside the drywell.

e. Level Trip Settings

The following are the level trip settings associated with Rx water level instrumentation and the explanation of each.

1) +56.5" - Protects the main turbine, the HPCI turbine and the RCIC turbine against carryover of moisture. Trips the reactor feed pump turbines to prevent overfill.

2) +40.5" - Level above which the moisture carryover in the steam is expected to increase at full load.

3) +36 to +38" - The reactor vessel normal water is based on minimizing moisture carryover and steam carryunder during transient level disturbance conditions.

4) +33.5" - The level below which the steam carryunder in the water affects the reactor recirculation flow rate at full load. Low Level alarm.

5) +12.5" - The quantity of reserve coolant required following an interruption of reactor feedwater flow without the reactor vessel water level dropping to -132.5".

6) -38" - Considerations involved in determining this reactor vessel water level setpoint are as follows:

   a) This volume corresponds to the void collapse during reactor SCRAM from full power.

   b) Low enough to avoid false start RCIC & HPCI after a Rx Scram due to low level.

   c) High enough so that for a complete loss of feedwater flow to the Rx RCIC & HPCI will prevent Rx from reaching Level 1.

7) -132.5" - Starts the EDG's to that they are up to rated speed in the event of a subsequent loss of normal power during a LOCA.

   a) If normal power was already lost, EDG's will start and automatically close onto the emergency busses. when they reach speed and voltage if NSS & RSS supply breakers are open.

   b) Setpoint high enough to provide time for the Core Spray Low Pressure Coolant Injection, and Automatic Depressurization Systems to function in the event of a large break in the primary system.

f. Steam Flow Effect on Reactor Water Level FIG 621-3

1) As steam flow through the dryers it is forced to change direction several times, thus resulting in a pressure drop across the dryers. At 100% steam flow, the pressure drop is 7" of water. Thus, the level outside the dryer skirt (downcomer region) is higher than inside the skirt. Since the vessel level instruments compare the reference column height to the downcomer (variable column) height, setpoints are adjusted to compensate for this 7" (maximum) error.

NOTE: Level differences inside and outside the dryer skirt will vary ranging from 0" difference at 0% steam flow to 7" difference at 100% steam flow.

2). Reactor Pressure Instrumentation

Consists of a group of pressure instruments which monitor pressure in the vessel. Utilizes the same piping as the vessel level instrumentation. Provides input for indication in the control room as well as automatic functions to be discussed under Interlocks.

a) A single overall differential pressure instrument, also utilizing the level piping, has a range of 0 to 50# and is used to evaluate jet pump performance during initial startup testing.

3) Vessel Temperature Instrumentation FIG 621-4

a. Temperature elements are provided on the RPV, and the RPV top head, on the RPV flanges, and on the RPV bottom drain line to monitor differential metal temperatures during startup and cooldown.

b. This system is primarily designed to monitor the temperature at various points of the RPV in order to map its temperature gradient during startup, shutdown, and transient conditions.

c. Consists of 22 copper-constantan thermocouples with braided glass insulation and stainless steel cladding which are symmetrically spaced over the metal skin, flange, and two studs of the reactor pressure vessel to provide temperature monitoring over the entire reactor pressure vessel surface. Two thermocouples are connected to TR-009 in the main control room, nine are connected to TR-010 on elevation 78' of the reactor bldg, and eleven are installed spares.

4) Jet Pump and Core Flow Instrumentation

a. Plant power output is proportional to the ability to remove the heat generated (core flow). Accurate flow measurements are required to elevate reactor power level.

b. Since the total flow of coolant must pass through the jet pump to reach the core inlet plenum, flow is measured in each jet pump and summed to yield total flow.

c. Each jet pump has a pressure tap on the pump diffuser. This pressure is compared to the core inlet plenum pressure to produce a differential pressure signal proportional to flow. The differential pressure signal has its square root taken thus producing an output representative of jet pump flow.

d. There are Four (4) Jet Pumps which are calibrated at a test facility and then installed in the vessel, one per quadrant. The remaining sixteen (16) jet pumps will be calibrated against them.

   1) The four (4) Jet Pumps are fully instrumented, each with a pressure tap in the throat and another in the pump diffuser.

   2) Jet pump 5, 10, 15, 20 are fully instrumented.

   3) The lower taps on jet pumps 5 and 15 also provide the variable leg signal to the Fuel Zone indication.

e. Individual Loop Flow and Total Core Flow is derived by taking the summation of the individual jet pump flows.

f. Core Plate Differential Pressure compares standby liquid control injection line pressure (below core plate) to above core plate pressure. May be used to determine long term trends in the indicated core flow and core plate differential pressure relationship.

5. Vessel Head Flange Leak Detection

   a. Detects leakage from the inside of the reactor vessel past the inner seal ring. An instrument line connects to the reactor pressure vessel in the annulus between the two concentric, metallic O-ring seals to permit detection of leakage through the inner seals.

b. If the inner seal begins to fail, steam leakage will eventually pressurize the annulus between the inner and outer O-ring seals initiating an annunciator at 600#.

c. If both the inner and outer O-ring seals fail, the leak will be detected by an increase in drywell temperature and pressure.

d. If the line was not properly drained prior to heatup, an erroneous inner seal leak will be annunciated.

IV CONTROLS AND INSTRUMENTATION

A. CONTROLS

The following Process Instrumentation system controls are located in the control room:

1. Post Accident Monitoring System (PAMS) Reset Switch S-26A & B. One switch for each Post Accident Monitoring System recorder *XR-004A & B. Upon actuation of a Rx water low level or high pressure trip, recorder will shift to fast speed (1 inch/min). When transient clear, push reset pushbutton to shift recorder speed to slow (1 inch/hr).

B. INDICATION

The following Process Instrumentation system parameters are monitored in the Control Room.

1. Rx Water Level

Instrument	Power Supply	Location
a. Fuel Zone		
LI-007	120VAC DIV I Inst. Bus	*PNL-601
LR-007	120VAC DIV I Inst. Bus	*PNL-601
b. Wide Range		
*XR-004A &B(PAMS)	RPS A(B) 120VAC DIV,I(II)Inst. Bus	*PNL-601
LI-004	RPS A	*PNL-602
LI-004D	120VAC DIV II, RPS B	*PNL-603
LI-155A(B)	120VAC DIV I(II), RPS A(B)	*PNL-101 A,B
c. Narrow Range		
C32*LI-008A	120VAC Vital Bus	*PNL-603
C32*LI-008B,C	125VDC Non-essent. Bus II,I	*PNL-603
1C32*XR-006(A or B)	120VAC Normal Inst. Bus	*PNL-603
LI-154A,B	120VAC DIV I(II), RPS A(B)	*PNL-101 A,B
d. Shutdown Range		
*LI-005	120VAC DIV I Inst. Bus	*PNL-602

e. Upset Range

1C32-XR-006	120VAC Normal Inst. Bus	*PNL-603

2. Rx Pressure Indication

a. Wide Range

*XR-004A&B	120VAC DIV I(II) Inst. Bus RPS A(B)	*PNL-601
1B21-P1-004	RPS A	*PNL-602

b. Normal Range

1C32-P1-003	120VAC UPS	*PNL-603
1B21*P1-156A,B	RPS Bus A(B)	*PNL-101 A,B

c. Narrow Range

1C32-XR-004	120VAC Normal Inst. Bus	*PNL-603

3. Jet Pump Flow

a. Total Core Flow

*XR-014	120VAC Normal Inst. Bus	*PNL-603
b. Jet Pump	120VAC DIV I Inst. Bus	*PNL-602

c. Individuals (1-20)

1B21-SD1-011A-W		*PNL-619

4. Rx Vessel Temperature

TR-009	120VAC Normal Inst. Bus	*PNL-602
TR-010	120VAC Normal Inst. Bus	*PNL-007

5. The following Process Instrumentation parameters can be monitored on the Remote Shutdown Panel.

a.	Reactor Pressure	0 - 1200 psig
b.	Wide Range Water Level	-150 - +60 in.

C. INTERLOCKS

1. <u>Narrow Range Interlocks</u>

Level	Actuation	Logic	Identification
a. +56.5"	Main Turbine Trips Trips RFPT's	008 A,B,C 2 out of 3	o Main Turbine Tripped (ARP 0140) o RFPT A(B) Tripped (ARP 0111,0387)
b. +40.5	High Level alarm	008 A or B 1 out of 2	o Rx Vessel Wtr Level Hi/Lo (ARP 1246)
c. +33.5	Low Level alarm	008 A or B 1 out of 2	o Rx Vessel Wtr Level Hi/Lo (ARP 1246)
	Rx Recirc Runback to 45% speed limiter (if FW sys. permissive is not met)	008A (B) 1 out of 1	o Recirc Pump A(B) Flow Limit (ARP 1268(9)) o Runback red light ill. on *PNL-603
d. +12.5"	Reactor scram signal to RPS	154 A,B,C,D A <u>or</u> C <u>and</u> B <u>or</u> D	o Rx Vessel Lo Level Trip A(B) (ARP 1207,1191)
	NSSSS isolation (RHR S/D cool)	154 A,B,C,D A and B-INBD C and D- OTBD	o Valve position for MOV-047,048 053, 054 037A(B)
	ADS permissive	LT 159 A,B 1 out of 1	o Reactor Sys A(B) Low Wtr Level Confirmed (ARP 1348(9))
	Rx Recirc Runback to 30% speed limiter if FW flow and recirc pump disch. vlvs. permissives not met.	008 A(B) 1 out of 1	o Recirc Pump A(B) Flow Limit (ARP 1268(9)) o Level Runback 'red' light ill.

2. Wide Range Interlocks

Level	Actuation	Logic	Identification
a. +56.5"	Trips HPCI and RCIC Turbines	LT 157 A,B,C,D HPCI-157 C and D RCIC-157 A and B	o RCIC Turbine Tripped (ARP 1062) o HPCI Turbine Tripped (ARP 1026) o Decreasing turbine RPM.
b. -38"	Starts HPCI and RCIC	LT 157 A,B,C,D RCIC/HPCI 157 A and C or B and D	o REAC WTR LEV LO-LO (ARP 1308(9)) o Increasing turbine RPM, pressure flow.
	Trips Recirc Pumps (RPT Breakers) Trip ARI valves	LT 157 A,B,C,D RPT 3A (B) ARI ØA, A and C RPT 4A (B) ARI ØB, B and D	o MG Sit A(B) DR MTR AUTO TRIP (ARP 1279(80))
	Group I Isolation	LT 155 A,B,C,D A and B or C and D	o Group 1 isolation Ch A(B,C,D) Trip (ARP 118,3,4,5,6)
	RBSVS initiation	LT 155 A,B,C,D A and B or C and D	o RBSVS Sys A(B) initiation (ARP 3084.5)
c. -132"	Start emergency diesels	LT 157 A,B,C,D EDG 101, 103- A and C EDG 102, 103- B and D	o Diesel rpm increase Indication gen voltage, frequency.
	Initiate core spray (via bus loading program).	Same as above	o Core Spray A(B) system actuated (ARP 1104(7)). CS Sys Amps, pressure, flow increase.
	Initiates LPCI (via bus loading Program)	Same as above	o RHR A(B) Reac Lo Level initiation (ARP 1130(1)). LPCI sys amps, pressure flow increase.

Permissive signal to ADS.	LT 157 A,B,C,D A - A and C B - B and D	o possible ADS A(B) timers initiated (ARP 1342(3)) if Hi Drywell pressure (1.69psig) has been actuated.
LOCA signal to Service Water.	LT 157 A,B,C,D A and C or B and D	o RB Service Wtr Auto Trip (0074(5,6) 0205), valve position.
FDW inlet check valves discs released	LT 157 A,B,C,D A and C or B and D	o Valve position

3. Rx Pressure Interlocks

Pressure(psig)	Actuation	Logic	Identification
a. 1120	Trip Recirc Pumps (RPT Breakers) Trip ARI valves	PT 158 A,B,C,D RPT 3A (B), ARI ØA, A and C RPT 4A (B), ARI ØA, B and D	o MG Set A(B) Dr Mtr Auto Trip (ARP 1279 (80)).
b. 1043	Rx Scram	PT 156 A,B,C,D A or C and B or D	o Reac Vessel Hi Pressure Trip A(B) (ARP 1206 Scram A1, A2, B1, B2, (1290)) Reactor Auto (ARP 1197, 1213, 1198, 1214)
c. 1025	High Pressure Alarm	C32-PS-003	o Reactor Press Hi (ARP 1245)
d. 465	LPCI Inj. vlvs permissive	PT 158 A,B,C,D A- A or C B- B or D	o LPCI Low Press Perm. Sys A(B) (ARP 1433 (4)).
e. 310	Auto close Rx Recirc Pump Discharge valve if LOCA signal present	PT 158 A,B,C,D A - A or C B - B or D	o NSSSS IN BD (OTBD) sys DEG. (ARP 1320 (1)). Rx sys A (B) PRESS LO (ARP 1126 (7)).

V SYSTEM PROCEDURES

A. SYSTEM PRECAUTIONS, CAUTIONS, AND/OR LIMITATIONS

1. The reactor operator should check the various reactor vessel water level instruments against each other for consistency and accuracy during reactor operation. Differences between similar ranges should be reported to the Watch Engineer.

   a. Purpose

      To ensure level indication is operating properly.

   b. Recognition

      Operator monitoring similar level ranges on Main Control Room Panels.

2. Station Technical Specifications should be consulted before removing any reactor vessel water level protective instrumentation from service for any purpose.

   a. Purpose

      To prevent operator from unknowingly entering a Tech Spec LCO condition.

   b. Recognition

      Must check Tech Specs as part of SECP.

3. Level indicator LI-ØØ5 monitors the reactor vessel water level from the instrument zero of 516-3/4 inches above vessel insert elevation to above the inside top of the reactor vessel top head. This level instrument has a scale of Ø-4ØØ inches and is utilized for flooding the reactor vessel during cooldown only. It should not be used for reactor vessel water level information during reactor power operation.

   a. Purpose

      To ensure operator is aware that Shutdown Range indication is reliable only under shutdown conditions.

   b. Recognition

      Shutdown range reading not corresponding to narrow range at power operations.

4. Level instruments LI-ØØ7, *LIT-ØØ7A & B, and LR-ØØ7 monitor the reactor core fuel zone water level. These instruments scales are -308 to -108" and during normal operation, should be indicating full scale. The variable by top of the water level instruments connect to the diffusers of jet pump 15 and 5. FLow through the

jet pumps during normal reactor operation interfaces with the variable leg signal rendering the level instruments useless for level indication. The instruments are calibrated for saturated water steam conditions at Ø psig in the vessel and in the drywell with no jet pump flow.

a. Purpose

Ensure operator is aware of limitations of Fuel Zone level instrumentation.

b. Recognition

Fuel Zone level pegged high with wide range indication low.

5. The following are wide range instruments: 1B21*LT157A, B, C, D and 1B21*LT155A, B, C, D. All these instruments are calibrated for 1ØØØ psig in the vessel, 135°F in the drywell and 2Ø Btu/lb subcooling below the middle water level nozzle and saturated conditions above the middle water level nozzle with NO JET PUMP FLOW.

a. Purpose

Ensure operator is aware of limitations of Wide Range Level Instrumentation.

b. Recognition

Level indicated higher than actual with jet pump flow. Level indicated higher at vessel pressure 1000 psig. Maximum offset at 0 psig in the RPV is ≈10 inches at normal level.

6. The following are narrow range instruments: 1B21*LT154A, B, C, D and 1B21*LT159A, B, 1C32-LT-ØØ8A, B, C. These instruments are calibrated for saturated water steam conditions at 1ØØØ psig in the vessel and 135°F in the drywell.

a. Purpose

Ensure operator is aware of limitations of Narrow Range Level Instrumentation.

b. Recognition

Level indicated higher with decreasing vessel pressure. Maximum offset at 0 psig in the RPV is ≈10" at normal level.

7. The following is an upset range instrument: 1C32-PDT-ØØ5. The instrument is calibrated for saturated water steam conditions at 1ØØØ psig in the vessel and 135°F in the drywell.

a. Purpose

Ensure operator is aware of limitations of Upset Range Level Instrumentation.

b. Recognition

Level would be higher with decreasing pressure.

8. The following is a shutdown instrument: 1B21-LT-ØØ5. The instrument is calibrated at Ø psig vessel pressure and 80°F in the drywell.

a. Purpose

Ensure operator is aware of limitations of Upset Range Level Instrumentation.

b. Recognition

Level indicated lower at higher reactor pressure.

9. Station Technical specifications should be consulted before removing any reactor vessel pressure protective instrumentation from service for any purpose.

a. Purpose

To prevent operator from unknowingly entering a Tech Spec LCO.

b. Recognition

Must check Tech Spec LCO as part of SECP.

10. The reactor operator should check the various reactor vessel pressure instruments against each other for consistency and accuracy during reactor operation. Noticeable differences in indications between pressure instruments designed to monitor similar ranges should be reported to the Watch Engineer.

a. Purpose

To ensure pressure indication is operating properly.

b. Recognition

Operator monitoring various pressure indicators available in the control room.

11. The reactor coolant system pressure shall not exceed 1325 psig.

a. Purpose

Not to exceed Tech Spec Safety Limit.

b. Recognition

Pressure indication on PAMS recorder *PNL-601, pressure indicator on *PNL-602, 603.

12. Maintain temperature within administrative and Technical Specification limits.

a. Purpose

To minimize temperature gradients on the reactor pressure vessel.

b. Recognition

Temperature recorder for RPV on *PNL-602.

14. Upon completion of any operation, such as refueling, during which water may have filled the bored passage and instrument line of the head seal leakage detection system, the instrument line must be completely drained. Failure to do so may result in alarm actuation or line rupture upon subsequent system heatup.

a. Purpose

As stated above.

b. Recognition

Reactor Vessel Head Seal Leakage (ARP 1336).

B. NORMAL OPERATION

The Process Instrumentation System is in operation during all modes of system operation.

1. During Rx Shutdown and periods when the Rx is at low and intermediate pressures the Shutdown Range instrumentation is most accurate.

2. At approximately 800psig, the narrow and wide range indicators should be used for monitoring Rx vessel level.

3. Rx Pressure is monitored using narrow and wide range pressure indication available in the control room.

4. Rx Vessel Temperature is continuously recorded and periodically checked by the control room operator to ensure temperature points are in the proper range.

C. ABNORMAL OPERATION

1. Reference Leg Failure (DIV I side) Fig 7

Upon Failure of the DIV I Reference Leg, the following indications/automatic actuations should occur:

a. Indications

1) Narrow Range A & C read upscale.

2) 'A' PAMS level recorder reads upscale.

3) HI/LO RX WATER LEVEL alarm if FWLC 'A' selected.

4) 'A' PAMS pressure recorder reads downscale.

5) Rx Pressure indicator -003A reads downscale.

6) Wide Range level ind. on 602 upscale

7) Wide Range press ind. on 603 reads downscale

8) NR recorder reads upscale if FWLC 'A' selected

b. Automatic actuations

1) Both RFPT's trip (high level).

2) Main Turbine trip.

3) DIV I ADS disabled.

2. Reference Leg Failure (Div II side) Fig 8

Upon failure of the Div II Reference Leg the following indicator/automatic actuations should occur:

a. Indications

1) "B" Narrow Range Indicator reads upscale.

2) 'B' PAMS level recorder reads upscale.

3) HI/LO RX WATER LEVEL alarm if FWLC 'B' is selected.

4) 'B' PAMS pressure recorder reads downscale.

5) Narrow Range recorder reads upscale if FWLC 'B' selected

6) Wide Range level ind. on 603 reads upscale

b. Automatic actuations

1) DIV II ADS is disabled

3. Narrow Range Variable Leg Failure (Div I Inside) Fig 9

a. Indication

1) Narrow range level indicators A & C read downscale.

2) Narrow range level recorder reads downscale if FWLC 'A' selected.

3) RX WTR LEVEL HI/LO ann. if FWLC 'A' selected.

4) RX VESSEL LOW LEVEL TRIP 'A', B SYS ALARMS

5) NR level ind on analog PNL 101A downscale

b. Automatic Actuation

1) Rx Scram

2) RHR isolation @ 12.5".

3) ADS Lo Level Confirmation 'A' alarm.

4) Note: Main Turbine & RFPT's will not trip or high level.

4. Narrow Range Variable Leg Failure (Div II side) Fig 10

a. Indication

1) "B" Narrow range level indicators reads downscale.

2) Narrow range level recorders reads downscale if FWLC 'B' selected.

3) RX WTR LEVEL HI/LO ANN. if FWLC 'B' selected.

4) RX VESSEL LOW LEVEL TRIP 'A','B' SYS ALARMS

5) NR level ind on analog PNL 101B downscale

b. Automatic Actuation

1) Rx Scram

2) RHR isolation @ 12.5"

3) ADS Lo Level Confirmation 'B' Alarm.

5. Wide Range Variable Leg Failure (Div I side) Fig 11

a. Indications

1) 'A' PAMS level recorder reads downscale.

2) Wide Range level ind. on analog PNL 101A indicate downscale.

3) Wide Range level ind on PNL 602 reads downscale.

4) RHR 'A' Lo Level initiated alarm.

5) Rx VESSEL LOW LOW LEVEL ALARMS. ON PNL-603.

b. Automatic Actions

1) Initiate HPCI, RCIC.

2) Initiate 'A' CS, 'A' LPCI, 101 and 103 EDG's, 'A' RBSVS, RBCLCW, and RBSW.

3) Div I valves isolate.

6. Wide Range Variable Leg Failure (Div II side) Fig 12

a. Indications

1) 'B' PAMS level recorder reads downscale.

2) Wide Range level indicator on PNL 603 downscale.

3) RHR 'B' Lo Level initiated alarm.

4) Wide Range level ind. on analog PNL 101B downscale.

b. Automatic Actions

1) Initiate HPCI, RCIC.

2) Initiate 'B' CS, 'B' LPCI, 102 and 103 EDG's, 'B' RBSVS, RBCLCW, and RBSW.

3) Div II valves isolate.

7. RPS MG Set 'A' Trip Fig 13

a) Indication

1) Group I Isolation CH A, C Trip

2) REAC WTR LEV LO-LO

3) Reactor Auto Scram A1, A2

4) REAC VESSEL HI PRESS TRIP SYS A

5) Wide Range Level indicator on Analog Ch 'A' fails downscale

6) Narrow Range level indicator on Analog Ch 'A' fails downscale

7) Rx Pressure on Analog Ch 'A' fails downscale

8) Wide Range level & pressure indicators on PNL-602 fails downscale.

9) PAMS 'A' downscale

8. RPS MG Set 'B' Trip Fig 14

a) Indication

1) Group II Isolation CH B, D Trip

2) REC WTR LEVEL LO-LO

3) Reactor Auto Scram B1, B2

4) Reactor Vessel HI Press Trip SYS B

5) Wide Range level indicator on Analog Ch 'B' fails downscale

6) Narrow Range level indicator on Analog Ch 'B' fails downscale

7) Rx Pressure on Analog Ch 'B' fails downscale

8) Wide range level indicator on PNL-603 fails downscale

9) PAMS 'B' downscale

9. Loss of Offsite Power   Fig 15

Initially upon loss of offsite power, all Rx vessel level and pressure instrumentation will be lost except Narrow Range indicators C32*LI-008B, C. Note: Power supply for meter indicating lights not available until emergency buses reenergized. Upon EDG's re-energizing the Emergency buses, Narrow Range indicators on PNL-603. Shutdown Range on PNL-602, and Fuel zone on PNL-601 will be available for readout in the Control Room.

10. Failed Level Transmitter

A gross failure of a level transmitter will cause instrument to read either upscale or downscale. Detected by comparison of similar level indication. The following are examples of failed level transmitters:

a. Narrow Range Failure (FWLC 'A' trans. selected) Upscale   Fig 16

b. Narrow Range Failure (RPS) Downscale.   Fig 17

c. Wide Range (ECCS) Downscale.   Fig 18

d. Wide Range (NS4) Upscale.   Fig 19

VI SYSTEM INTERRELATIONS

A. WIDE RANGE

Provides indication for the control room operator, ECCS actuation signals, and Nuclear Steam Supply Shutoff System actuation signals.

B. NARROW RANGE

Provides indication for the control room operator, Scram signals, and Rx Recirc runbacks.

C. Rx PRESSURE

Provides for indication in the control room, Scram Signal circuitry, RPT Breaker Trip signal, Nuclear Steam Supply Shutoff System actuation signals, and RHR permissives.

VII TECHNICAL SPECIFICATIONS

A. All process instrumentation shown on Figure 2 has Tech Spec related LCO's with the exception of:

1. Pressure Transmitters

   a. C32 - PT - 41

   b. C32 - PT - 003

   c. C32 - PT - 42

2. Level Transmitters

   a. B21 - LT - 005

   b. B21 - PDT - 005

   c. B21 - PDT - 014

B. The remaining Process Instrumentation are related to Tech Specs as follows:

	Tech Spec LCO #.
1. Level Transmitters	
a. C32 - LT - 008 A, C, B	3.3.9 Feedwater/ Main Turbine Trip.
b. B21 - LT - 159 A, B	3.3.3 ECCS (ADS)
c. B21 - LT - 154 A, B, C, D	3.3.1 RPS, 3.3.2 Isolation (RHR)
d. B21 - LT - 155 A, B, C, D	3.3.2 Isolation (CONT) 3.6.5.3 (RBSVS) 3.3.7.5 Accident Monitoring 3.3.5 RCIC
e. B21 - LT - 157 A, B, C, D	3.3.3 ECCS, 3.3.4.1 ATWAS
2. Pressure Transmitters	
a. B21 - PT - 004 A, B	3.3.7.5 Accident Monitoring
b. B21 - PT - 156 A, B, C, D	3.3.1 RPS
c. B21 - PT - 158 A, B, C, D	3.3.4.1 ATWAS 3.3.3 ECCS (LPCI Perm)
d. B21 - PT - 006	3.3.7.4 Remote Shutdown Monitoring

C. Reactor Coolant System

3.4.6.1 The reactor coolant system temperature and pressure shall be limited in accordance with the limit lines shown on Figure 3.4.6.1-1 (1) curves A and A' for hydrostatic or leak testing; (2) curves B and B' for heatup by non-nuclear means, cooldown following a nuclear shutdown and low power PHYSICS TESTS; and (3) curves C and C' for operations with a critical core other than low power PHYSICS TESTS, with:

a. A maximum heatup of 100°F in any one hour period,

b. A maximum cooldown of 100°F in any one hour period,

c. A maximum temperature change of less than or equal to 20°F in any one hour period during inservice hydrostatic and leak testing operations above the heatup and cooldown limit curves, and

d. The reactor vessel flange and head flange temperature greater than or equal to 70°F when reactor vessel head bolting studs are under tension.

APPLICABILITY: At all times.

ACTION:

With any of the above limits exceeded, restore the temperature and/or pressure to within the limits within 30 minutes; perform an engineering evaluation to determine the effects of the out-of-limit condition on the structural integrity of the reactor coolant system; determine that the reactor coolant system remains acceptable for continued operations or be in at least HOT SHUTDOWN within 12 hours and in COLD SHUTDOWN within the following 24 hours.

VIII Significant Industry Events

As a consequence of the Three Mile Island, Unit 2 accident, problems observed with water level instrumentation at operating BWR's have brought up six major areas of concern. The first four areas, Yarway Temp. Compensated legs, Orifices in Reference and Variable Legs, Differential Vertical Drop of Reference & Variable Legs in Drywell and Mechanical Instrumentation Failure have no significance due to SNPS design. The other two are addressed below.

A. Significant Reference Leg Verticle Drop in Drywell.

1. With a high drywell pressure and low vessel pressure condition the fluid in the vertical portion of the reference leg can flash to steam resulting in an error in level indication.

2. At SNPS, the reference leg drops are substantially less for the wide range and fuel zone instrument ranges, therefore, the significance of flashing errors is limited.

B. Logic Configuration Fig 2

1. If one assumes a break of one reference leg and a logic configuration whereby a single instrument failure can defeat a particular safety function, a sequence of events can result that would require operator action to manage vessel inventory.

For example, assume DIV I reference leg failure in conjunction with LT-157B failing upscale, this will render the following systems inoperable:

- o HPCI
- o RCIC
- o EDG's
- o Core Spray
- o LPCI
- o ADS
- o Rx Bldg Service Water

In the event of a Loss of Coolant Accident in conjunction with the above failures, the operator must immediately take action to manually start the ECCS to regain vessel inventory.

IX

APPENDIX 1

SUMMARY OF REACTOR VESSEL WATER LEVEL TRIPS

Reactor Vessel Level	Actions
Level 8 (+56.5")	Trip Main Turbine Trip Reactor Feed Pump Turbine Trip HPCI Turbine Trip RCIC Turbine
Level 7 (+40.5")	High Level Alarm
Level 4 (+33.5")	Low Level Alarm Rx Recirc Runback to 45% limits
Level 3 (+12.5")	Reactor Scram ADS Confirmation for System Activation Rx Recirc Runback to 30% Speed. RHR Isolation (Shutdown Cooling Mode)
Level 2 (-38")	Start HPCI Turbine Start RCIC Turbine Trip Reactor Pumps Group I Isolation Signal to ARI valves RBSVS initiation.
Level 1 (-132")	Start Emergency Diesels Initiate Core Spray Initiate LPCI ADS Permissive Signal

X

APPENDIX 2

SUMMARY OF REACTOR VESSEL PRESSURE TRIPS

Reactor Vessel Level	Actions
57 psig	RCIC isolation
100 psig	HPCI isolates
125 psig (Rx Recirc Suction)	RHR S/D Cooling Isolates
310 psig	Reactor Recirc Discharger Valve Auto close (with LOCA signal)
465 psig	LPCI inj valve permissive
825 psig (Main Steam Line)	Group I valves isolate if Mode Switch in RUN
1025 psig	High Pressure Alarm
1043 psig	Rx Scram
1120 psig	Trip Reactor Recirc Pumps Signal to A.R.I. valves

XI REFERENCES

A. System Description 1020.621, 622, 623, 624

B. FSAR Sec. 5.6, Sec. 7.5, Sec. 7.7

C. Technical Specifications - Proof & Review Rev. 2

D. Drawings

1. MFSK's 48A - Rev. 6, 48B Rev. 4

2. GE DWG's

729E616 BD - Rev. 17 -	Nuclear Boiler System
791E402TF	Nuclear Boiler Process Inst.
791E401TF	Nuclear Steam Supply Shutoff System
791E408TF	Feedwater Control System
931E761	Analog Trip System

E. System Procedures

1. 23.621.01 Rev. 3

2. 23.622.01 Rev. 3

3. 23.623.01 Rev. 1

4. 23.624.01 Rev. 1

5. ARP 1336 Rx VESSEL HEAD SEAL LEAK

CONTAINMENT
STUDENT HANDOUT FOR
SHIFT (SRO) ADVISOR TRAINING

Date: 5/10/84

Revision Ø

Prepared by: L. T. [illegible] 5/10/84
Training Instructor / Date

Approved by: Ken [illegible] for 5/10/84
Operation Training Specialist / Date

OBJECTIVES

7.1 State the purpose of the Containment System as given in the Student Handout.

7.2 Trace the flowpath of nitrogen within the primary containment for any of the following:

- a) LOCA Blowdown
- b) Post LOCA Drywell Spray
- c) Post LOCA Suppression Chamber Spray with the drywell floor seal intact
- d) Post LOCA Suppression Chamber Spray with a leak in the drywell floor seal.

7.3 Given Control Room Indications, Visual Inspection Results and/or Annunciators associated with the Containment System, identify conditions that require use of the following Emergency Procedures.

- a) SP 29.Ø13.Ø1 Loss of Primary Containment Integrity
- b) SP 29.Ø13.Ø2 Loss of Secondary Containment Integrity
- c) SP 29.Ø23.Ø3 Containment Control

7.4 State the Design Bases Accident for the following parameters:

1. Drywell Internal Pressure
2. Suppression Chamber Internal Pressure
3. Drywell Floor Differential Pressure
4. Drywell Atmosphere Temperature
5. Suppression Chamber Atmosphere Temperature

7.5 State why the drywell should not be purged if drywell temperature is greater than 212°F.

II PURPOSE

The Containment System limits off-site and controls personnel doses to values less than 10 CFR limits in the event of a break in Primary System Piping.

III SYSTEM DESIGN

A. General Description, Figure 1

1. The Containment System consists of a primary and secondary containment.

a) The Primary Containment consists of a drywell which encloses the Reactor Primary Coolant Systems and a Pressure Suppression Chamber which contains the Suppression Pool.

b) The Secondary Containment consists of the Reactor Building and completely encloses the Primary Containment. The Secondary Containment collects any leakage from the Primary Containment for treatment prior to release to the environment.

2. During a Loss of Coolant Accident, the steam released to the drywell is directed into the Suppression Pool by Downcomer Pipes. The Suppression Pool condenses the steam thereby minimizing the peak pressure reached in the containment. The Emergency Core Cooling Systems take a suction on the Suppression Pool and discharge into the Reactor Vessel. The water will then flow out the break and end up back in the Suppression Pool forming a Closed Loop Flow Path.

B. COMPONENT DESCRIPTION

1. Drywell

a) The Drywell is the upper portion of the Primary Containment and is constructed of steel lined reinforced concrete with a removable head. The removable head allows access to the Reactor Vessel for refueling operations. A bellows assembly forms a watertight seal between the Reactor Vessel Flange and the Fuel Pool to allow flooding the volume above the vessel during refueling.

b) A shield wall surrounds the Reactor Vessel and reduces radiation levels in the drywell to permit inspection and maintenance when the plant is shutdown.

c) The Drywell Walls provide shielding during power operation to permit normal access to the Reactor Building.

2. Drywell Floor

a) The Drywell Floor separates the Drywell and the Suppression Chamber. The floor is supported by the Reactor Vessel Pedestal and concrete columns. The floor is not attached to the outer containment wall to allow relative movement between the floor and the Containment Wall.

Figure 2

b) Two nitrogen pressurized flexible seals between the Drywell Floor and the Containment Wall ensure that steam from a Loss of Coolant Accident does not bypass the Suppression Pool.

c) Downcomer Pipes penetrate the Drywell Floor and terminate below the surface of the Suppression Pool. The Downcomers direct the Drywell Atmosphere (steam and noncondensable gases) to the Suppression Pool during a LOCA, where the steam is condensed by the Suppression Pool Water.

d) The Drywell Floor is also penetrated by discharge lines from the Main Steam Safety Relief Valves. The lines direct steam to spargers located below the surface of the Suppression Pool.

e) Six of the Downcomer Pipes are equipped with Drywell Vacuum Breakers that prevent exceeding 3 psid (upward force) on the Drywell Floor. This can occur after a LOCA Blowdown when the steam in the drywell starts to condense. Each vacuum breaker consists of two check valves in series located in the Suppression Chamber. Each valve has OPEN/CLOSED position indication and a pneumatic actuator capable of partially opening the valve for testing.

3. Suppression Chamber

a) The Suppression Chamber contains the Suppression Pool and a free air space above the pool. The Suppression Pool acts as a heat sink for Safety Relief Valve Actuation and A Loss of Coolant Accident. The Suppression Pool also serves as a source of water for the Emergency Core Cooling Systems and the Reactor Core Isolation Cooling System.

b) The Suppression Pool is filled from the Condensate Storage Tanks. The pool can be cooled by the Residual Heat Removal System and water quality increased by use of the Fuel Pool Cleanup Filters and Demineralizer.

4. Containment Penetrations — Fig. 3

a) Each piping and electrical penetration through the containment has a sealing mechanism to prevent leakage.

b) Each sealing mechanism is provided with connections to allow pressurization for leak testing.

c) The penetrations that carry hot fluids are built to minimize the heat transferred to the surrounding concrete. Overheating the concrete can cause damage.

5. Containment Access Fig. 4

a) The Drywell has the following three access points:

1. Two personnel access points are through double closure hatches. The hatches have inner and outer doors that are interlocked to prevent simultaneously opening both doors. Valves are provided for pressure equalization across the doors.

2. A Bolted Equipment Hatch is provided for replacement of large equipment. One of the personnel hatches is welded into the Equipment Hatch.

3. A Control Rod Drive (CRD) removal hatch provides a path for moving CRD Mechanisms through the Drywell Wall.

b) The Suppression Chamber has two bolted manholes to allow access.

c) All access points have double gasket seals with connections for pressure testing between the seals.

6. Secondary Containment Fig. 1

a) The Secondary Containment completely encloses the Primary Containment and Houses Equipment needed for safe shutdown such as the Emergency Core Cooling Systems. The Secondary Containment also encloses the refuel floor and acts as a Primary Containment during maintenance and refueling operations.

b) The Secondary Containment collects any leakage from the Primary Containment for holdup and treatment prior to release to the atmosphere.

c) Secondary Containment Access is provided from the Turbine Deck and via a truck bay. Both accesses are provided with double doors which allow the passage of equipment and personnel while maintaining one door shut in the access.

7. Containment isolation

a) The Containment Isolation System is a subsystem of the Nuclear Steam Supply Shutoff System.

b) The system automatically shuts the Containment Isolation Valves (normally one inside or inboard and one outside or outboard the Primary Containment) on systems not important for safety during accident or possible radioactive release conditions.

IV CONTROLS AND INSTRUMENTS

A. The following Containment System Controls are located on Main Control Room Panel PNL-MXP.

1. Drywell Vacuum Breaker Test Switches
2. Drywell Floor Upper and Lower Seal Isolation Valve Switches.

Fig. 5

B. Valve positions for most of the Containment Isolation System Valves are located on the Isolation Valve Display on Main Control Room Panel PNL-602.

C. See the Containment Support Lesson Plan for Containment Instrumentation.

D. Annunciators

- The following parameters are annunciated in the main control:

	Annunciator	ARP#	Control Room Verification
1.	D.W. Floor Up(LWR) Seal ISOL. LCTL	0447(0448)	1. a) Blue light out b) Red, Green and Blue Lights out.
2.	DW Floor Up(LWR) Seal Press. Hi/Lo	0438(0439)	2. Seal Pressure is a Local indication
3.	D.W. Upstrm(Dwnstrm) Vac Bkr not Clsd	0411(0412)	3. Vacuum Bkr Indicating Lights

V SYSTEM PROCEDURES

A. System precautions cautions and/or limitations

1. Personnel shall not be permitted inside the Drywell and/or the Suppression Chamber until the atmosphere has been checked by Health Physics Personnel.

   a) Purpose - The atmosphere must be checked to ensure it will support life, i.e., there is sufficient oxygen concentration, and checked for airborne radioactivity.

2. The Drywell must not be vented when Drywell Temperature is $\geq$212°F.

   a) Purpose - If the Drywell Temperature is $\geq$212°F, part of the pressure in the Drywell may be caused by steam. If the Drywell is vented, steam and non-condensable gases will be removed. If the Drywell is then cooled down condensing the steam the Drywell pressure may go into a vacuum. This could cause a containment implosion.

B. NORMAL OPERATION

During normal power operation the Containment Atmosphere is inerted with nitrogen to keep oxygen concentration below the Tech. Spec. limit of 4% by volume. The Secondary Containment is kept at a slight subatmospheric pressure to prevent the unmonitored leakage of radioactivity to the environment. The following are normal and High/Low limits for key containment parameters:

1. Drywell Pressure should normally be approximately 0.8 psig. The limits on Drywell Pressure are - 0.7 psig and 1.69 psig. The limits ensure that the Drywell Design internal and external pressures are not exceeded during a LOCA. If 1.69 psig is reached the containment will isolate, the reactor will scram and ECCS will initiate.

2. Drywell average temperature shall be less than 145°F. This ensures that the Drywell Design Temperature is not exceeded during a LOCA.

3. Drywell oxygen concentration shall be less than 4% by volume. This ensures that the short term hydrogen generation from a LOCA will not produce a flamable mixture.

4. The normal suppression pool level is approximately Ø" indicated. The limits on suppression pool level are -6" and +6". The lower limit ensures there is sufficient water in the pool to absorb the energy from a LOCA. The upper limit ensures the Drywell Design Pressure Limit is not exceeded during a LOCAL blowdown by limiting the downcomer submergence.

5. Suppression Pool Temperature shall be less than 90°F. This works with the minimum level to ensure the pool can absorb the energy from a LOCA. This also ensures there would be sufficient NPSH to the ECCS pumps following a LOCA.

6. Secondary Containment Pressure shall be less than 0.5" H_2O vacuum. This ensures that all leakage through the Secondary Containment is inleakage.

C. EMERGENCY OPERATION

1. Loss of Primary Containment Integrity Emergency Procedure SP 29.Ø13.Ø1.

   a) This procedure is entered when a breach of Primary Containment from a physical failure has occurred.

   b) The following are symptoms that would require the use of this procedure.

1) An unexplained decrease in Suppression Pool Level and/or visual observation of water leakage from the Suppression Pool causing a Suppression Pool Level Lo Alarm. The Low Level Alarm is 6" below the normal level. If level was initially normal, approximately 17,000 Gal had to have been lost from the pool.

2) An excessive amount of nitrogen makeup for containment inerting due to unexplained decreases in Drywell Pressure. This would have to be determined by trending the amount of nitrogen used for makeup.

3) Visual Indication - This could be anything that has breached the Primary Containment

2. Loss of Secondary Containment Integrity Emergency Procedure SP 29.013.02

a) This procedure is entered when a Breach of Secondary Containment from a physical failure has occurred.

b) The following are symptoms that would require the use of this procedure

1) A sudden unexplained change in Reactor Building Pressure. A failure in the ventilation system, opening both truck bay doors or an actual Reactor Building structural failure are among things that could cause this.

2) A Reactor Building Differential Pressure Low Alarm. This Alarm indicates that the Reactor Building Differential Tech Spec. limit has been exceeded and Secondary Containment Integrity has been lost.

3) Visual Indication - This could be anything that has breached the Secondary Containment.

3. Containment Control Emergency Procedure SP 29.023.03.

a) This procedure is entered when any of the following occur:

1) The Suppression Pool Temperature is > 90°F
2) The Drywell Temperature is ~~>135°F~~ >145°F
3) The Drywell Pressure is > 1.69 PSIG
4) The Suppression Pool indicated level is > +6
5) The Suppression Pool indicated level is < -6"

b) In general, this procedure goes through steps to first try and restore the parameter to a safe range. If this cannot be accomplished, steps are taken to ensure that the out of range parameter will not result in a breach of the Primary Containment Boundary during or after an accident situation.

Fig. 1 & 6

4. The Containment response to an accident - The following discussion describes the containment response to a Recirc System Suction Line Break. This accident is the Design Bases Accident (DBA) for Drywell Internal Pressure, Suppression Chamber Internal Pressure, Drywell Floor Differential Pressure and Suppression Chamber Atmosphere Temperature. Any pressures, temperatures or times given in the discussion are for information only.

a) Immediately after the break the Reactor blowdown occurs through both ends of the Recirc Line.

b) Reactor scram signals are initiated by a Low Reactor Vessel Level and a High Drywell Pressure.

c) The Low Reactor Vessel Level also causes a Containment Isolation and the Main Steam Isolation Valves to shut.

d) Immediately following the break, the Drywell is filled with steam and pressure rises very rapidly.

e) The increasing Drywell Pressure pushes the water level down in the downcomers with the downcomers clearing in 0.5 sec with a Drywell Pressure of $\sim$22.6 psig. The Maximum Drywell Floor Differential Pressure of 21.? psid occurs at this time.

f) Steam and noncondensable gases enter the suppression pool where the steam is condensed and the noncondensables raise Suppression Chamber Pressure.

g) Drywell Pressure peaks at 46.0 psig in $\sim$9.26 sec. The Reactor Vessel Blowdown ends in $\sim$57.7 sec. The Suppression Chamber pressure stabilizes at $\sim$ 34 psig with the Drywell and Reactor Pressure slightly higher due to the downcomer submergence.

h) In approximately 155 seconds the Emergency Core Cooling Systems have filled the Reactor Vessel to level of the broken recirc line. The ECCS flow cascades into the Drywell condensing the steam and reducing drywell pressure.

i) As Drywell Pressure decreases the Vacuum Breakers open and noncondensable gases from the Suppression Chamber flow back into the Drywell limiting the upward force on the Drywell Floor.

j) The Containment Spray Mode of RHR is used to further reduce Drywell and Suppression Chamber pressures and reduce the Suppression Pool Temperature.

NOTE: Containment Spray is used to prevent the containment from reaching its design pressure and/or to mix the atmosphere to prevent the formation of local pockets of combustible hydrogen oxygen mixtures.

k) The following closed Loop Cooling Path is formed for long term cooling. Water from the ECCS Systems enters the Reactor Vessel and flows out the break. The water ends up on the Drywell Floor where it flows through the downcomers into the Suppression Pool. The ECCS Systems take a suction on the Suppression Pool and return the water to the Reactor Vessel.

5. The DBA for Drywell Temperature is a small steam line break. This type of break results in superheated steam being discharged into the Drywell.

VI SYSTEM INTERRELATIONS

A. The Containment System requires the operation of Containment Support and Ventilation Systems and the Emergency Core Cooling Systems to ensure the containment can perform its function during accident conditions.

VII TECHNICAL SPECIFICATIONS

A. 3.6.11 PRIMARY CONTAINMENT INTEGRITY SHALL BE MAINTAINED.

APPLICABILITY: Operational Conditions 1,2, and 3

ACTION: Without Primary Containment Integrity, restore Primary Containment Integrity within 1 hour or be in at least HOT SHUTDOWN within the next 12 hours and in COLD SHUTDOWN within the following 24 hours.

DEFINITION

PRIMARY CONTAINMENT INTEGRITY SHALL EXIST WHEN:

a) All Primary Containment penetrations required to be closed during Accident Conditions are either:

1. Capable of being closed by an Operable Primary Containment Automatic Isolation System, or

2. Closed by at least one Manual Valve, Blind Flange, or Deactivated Automatic Valve secured in its closed position.

b) All Primary Containment Equipment Hatches are closed and sealed.

c) Each Primary Containment Air Lock is operable.

d) The Primary Containment Leakage rates are within limits.

e) The Suppression Chamber is operable

f) The Sealing Mechanism associated with each Primary Containment penetration is operable.

B. 3.6.1.3 Each Primary Containment Air Lock shall be OPERABLE with:

a. Both doors closed except when the air lock is being used for normal transit entry and exit through the containment, then at least one air lock door shall be closed, and

b. An overall air lock leakage rate of less than or equal to $0.20\ L_a$ at Pa, 46.0 psig.

APPLICABILITY: Operational conditions 1,2, and 3

ACTION: With one Primary Containment Air Lock Door inoperable, maintain at least the operable Air Lock Door closed and either restore the inoperable Air Lock Door to operable status within 24 hours or lock the Operable Air Lock Door closed.

C. 3.6.1.5 The structural integrity of the Primary Containment shall be maintained at a level consistent with the acceptance criteria.

APPLICABILITY: Operational Conditions 1,2 and 3

D. 3.6.1.6.1 Drywell and Suppression Chamber Internal Pressure shall be maintained within the limits of Figure 3.6.1.6-1

APPLICABILITY: Operational Condition 1.

ACTION: With the Drywell and/or Suppression Chamber Internal Pressure outside of the specified limits, restore the internal pressure to within the limit within 1 hour or be in at least HOT SHUTDOWN within the next 12 hours and in COLD SHUTDOWN within the following 24 hours.

E. 3.6.1.6.2 Drywell and Suppression Chamber Internal Pressure shall be maintained between -0.7 and 1.69 psig.

APPLICABILITY: Operational Conditions 2 and 3

ACTION: With the Drywell and/or Suppression Chamber Internal Pressure outside of the specified limits, restore the Internal Pressure to within the limit within 1 hour or be in at least HOT SHUTDOWN within the next 12 hours and in COLD SHUTDOWN within the following 24 hours.

F. 3.6.1.7 Drywell Average Temperature shall not exceed 145°F.

APPLICABILITY: Operationals Conditions 1,2 and 3

G. 3.6.2.1 The Suppression Chamber shall be OPERABLE with:

a. The Pool Water:

1. Volume between 76,839 ft^3 and 81,350 ft^3, equivalent to a level between -6 inches gauge and + 6 inches gauge, and A.

2. Maximum Average Temperature of 90°f during Operational Condition 1 or 2, except that the maximum average temperature may be permitted to increase to:

   a) 105°F during testing which adds heat to the suppression pool.

   b) 110°F with thermal power less than or equal to 1% of RATED THERMAL POWER.

   c) 120°F with the main steam line isolation valves closed following a scram.

b. Drywell-To-Suppression Chamber Bypass Leakage less than or equal to 3% of the acceptance $A/\sqrt{K}$ design value of 0.16 ft^2 (0.0048 ft^2).

c. The Drywell Floor Perimeter Nitrogen - pressurized seal pressurized to greater than or equal to 53 psig.

APPLICABILITY: Operational Conditions 1,2 and 3

Action:

a. With the suppression pool water level outside the above limits, restore the water level to within the limits within 1 hour or be in at least HOT SHUTDOWN within the next 12 hours and in COLD SHUTDOWN with the following 24 hours.

b. In Operational Condition 1 or 2

   1. With the Suppression Pool Average Temperature greater than 105°F during testing which adds heat to the Suppression Pool, Stop testing which adds heat heat to the Suppression Pool and restore the average temperature to less than 90°F within 24 hours.

   2. With the Suppression Pool Average Temperature greater than 110°F, Place the Reactor Mode Switch in the Shutdown Position and operate at least one residual heat removal loop in the Suppression Pool Cooling Mode.

c. With the Drywell Floor Perimeter Nitrogen - Pressurized seal not meeting the above pressure limit, restore the pressure to equal to or greater than the limit within 1 hour.

H 3.6.2.2 The Suppression Chamber Mode of the Residual Heat Removal (RHR) System shall be operable with two independent loops, each loop consisting of:

a. One operable RHR Pump, and

b. An Operable Flow Path capable of recirculating water from the Suppression Chamber through an RHR Heat Exchanger and the Suppression Chamber Spargers.

APPLICABILITY: Operational Conditions 1,2 and 3

I 3.6.2.3 The Suppression Pool Cooling Mode of RHR shall be operable with two Independent Loop, each consisting of:

a. One Operable Pump, and

b. An Operable Flow Path capable of recirculation water from the Suppression Chamber through an RHR Heat Exchanger.

APPLICABILITY: Operational Conditions 1,2, and 3

J 3.6.3 The Primary Containment Isolation Valves and the Reactor Instrumentation Line excess Flow Check Valves shall be OPERABLE with Isolation Times within SPECIFICATION.

APPLICABILITY: Operational Conditions 1,2 and 3

K 3.6.4 Each pair of Suppression Chamber - Drywell Vacuum Breakers shall be OPERABLE and CLOSED.

APPLICABILITY: Operational Conditions 1,2 and 3

L 3.6.5.1 SECONDARY CONTAINMENT INTEGRITY shall be maintained.

APPLICABILITY: Operational Conditions 1,2,3 and when irradiated fuel is being handled in the secondary containment and during CORE ALTERATIONS and operations with a potential for draining the reactor vessel.

DEFINITION

SECONDARY CONTAINMENT INTEGRITY shall exist when:

a. All Secondary Containment Penetrations required to be closed during accident conditions are either:

1. Capable of being closed by an operable secondary containment automatic isolation system, or

2. Closed by at least one manual valve, blind flange, or deactivated automatic valve secured in its closed position.

b. All Secondary Containment Hatches are closed and sealed.

c. The Reactor Building Standby Ventilation System is OPERABLE.

d. At least one door in each access to the Secondary Containment is closed.

e. The sealing mechanism associated with each Secondary Containment Penetration is operable.

f. The pressure within the Secondary Containment is less than or equal to 0.5 inch of Vacuum Water Gauge.

M. DESIGN FEATURES:

The Primary Containment is designed and shall be maintained for:

1. Maximum Internal Pressure 48 psig.

2. Maximum Internal Temperature:

Drywell 340°F

Suppression Pool 225°F

3. Maximum External Pressure 5.7 psid.

4. Maximum Floor Differential Pressure

30 PSID, Downward

4 PSID, Upward.

VIII SIGNIFICANT INDUSTRY EVENTS

A. The most common problem with the containment system has been failures associated with the personnel access air locks. The following is a list of typical problems.

1. Excessive leakage on door seals.

2. Both doors being open simultaneously due to an interlock failure or out of adjustment and personnel error.

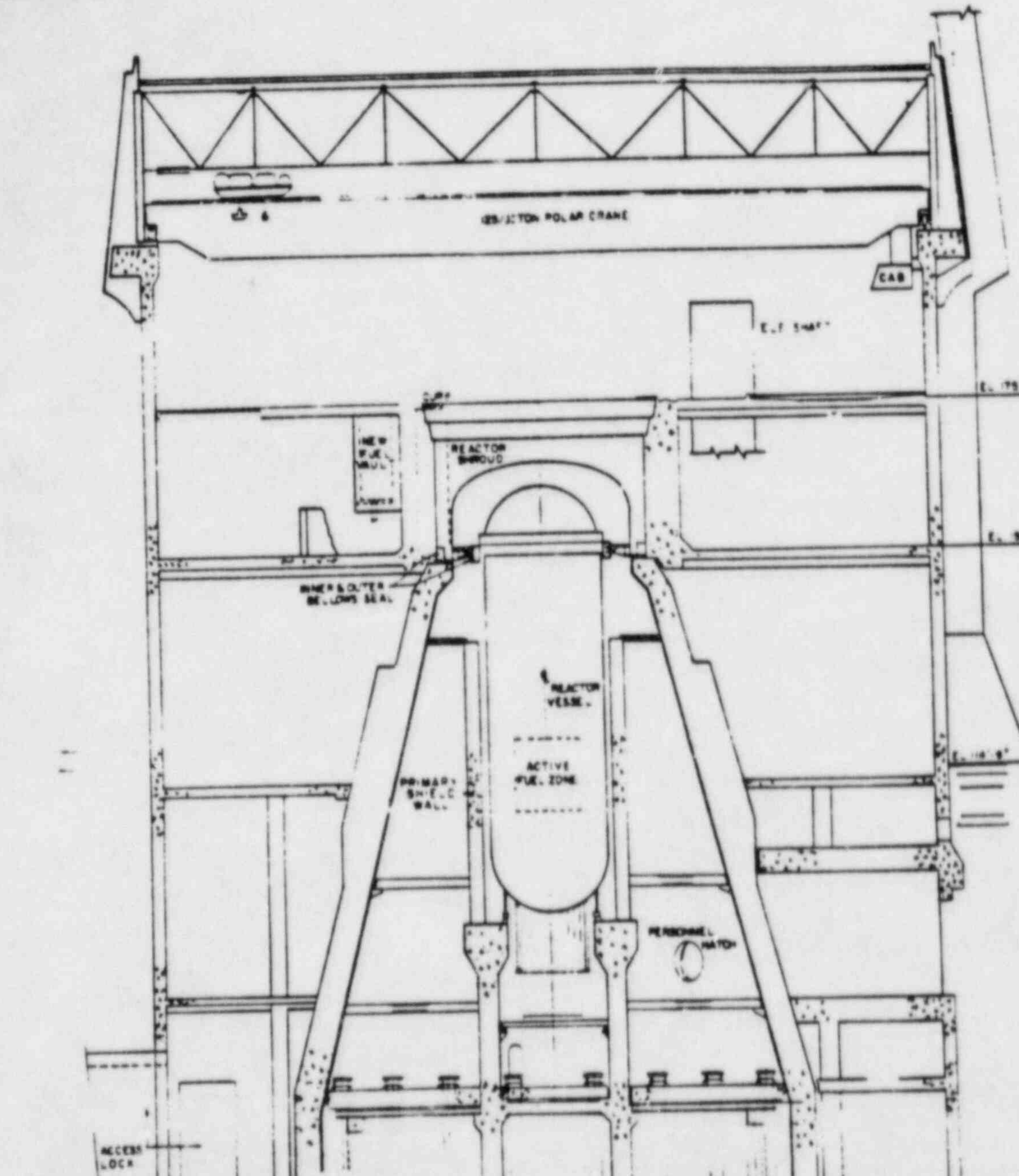
3. Doors failing to close due to mechanical failure

4. One plant left the supply valve for seal pressure testing on the inner door open. Leakage of the door seal allowed the air lock to become pressurized. The air lock pressure was relieved when the inner door blew open causing significant damage.

B. Another common problem is a loss of Secondary Containment Integrity due to the simultaneous opening of both doors in a Secondary Containment Access due to personnel error.

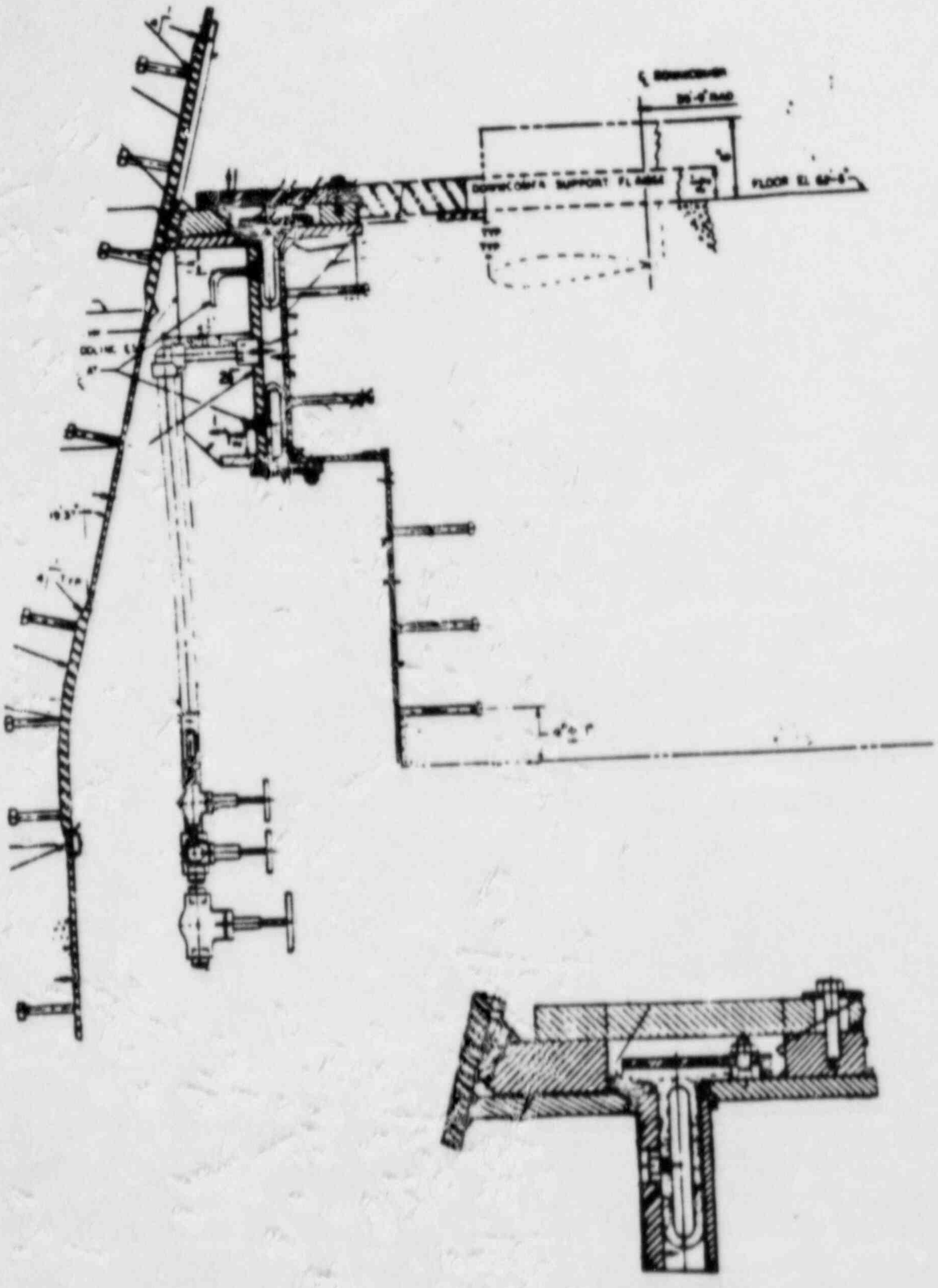
C. Drywell Vacuum Breakers have caused many problems due to excessive leakage, failing to close and inoperative position indications.

D. Excessively high and low suppression pool levels have been caused by lack of operator attention during normal plant evolutions such as entering shutdown cooling.



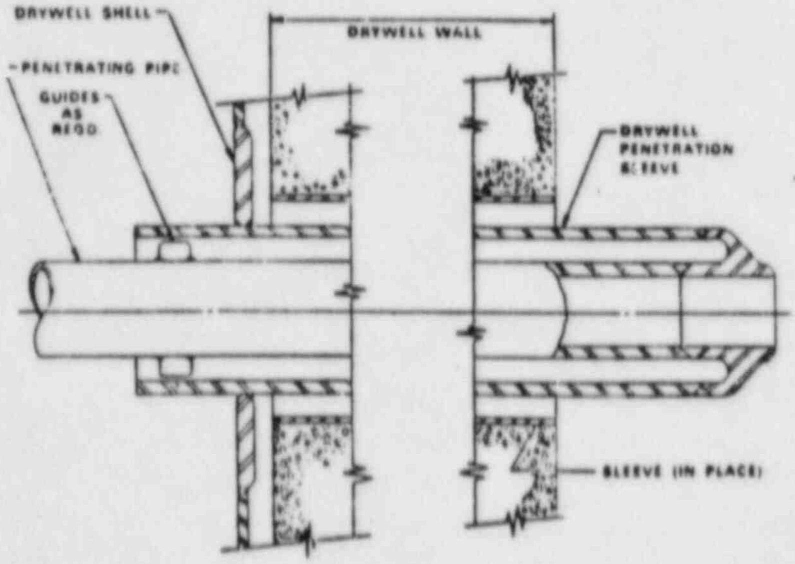
PRIMARY AND SECONDARY CONTAINMENT

FIG. 1

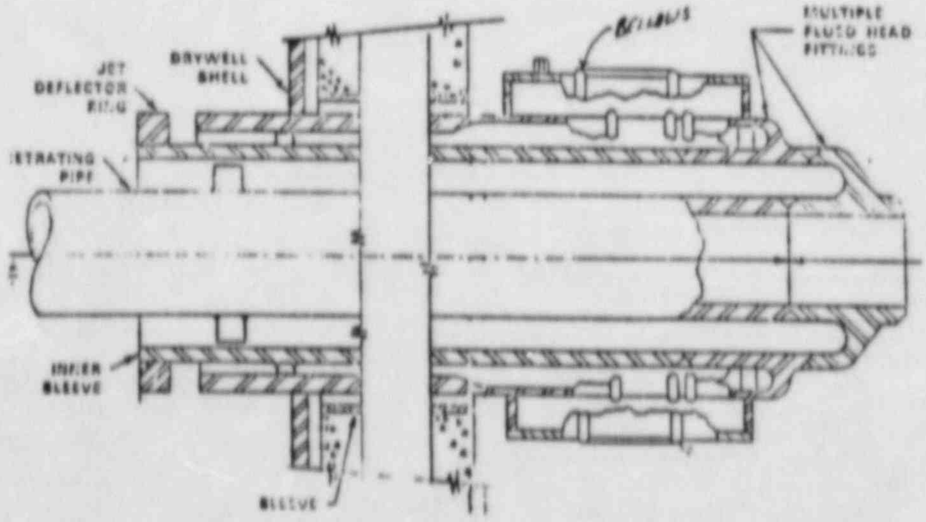


DRYWELL FLOOR SEAL

FIG. 2



Cold Fluid Piping Penetration Assembly



Hot Fluid Piping Penetration Assembly

FIG. 3

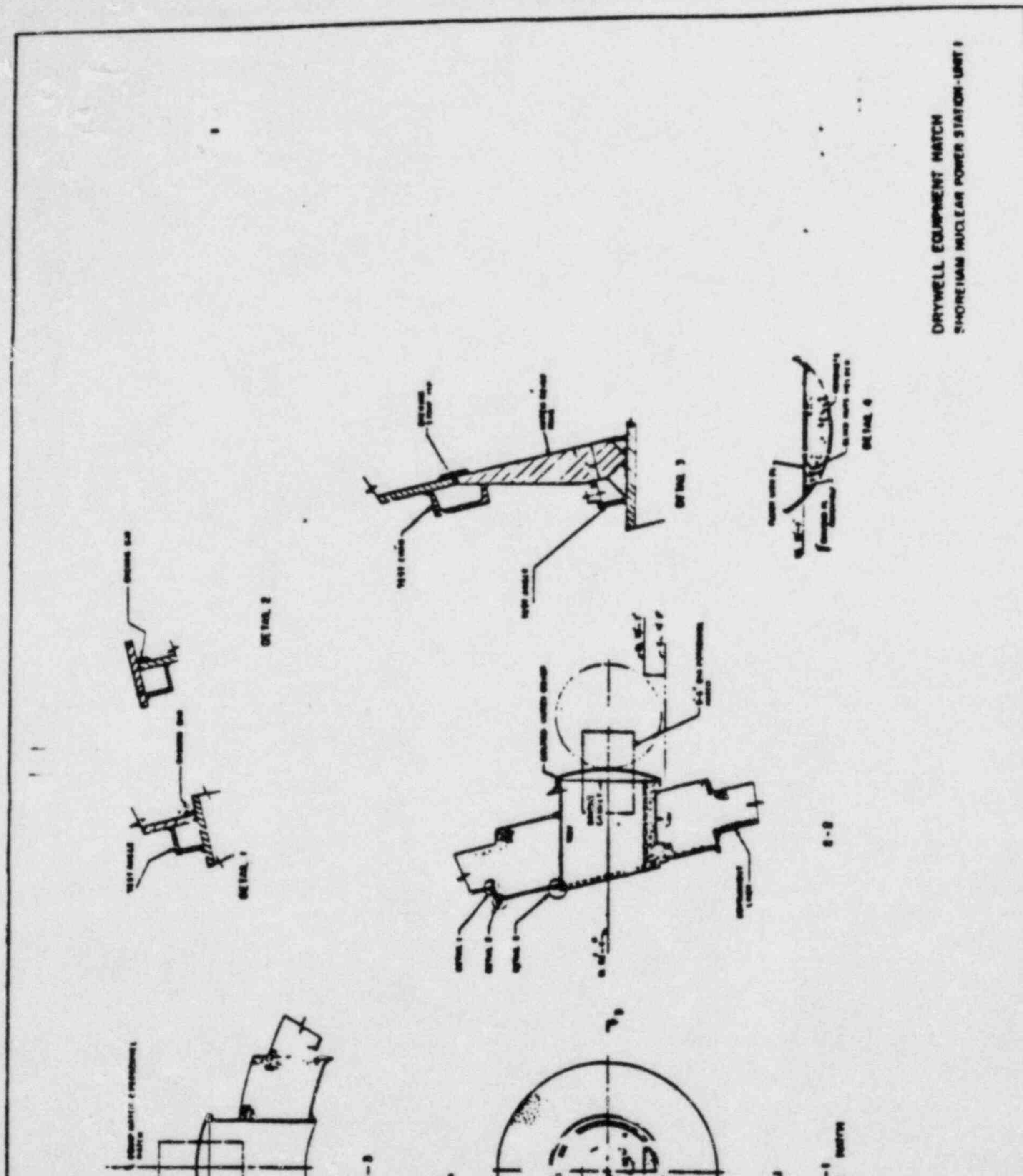

DRYWELL EQUIPMENT HATCH
SHOREHAM NUCLEAR POWER STATION-UNIT 1
DETAIL 1
DETAIL 2
DETAIL 3
DETAIL 4

FIG. 4

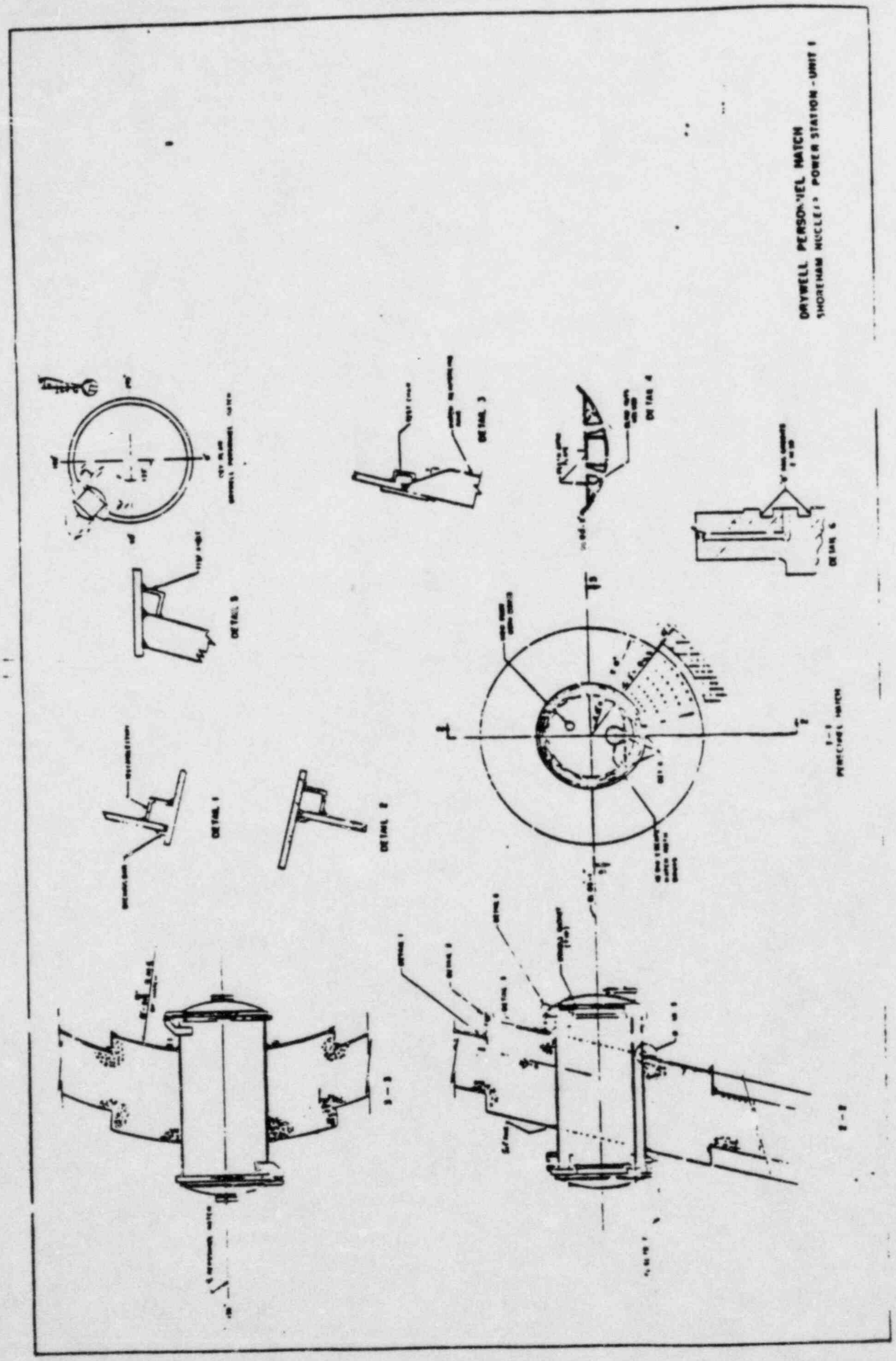

DRYWELL PERSONNEL HATCH
SHOREHAM NUCLEAR POWER STATION - UNIT 1

FIG 4a

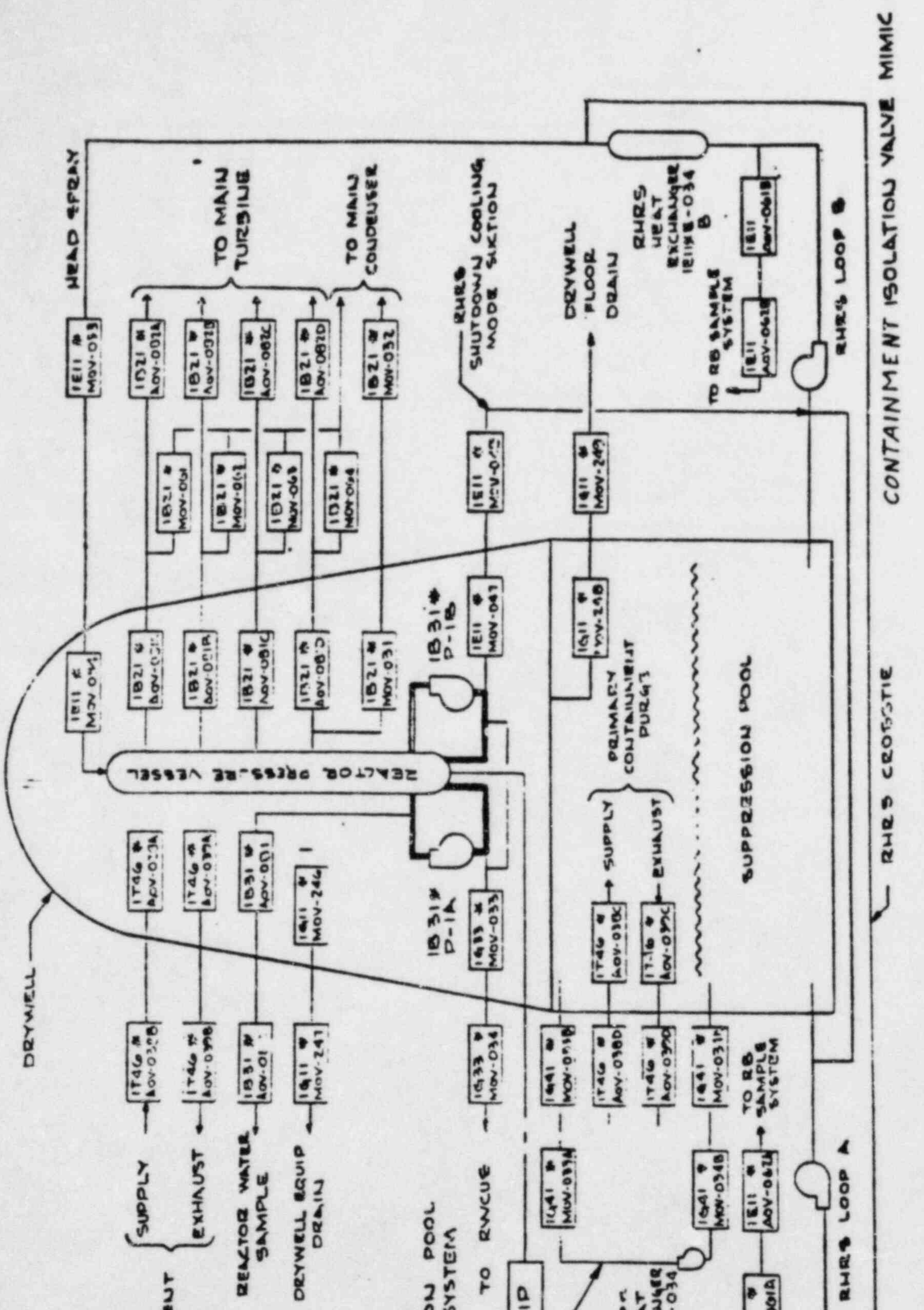
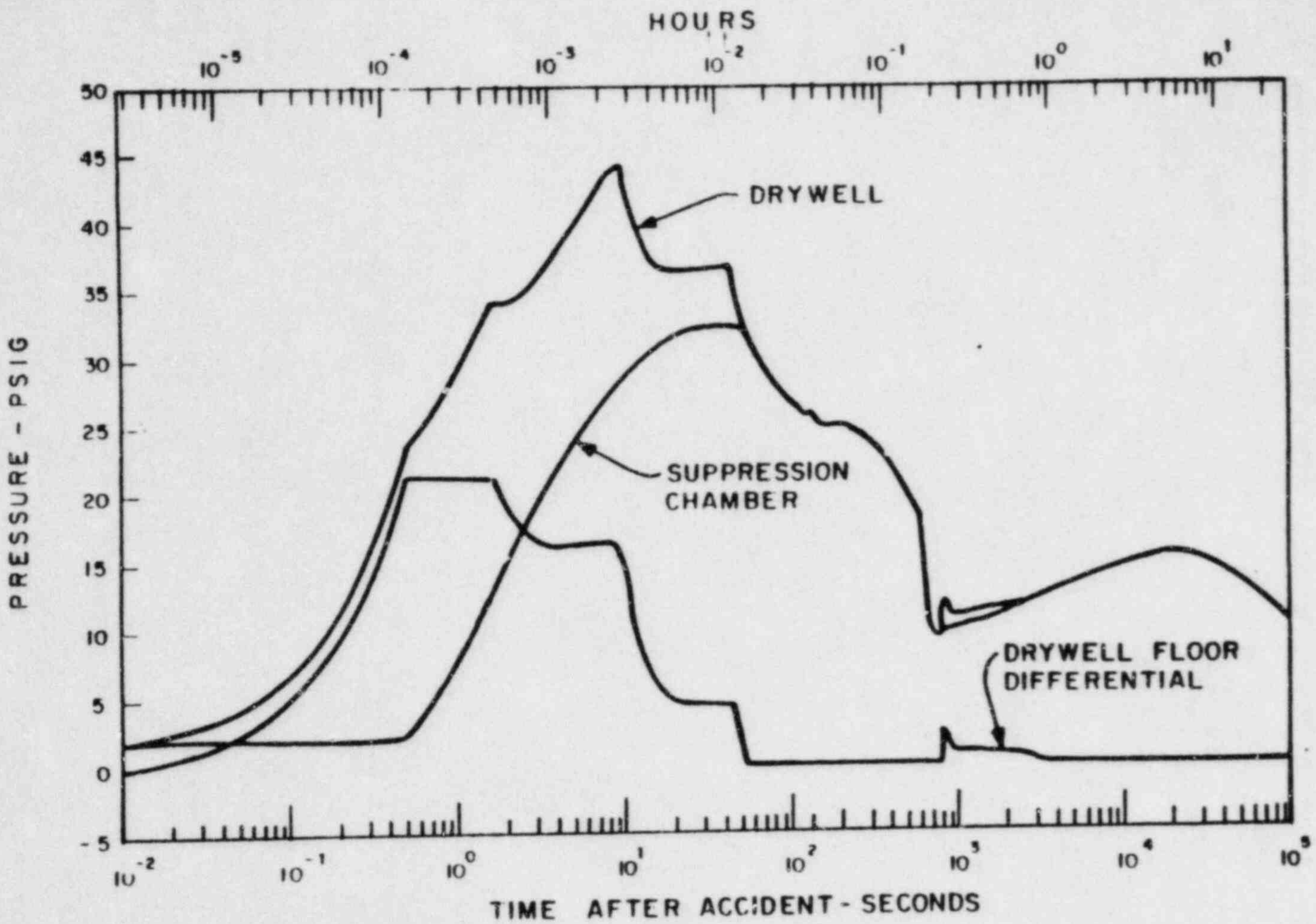

CONTAINMENT ISOLATION VALVE MIMIC
DRYWELL
REACTOR PRESSURE VESSEL
SUPPRESSION POOL
HEAD SPRAY
TO MAIN TURBINE
TO MAIN CONDENSER
RHRS SHUTDOWN COOLING MODE SUCTION
DRYWELL FLOOR DRAIN
SUPPLY
EXHAUST
REACTOR WATER SAMPLE
DRYWELL EQUIP DRAIN
TO RWCUE
TIP
RHRS LOOP A
RHRS CROSSTIE
TO RB SAMPLE SYSTEM
TO RADWASTE
1B31 # P-1A
1B31 # P-1B

FIG. 5



PRIMARY CONTAINMENT LONG TERM PRESSURE RESPONSE TO A RECIRCULATION LINE BREAK,

REVISION 31 - AUGUST 1983

SERVICE WATER STUDENT HANDOUT

FOR SHIFT (SRO) ADVISOR

TRAINING PROGRAM

Date: 5/10/84

Prepared by: MP

Training Instructor/Date

Revision: ϕ

Approved by: Ken [illegible] 5/10/84

Operations Training Specialist/Date

1.0 LESSON PLAN: SERVICE WATER

2.0 LECTURE DURATION: 4 hrs.

3.0 MATERIALS REQUIRED FOR STUDENTS:

3.1 Service Water System Lesson Plan

3.2 Service Water Operational Procedure 23.122.01

3.3 Technical Specifications 3/4.7.1

4.0 MATERIALS REQUIRED FOR INSTRUCTOR:

4.1 Related Graphics

5.0 REFERENCE MATERIALS:

5.1 Service Water System Description 1020.122

5.2 Service Water System Procedure

5.3 FSAR Sections 2.4.12, 7.3 - 7.3.1.1, 7.3.2.8 and 9.2.1

5.4 Technical Specifications 3/4.7.1

5.5 Flow Diagrams FM-47A to 7N

5.6 Logic Diagrams LSK-9-7A to 7N

5.7 Electrical Elementary Diagram ESK-5P4101

6.0 SCOPE OF LECTURE:

To teach the student the piping arrangement, major components, instrumentation system operation, and system interrelationships of the Service Water System.

7.0 STUDENT SYNOPSIS:

At the end of the lecture the student should:

7.1 State the purpose of the Reactor Building Service Water System.

7.2 State the purpose of the Turbine Building Service Water System.

7.3 Given a diagram of the system or control panel display, trace out the flowpath for:

a) Normal Operation

b) Loss of Offsite Power

c) LOCA

7.4 Given a diagram of the Service Water system and a control panel display, identify the following SW SYSTEM ALIGNMENTS:

a) Loss of offsite power

b) LOCA

7.5 State the condition that will cause the RBSWS to split.

7.6 List the heat loads supplied by the RBSWS.

7.7 List the heat loads supplied by the TBSWS.

8.0 <u>LESSON OUTLINE:</u>

8.1 Theory

8.1.1 Purpose:

.1 Transfer heat from various plant components to the Long Island Sound.

.2 The Reactor Building Service Water system provides a reliable, unexhaustable source of emergency cooling water for the reactor core and the spent fuel in the spent fuel pool.

.3 The RBSW system transfers heat from the reactor building loads during normal operations and also provides heat removal capacity from safety related loads during a LOCA.

.4 The TBSW system transfers heat from BOP plant components.

8.1.2 Design Bases:

.1 Reactor Building service water is designed to supply adequate cooling during a LOCA with L.I. Sound at its maximum Tech. Spec. limit & any single failure.

.2 Reactor Building service water is nuclear safety related and must be:

a. seismic Cat I

b. protected from Tornado Winds & Missiles

c. protected from floods

d. meet single failure criteria

8.2 Physical Description

8.2.1 General

8.2.1.1 Reactor Building Service Water FIG. 1,2

.1 Consists of:

a. four motor driven, vertical, wet pit, centrifugal pumps

b. four motor operated strainers

c. necessary pipes, valves and instrumentation

1) piping is copper nickel: compatability with sea water

2) Valves are carbon steel lined with rubber for same reason.

3) all buried piping is encased in concrete

4) screenwell components have cathodic protection

.2 RB service water pumps

a. each in a separate bay in the intake structure

b. 8,600 gpm @ 65 PSIG

c. suction is in the forebay after the traveling screens

d. capacity: 50% during DBA & for normal ops.

.3 Flow Path:

a. through motor operated discharge valve (MOV-31A-D)

b. through automatic self cleaning rotary type strainers

c. through a check valve

d. to a common header

e. discharge valve has a 4" normally open bypass valve: Provides for min flow & system fill

f. the header can be divided by two series motor operated valves (MOV-32A & B)

   1. 32A supplied by DIV I MCC

   2. 32B supplied by DIV II MCC

   3) normally open

   4) auto close during LOCA

   5) pumps A&C supply header A

   6) pumps B&D supply header B

g. One 20" supply line comes off each header to supply one set of the redundant safety related loads and either line can supply:

   1) each diesel

   2) main chill water condenser

   3) ultimate cooling connection

   4) fuel pool emergency makeup

h. One 24" tie line comes off the B header and goes to the TB service water through two series motor operated valves.

   1) normally closed

   2) auto close during a LOCA

   3) has a locked closed 16" manual bypass valve around the MOV's.

i. loads:

   1) RBCLCW heat exchangers

   2) Drywell Booster heat exchangers

   3) RBSVS & CRAC chill water condensers

   4) main chill water condensers

5) emergency diesel jacket coolers

6) RHR heat exchangers

7) ultimate cooling supply

8) spent fuel pool emergency supply

9) aux boiler blowdown tank cooling

j. The outlets of loads 1 through 6 above, go to the discharge tunnel and return to the sound. Standpipes on discharge lines ensure flow path.

k. If the emergency cooling supplies are used the water would be contaminated and retained in the reactor building for processing.

l. Blowdown tank will have phosphates and therefore drains to the sanitation system.

m. The heat exchangers and diesel coolers have relief valve protection. Thermal relief in event service water is isolated to a cooler that is still rejecting heat.

n. Samples for radiation monitors are taken on the outlet of each RHR heat exchanger to detect tube leaks.

8.2.1.2 Turbine Building Service Water FIG.3

.1 Consists of:

a. three motor driven, vertical, wet pit centrifugal pumps

b. two motor operated strainers

c. necessary piping valves and instrumentation

1) piping copper nickel

2) buried pipe is concrete encased

.2 Pumps:

a. separate suction on circ water cubicles

b. 8000 gpm at approximately 50 PSIG.

c. capacity: 50% at rated operating conditions

100% when shutdown or with low inlet temperature

.3 Flow Path

a. expansion joint

b. check valve

c. motor operated discharge valve (MOV-112A-C)

d. common header

e. two parallel strainers with individual motor operated inlet isolation valves (MOV-113A & B)

f. to the supply header

g. pump discharge valve has a 6" normally open bypass valve

h. loads

1) TBCLCW heat exchangers

2) Cir water pump bearing cooling

3) screen wash pumps motor oil coolers

4) vacuum priming pump seal water coolers

5) supply to fish retention pool

6) supply to vacuum priming drain tank

i. the outlet from loads 1 and 4 go to the discharge tunnel

j. outlet from 2 and 3 go to screenwell while 5 goes to the intake canal

k. outlet from 6 goes to the salt water drain tank before returning to the discharge tunnel

l. TBCLCW heat exchangers have 100 psi relief valves for overpressure protection when their outlet is shut

8.2.1.3 Both systems receive hypochlorite injections at timed intervals to prevent fouling of heat exchanger tubes

8.2.2 Major Components

.1 RB service water pumps

a. vertically mounted, wet pit, dual stage centrifugal type pumps

b. 8600 gpm

c. shutoff head 252 ft. (96 psi)

d. minimum required flow 800 gpm

e.. self-lubricating

f. has vibration monitor

.2 RB service water pump motor

a. 450 horsepower, full load current 58.1 amps

b. powered from 4160V emergency buses

1) A - Bus 101 (DIV I)

2) B - Bus 102 (DIV II)

3) C&D - Bus 103 (DIV III)

c. control switches on RSP and in main control room

d. has a non-reversing ratchet

e. has a 200 watt space heater

.3 Strainers:

a. prevent fouling of Hx's

b. self-cleaning: Requires 450 gpm during backwash

c. motors powered from 480V Normal MCC's

d. flashing light on MCB-Ø1 indicates 4 PSID

e. alarm at 8 PSID

.4 Turbine Building service water pumps

a. single stage, vertically mounted wet pit centrifugal type pumps

b. 8,000 gpm

c. shutoff head approximately 50 PSIG

d. air release valve, vent air from pump and auto close when liquid pumped. Also prevents vacuum forming in the pump discharge when the pump is stopped

.5 TB service water pump motor

a. 350 HP

b. power supply: 4160V normal bus

1) A-Bus 11

2) B&C-Bus 12

.6 Strainers

a. automatic backwashing, 100% flow capacity strainers

b. requires 420 gpm during backwash

c. clean dp 2.2 psig

d. power supply: 480 Volt Normal MCC's

8.3 PRINCIPALS OF OPERATION

8.3.1 System operating modes

8.3.1.1 Normal operation

.1 Two RBSW pumps operating to supply:

a. one Drywell Booster heat exchanger

b. one RBCLCW HX

c. one RBSVS & CRAC chill water condensers

d. Main chill water condensers

.2 Two TBSW pumps operating to supply:

a. one TBCLCW heat exchanger

b. Circ water bearing cooling

c. Vacuum Priming seal water HX

.3 All other loads can be valved in as necessary

8.3.1.2 Abnormal operation: Loss of off site power

.1 All SW pumps trip

.2 EDG start and close in on emergency buses

.3 When diesels are up to speed, pumps P-003A, B, C and D start

.4 RBSW will supply:

a. EDG coolers

b. Both RBCLCW HX

c. One Drywell Booster HX

d. RBSVS & CRAC chill water condensers

.5 The following will be available to the operator:

a. RHR HX

b. Spent Fuel Pool Emergency Supply

c. Ultimate cooling supply

8.3.1.3 Accident Condition: Loss of Coolant

.1 The A, B, C & D RBSW Pumps receive start signals from the emergency Bus Program (12 sec From time bus is energized)

.2 RBSW will supply water to:

a. Both RBCLCW HX

b. All Four RBSVS and CRAC chill water condensers

c. EDG

.3 RBSW will be available to the following:

a. RHR HX

b. Ultimate Cooling

c. Spent Fuel Pool

8.3.2 Instrumentation and Controls FIG 4,5 & 6

8.3.2.1 Control Room

.1 Major instrumentation

a. RB Service Water (on MCB)

1. Motor Current

2. Header Pressure

3. RHR HX Flow

4. RBCLCW HX Flow

5. Strainer dp

6. RBCLCW Outlet Valve Position

7. RHR Hx Outlet Valve Position

b. TB Service Water (on MXP)

1. Motor Current

2. Header Pressure

.2 Controls

a. Individual Pump Control switches:

1. spring return to auto or neutral pos.

2. targets are red after start, green after stop

3. PTL/STOP/AUTO/START positions (Note: RBSW-C has neutral vice auto)

4. RBSW on MCB; TBSW on MXP

5. White light near control switch goes right when motor lockout occurs. (Note: must reset at switchgear)

b. TBSW standby pump select switch

1. Maintain contact

2. OFF/A/B/C

3. on MXP

c. The following valves have control switches of various types for position control. (open or close)

1. on the MCB

MOV 31 A - D	RBSW Pump Discharge
MOV 32 A - B	RBSW header isolation
MOV 33 A - D	Ultimate Cooling Supply isolation
MOV 34 A - B	RHR HX outlet
MOV 35 A - B	RB - TB SW Isolation
MOV 36 A - C	Main Chill Water
MOV 37 A - B	RBCLCW HX OUTLET
MOV 39 A - B	Ultimate Cooling Line Drain
MOV 129 A - B	Drywell Booster HX outlet
AOV 16 A - C	EDG Cooler Outlet

2. on the MXP

MOV 42 A - B	Spent Fuel Pool Emerg. Supply Isol.
MOV 43	Spent Fuel Pool Emerg. Supply Drain
MOV 111 A - B	TBCLCW HX outlet
MOV 112 A - C	TBSW Strainer inlet

3. MOV 33 and 42 valves have keylock control switches

4. MOV 35 valves also have

   a. Keylock switch and an override switch to allow the operator to open these valves during a LOCA

5. MOV 34 and 37 valves also have

   a. Keylock switch (Normal/Throttle) and a pushbutton (intermediate) to throttle the valves to 50%

   b. An override switch to allow the operator to open these for post LOCA cooling

8.3.2.2 Remote Shutdown Panel (RSP)

.1 Control switches for

a. P41-P-003 B&D: RBSW Pumps B&D

b. MOV - 31 B&D: B&D RBSW Pump Discharge Valves

c. MOV - 32B: Service Water header isolation

d. MOV - 34B: 'B' RHR HX Discharge

e. MOV - 35B: 'B' RB-TB SW Cross tie

f. MOV - 37B: 'B' RBCLCW HX Discharge

.2 Transfer switches: (Norm/Emerg Positions)

a. one for the B RBSW pump & discharge valve

b. one for the D RBSW pump & discharge valve

c. one for MOVs 32B, 35B, 37B

d. one for MOV 34B

.3 Indication: RBSW header B Pressure

8.3.2.3. Local Controls

.1 RB Service Water pumps have target type control switches at their respective switchgear

.2 All strainers have control switches in the screen well (Hand/Off/Auto)

8.3.3 Interlocks

.1 RBSW Pumps

a. Auto Trip

1. sustained bus undervoltage

2. Motor Fault (86 Lockout)

b. Auto Start

1. CS in Auto

2. Either

a. LOCA Signal Present and Bus Powered and up to Voltage for 12 sec

b. No LOCA Present and Diesel 400 RPM for 7 sec

NOTE: either of the above will supply start signals to the SW pumps but pump discharge valve must be closed in order for breaker to be closed.

c. RSP Transfer switch in emergency overrides CR Control Switch and Auto Start signals for B & D Pumps

d. Pump discharge valve

1. Opens 20 sec after Breaker closes

2. Shuts when Breaker opens

.2 RHR & RBCLCW HX Outlet Valves

a. Go to 50% Position if key lock switch is in Normal and intermediate Pushbutton Pressed.

b. Can be throttled if its keylock switch is in throttle and the open or close pushbutton is pressed (releasing push button stops the valve)

.3 LOCA Interlocks

a. LOCA Signal Cause

1.	MOV 34 (A,B)	Close	RHR HX OUT
2.	MOV 37 (A,B)	Open	RBCLCW HX OUT
3.	MOV 32 (A,B)	Close	RBSW HEADER ISO.
4.	MOV 35 (A,B)	Close	RB-TB XCON
5.	MOV 36 (A,B,C)	Close	MAIN CHILL WATER SUPPLY
6.	MOV 129 (A,B)	Close	DRYWELL BOOSTER HX

b. Override switches allow MOV 34, 35 & 37 to be repositioned

c. Depressing their override pushbutton allows the RHR Hx outlet MOV's 34 and the RBCLCW Hx outlet MOV's 37 to be repositioned even if a LOCA signal is present. MOV's 35 cross tie valve has a keylock override switch.

d. White light above override pushbutton indicates LOCA signal has been overridden.

e. Other valves are interlocked closed (32,35,36 & 129)

.4 RBCLCW head tank levels are low low

a. RBCLCW Hx service water outlet MOV's 39 open

.5 Loss of Power Interlocks

a. Loss of Power Causes same valve lineup as

LOCA except for MOV 129 (A&B)

b. If Diesel supplies the bus, MOV 35 & 36 are interlocked closed

c. Once condition clears & the valves reach their intended position valves can be repositioned (except for 34 & 37 valves)

d. After loss of power clears, the RHR Hx outlet valves and the RBCLCW Hx outlet valves override pushbutton must be depressed in order to be able to reposition the valves.

.6 DG cooling supply valves open when diesel starts; close when diesel shuts down

.7 Emergency open on MOV - 33 (A-D) and both emergency open and emergency close on MOV-42 (A & B) override the motor overloads

.8 TB SW Pumps

a. Trip

1. Bus U.V. for 2 sec

2. Motor Fault (86 lockout)

b. Auto Start

1. No Pump Running

2. Selected for Standby

3. CS in Auto after Stop & Disch Valve Shut

4. Motor Fault on either of other pumps

c. Discharge Valve

1. Opens 2 min after pump starts

2. Shuts when pump stops

.9 TBCLCW Hx Outlet MOV 120

a. Opens with 2 or 3 pumps running

b. Closes with 1 or 0 pumps running

8.3.4 SYSTEM INTERRELATIONS

8.3.4.1 STARTUP

.1 The RB service water system is nuclear safety-related and requires no support, other than power available to the emergency buses, for start-up and operation. The TB service water system is not safety-related and requires support from the normal buses.

.2 The following systems should be operational to support the service water system during normal operation:

a. Traveling water screens and screen wash system

b. Hypochlorination system

8.3.4.2 SHUTDOWN

.1 The loss of service water cooling to nuclear safety-related components supplied by this system will result in the inability of these components to function during an accident. The effects are as follows:

a. Emergency Diesel Generators. The emergency diesel generators will overheat and trip out due to loss of cooling water, resulting in the loss of all a-c power during an accident if off-site power is not available.

b. RBCLCW. Loss of service water during an accident will prevent the RBCLCW system from cooling the RHR pumps and the spent fuel pool. Loss of cooling to the RHR pumps will result in immediate loss of those pumps and a reduction in core cooling capability. Loss of cooling to the spent fuel pool will have less immediate effects but will result in high temperatures and potential radioactive release from the spent fuel pool.

c. RBSVS and CRAC Chilled Water.

Loss of service water during an accident will cause loss of the RBSVS and CRAC Chilled Water System, resulting in above atmospheric pressures in the secondary containment and potential unmonitored radioactivity release to the environment.

d. Emergency Service Water (Ultimate Cooling). Loss of emergency service water should have no effect during an accident, as it is normally not used. However, there will be no backup cooling supply to the ultimate cooling connection or to the spent fuel pool.

.2 Loss of service water cooling during normal operation will result in the operational failure of the following systems due to lack of cooling. The effect will be to require immediate plant shutdown.

a. TBCLCW

b. RBCLCW

c. RBSVS and CRAC chilled water

d. Main ventilation chilled water

e. Main circulating water (loss of pump bearing cooling)

8.4 SUMMARY:

8.4.1 The service water system is divided into two systems, one supplying the Reactor Building and Control Building; the other supplying the Turbine Building.

8.4.2 The Reactor Building service water system is safety related and therefore is powered from the emergency buses. Two pumps are required during operation and two during accident conditions. Its supply header can be divided into two redundant systems to insure a supply to at least one of every safety related load and all three diesels. The supply header is equipped with series MOV's for isolation purposes. Power to the "A" valves is from DIV I and power to the "B" valves is from DIV II. Therefore, if a EDG fails to start the loops will still isolate.

8.4.3 The Turbine Building service water system requires two pumps during normal operations. It is not safety related and therefore is powered by the normal station buses.

TABLE 9.1

	COMPONENT	NO	NORMAL	LOSS OF OFFSITE POWER	LOCA
1.	EDG HX Outlet	AOV-16 (A-C)	Closed	Open	Open
2.	Discharge Header Cross Connect	MOV-32 (A,B)	Open	Closed	Closed
3.	Ultimate Cooling Isolation	MOV-33 (A,D)	Closed	Closed	Closed
4.	Ultimate Cooling Drain	MOV-39 (A,B)	Open	Open	Open
5.	RHR HX Outlet	MOV-34 (A,B)	Closed	Closed	Closed
6.	Main Chill Water Supply	MOV-36 (A-C)	Open	Closed	Closed
7.	RBCLCW HX Outlet Service Water	MOV-37 (A,B)	1 Open / 1 Closed	Both Open	Both Open
8.	RBCLCW HX Inlet	MOV-42 (A,B)	1 Open / 1 Closed		Both Open
..	Spent Fuel Pool Drain	MOV-43	Open	Open	Open
10.	Drywell Booster Heat Exchanger	MOV-129 (A,B)	1 Open / 1 Closed	1 Open / 1 Closed	Both Closed

SHIFT OPERATIONS ADVISOR

EXAMINATION MATRIX

	NAME	WEEK 1	WEEK 2	WEEK 3	WEEK 4
*	Eric Dean	93	86.5	87	92
	Howard Drake	91.5	93.8	83.7	95.5
	David Lee	85.9	93.3	77.2	90.2
	Paul Oreshack	93	89.6	76.1	91.2
	Boyd Strickland	88	97.9	98.9	89.5
	Roger Varnadore	88.7	97.9	100	93.8

* Not assigned as shift advisor

NOTE: Final certification exam completed, not yet graded

June 18, 1984

TRAINING DIVISION DIRECTIVE

ADMINISTRATION OF SHIFT OPERATIONS ADVISOR ORAL EXAMINATIONS

This directive shall establish the guidelines to be used in the administration of oral examinations to Shift Operations Advisor Candidates. The oral examination shall be required, in addition to a written examination, to complete the Long Island Lighting Company certification as Shift Operations Advisor. The following individual guidelines are included in this directive:

- Examination panel
- Examination location
- Examination categories
- Examination length
- Examination response evaluation and grading

I. Examination Panel

Shift Operations Advisor oral examinations shall be administered by a panel consisting of the following individuals:

1. Operations Division Manager (chairman)
2. Operating Engineer
3. Senior Reactor Operator (to be appointed by the Training Division)

II. Examination Location

Shift Operations Advisor oral examinations shall be administered at least in part in the control room. This will ensure that an adequate evaluation of the candidate's ability to interpret actual control room information and available reference documents, including Technical Specifications, can be made. For that portion of the examination administered in a location other than the control room, appropriate reference documents (Procedures, Technical Specifications, drawings) shall be made available to the examinee.

III Examination Categories

The Shift Operations Advisor oral examination shall consist of questions in the following categories, with questions limited to the objectives set forth in the Shift (SRO) Advisor Training Program Description:

1. Plant Systems
2. Plant Emergency Procedures
3. Plant Administrative Procedures and Technical Specifications

A minimum of five (5) and a maximum of ten (10) questions or problems shall be presented in each category. Each panel member shall develop at least one question or problem for solution in each category.

IV Examination Length

The Shift Operations Advisor oral examination shall not exceed three (3) hours in length.

V Examination Response Evaluation and Grading

Each examination panel member will record in writing the text or a paraphrase of the text of each question asked or problem presented during the examination. Each panel member will evaluate the candidate's answer or problem solutions based upon his understanding of the problems and their solutions and assign a grade of 0 to 100% for each answer or solution. An answer/solution grade of 0 will indicate an incorrect answer. An answer/solution grade of 100% will indicate a completely correct answer. An answer/solution grade between 0 and 100% will indicate the percentage of the answer or solution which was correct.

At the completion of the examination, the panel chairman will collect from each panel member the record of questions and assigned grades, and compute the average grade for responses in each category. A panel discussion of grades assigned shall only occur when, in the Chairman's judgement, a disparity exists in the grade assigned by two or more panel members.

Oral examination certification shall result if the candidate's average grade in each category is 70% or greater, and average of all responses to questions or problems presented is 80% or greater.

This directive shall remain in effect for the duration of the Shift Operations Advisor Training and Certifications Program.

L J Calone

L.J. Calone
Training Division Manager

SHIFT ADVISOR TRAINING

WEEK #1 EXAMINATION

TOTAL POINTS 35.5

NAME ______________________

SCORE ______________________

Prepared by: 5/22/84
Training Instructor / Date

Reviewed by: KHR
Training Specialist / Date

Approved by: Ken 5/22/84.
Training Supervisor / Date

1. List the conditions or parameters which initiate a reactor scram. For each parameter listed, include the scram setpoint and how and when the scram signal is bypassed if it can be bypassed.

(6.0)

2. Identify the existing RPS malfunction using the attached diagram which shows the status of system alarms and indications displayed in the control room.

(2.0)

	1	2	3	4	5	6	7	8	9	10
A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1 2 3 4
SCRAM GROUP
ENERGIZED

W W W W

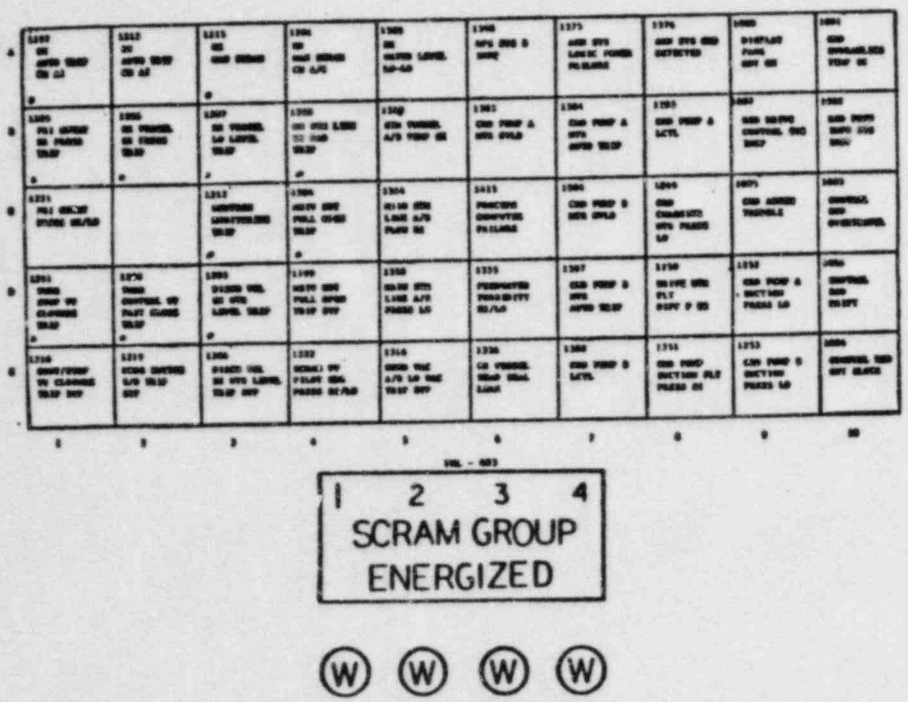
	1	2	3	4	5	6	7	8	9	10
A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

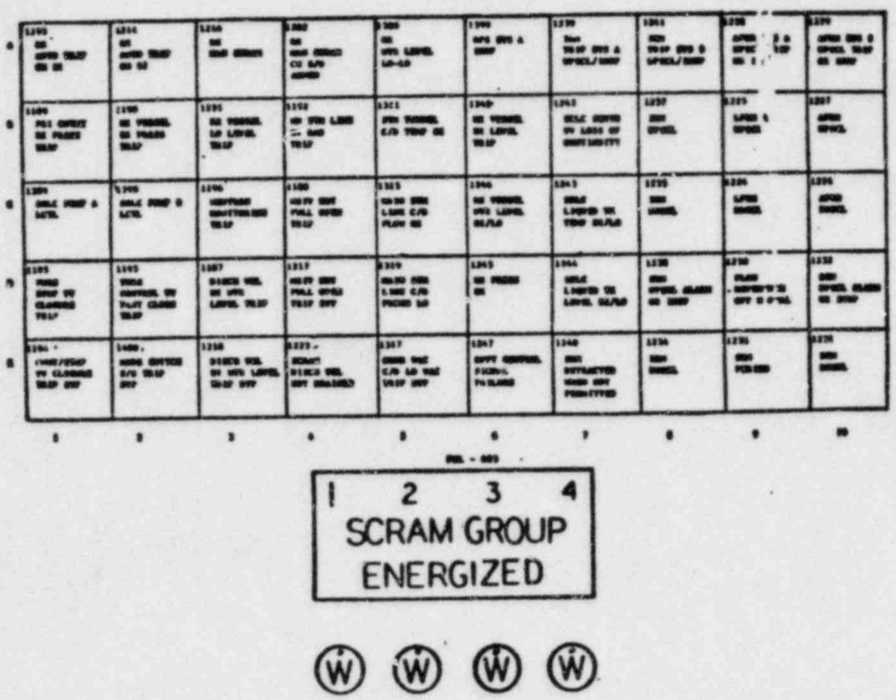
1 2 3 4
SCRAM GROUP
ENERGIZED

W W W W

3. Identify the existing RPS condition using the attached diagram which shows the status of system alarms and indications displayed in the control room.

(2.0)


1 2 3 4
SCRAM GROUP
ENERGIZED
W W W W


1 2 3 4
SCRAM GROUP
ENERGIZED
W W W W

4. List the five reactor vessel water level instrumentation systems and list the RPV pressures and drywell temperatures for which each system is accurate.

(2.5)

5. During periodic surveillance of the RPV Instrumentation System it is determined that PT 156A has failed. Failure was determined 1.5 hours after the surveillance was initiated. Using the Technical Specifications list any LCO's which may be applicable, and state the actions to be taken if an LCO is applicable. S· (You may use SP 44.622.02 to formulate your answer.)

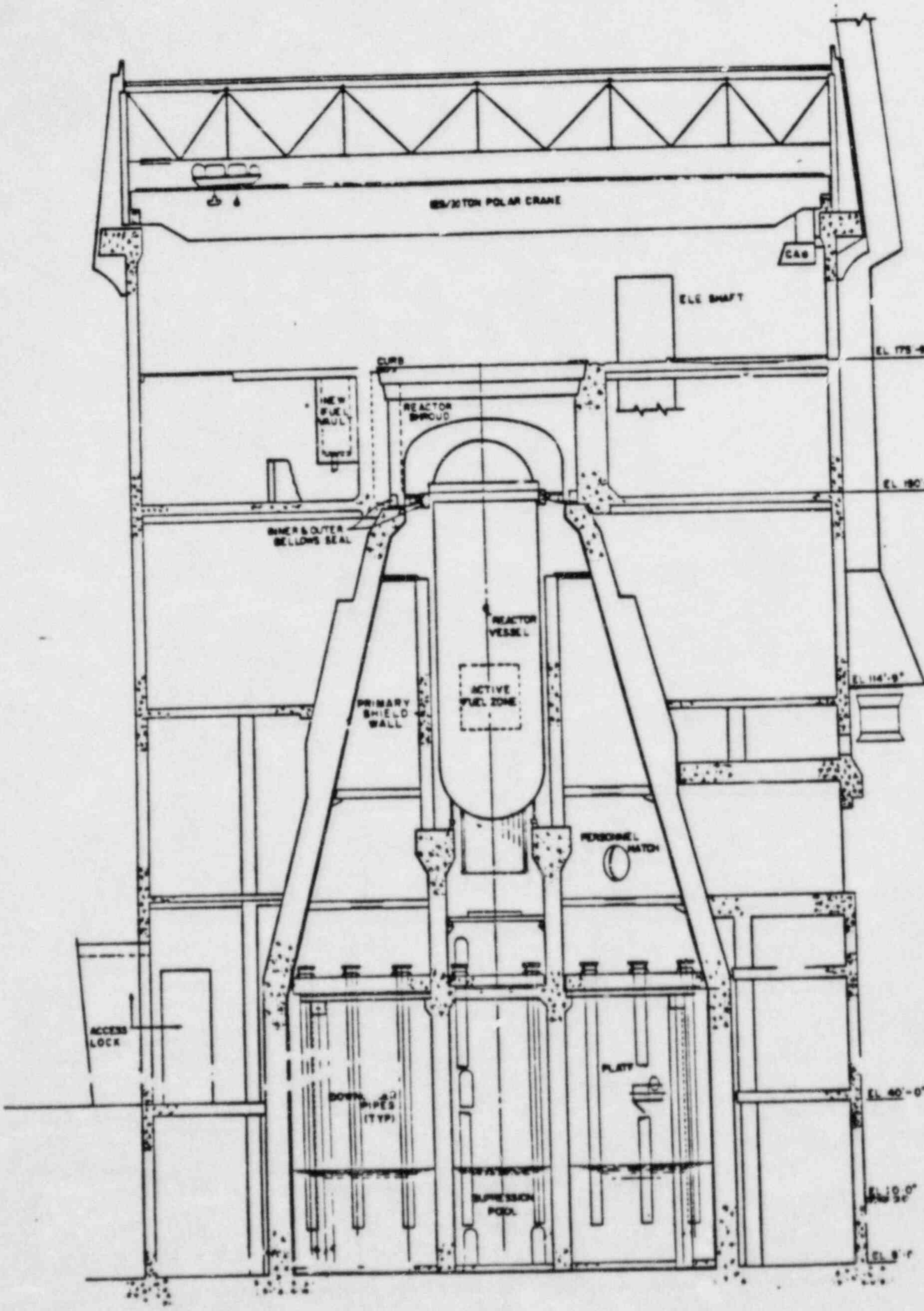
(2.0)

6. With the mode switch in STARTUP during low power physics testing, the containment air lock doors are opened to allow entry and exit from the containment for the purposes of data recording. While operating in this configuration, the following data taken at 15 minute intervals is recorded. 1. Reactor power: .005% of rated thermal power. 2. Reactor coolant temperature: 205F. Using the Technical Specifications, state the actions to be taken, if any, based on these conditions.

(3.0)

7. Using the attached figure trace the flowpath of the containment atmosphere during post LOCA suppression chamber spray with a leak in the drywell floor seal.

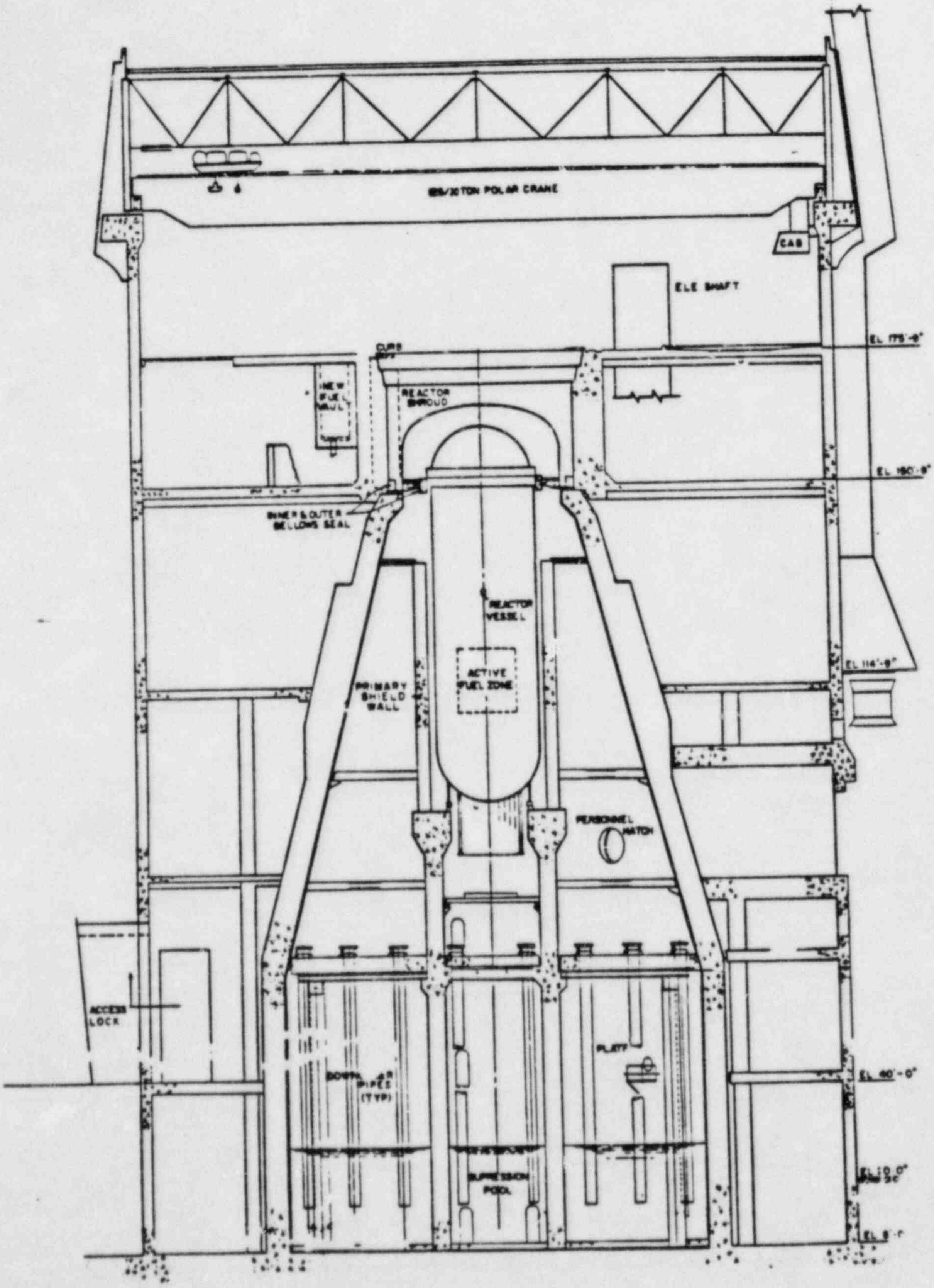
(2.0)



PRIMARY AND SECONDARY CONTAINMENT

8. Using the attached figure trace the flowpath of the containment atmosphere during post LOCA drywell spray.

(2.0)



PRIMARY AND SECONDARY CONTAINMENT

9. Identify the existing RPV Instrumentation System malfunction using the attached diagram which shows the status of system alarms and indications displayed in the control room.

(2.0)

PNL-601

1104 CS SYS A ALTUATED	1126 RX SYS A PRESS LO	1107 CS SYS B ALTUATED	1127 RX SYS B PRESS LO
1433 LPCI LOW PRESS PERM SYS A	1122 RHR SYS A DISCH/HDR SDC SUCT PRESS HI	1434 LPCI LO PRESS PERM SYS B	1123 RHR SYS B DISCH HDR PRESS HI
1096 CS SYS A RPV HDR DIFF PLO	1130 RHR SYS A RX LO LEVEL INIT	1097 CS SYS B RPV HDR DIFF.P LO	1131 RHR SYS B RX LO LEVEL INIT
	1144 RX SYS A LEVEL LO		1145 RX SYS B LEVEL LO

PNL-602

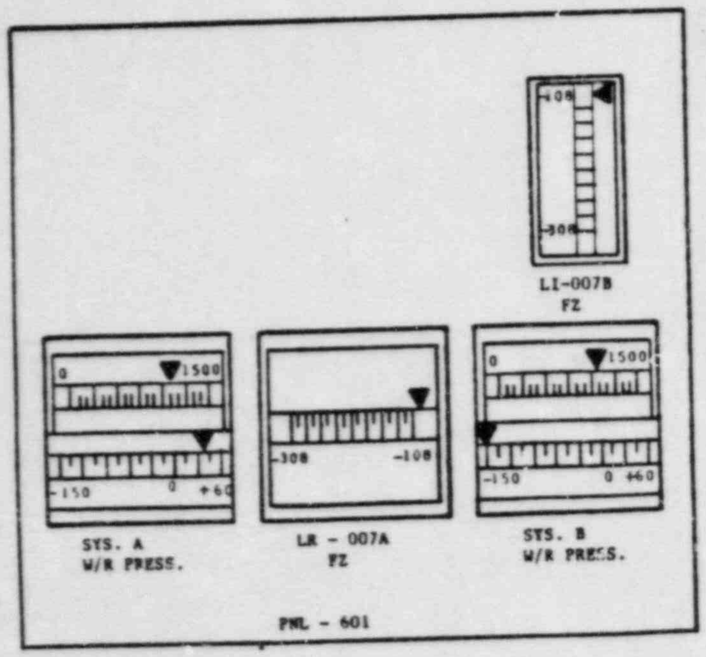
1026 HPCI TURB TRIPPED	1348 RX SYS A LEVEL LO CONFIRMED	1351 RPT SYS A TRIP
1071 RCIC TURB HI WTR LEVEL TRIP	1349 RX SYS B LEVEL LO CONFIRMED	1395 RPT SYS B TRIP
1185 CPI ISOL CH B TRIP	1183 CPI ISOL CH A TRIP	RWCU FLOW LO
1186 GPI ISOL CH D TRIP	1188 GPI ISOL CH C TRIP	RWCU DISCH. PRESS HI /40

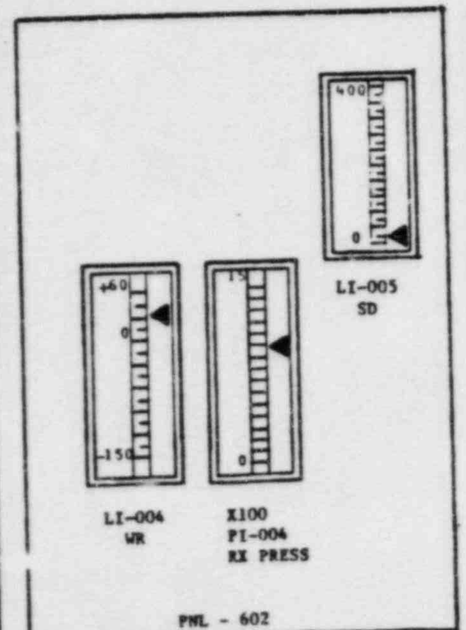
PNL-603

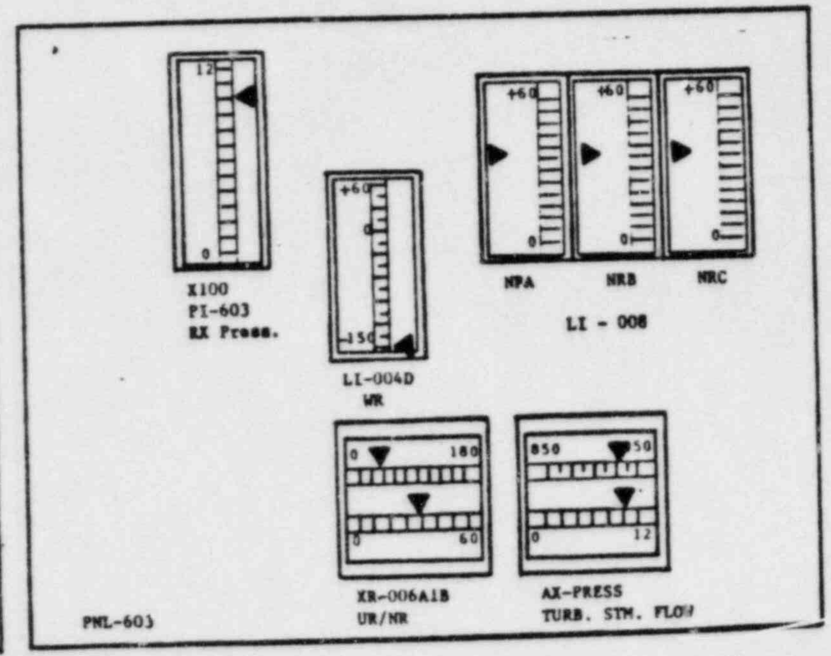
1206 RX VESSEL HI PRESS TRIP	1190 RX VESSEL HI PRESS TRIP	1193 RX AUTO TRIP CH B1
1207 RX VESSEL LO LEVEL TRIP	1191 RX VESSEL LO LEVEL TRIP	1214 RX AUTO TRIP CH B2
1308 RX WATER LEVEL LO/LO	1246 RX WATER LEVEL H/LO	
1197 RX AUTO TRIP CH A1	1213 RX AUTO TRIP CH A2	

PNL-MCB

0111 RFPT A TRIPPED	0387 RFPT B TRIPPED
0140 MAIN TURBINE TRIPPED	







10. Identify the existing RPV Instrumentation System malfunction using the attached diagram which shows the status of system alarms and indications displayed in the control room.

(2.0)

PNL-601

1104 CS SYS A ALTUATED	1126 RX SYS A PRESS LO	1107 CS SYS B ALTUATED	1127 RX SYS B PRESS LO
1433 LPCI LOW PRESS PERM SYS A	1122 RHR SYS A DISCH/HDR SDC SUCT PRESS HI	1434 LPCI LO PRESS PERM SYS B	1123 RHR SYS B DISCH HDR PRESS HI
1096 CS SYS A RPV HDR DIFF PLO	1130 RHR SYS A RX LO LEVEL INIT	1097 CS SYS B RPV HDR DIFF.P LO	1131 RHR SYS B RX LO LEVEL INIT
	1144 RX SYS A LEVEL LO		1145 RX SYS B LEVEL LO

PNL-602

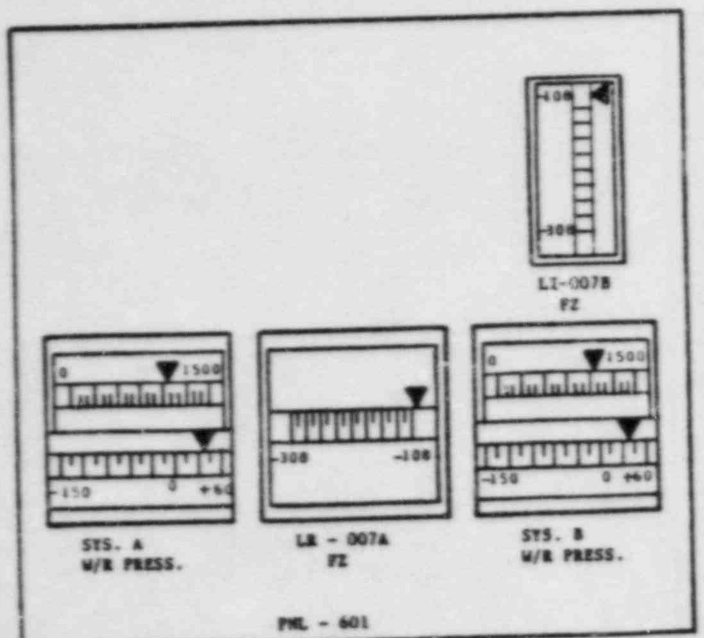
1026 HPCI TURB TRIPPED	1348 RX SYS A LEVEL LO CONFIRMED	1351 RPT SYS A TRIP
1071 RCIC TURB HI WTR LEVEL TRIP	1349 RX SYS B LEVEL LO CONFIRMED	1395 RPT SYS B TRIP
1185 CPI ISOL CH B TRIP	1183 CPI ISOL CH A TRIP	RWCU FLOW LO
1186 CPI ISOL CH D TRIP	1184 CPI ISOL CH C TRIP	RWCU DISCH. PRESS HI /40

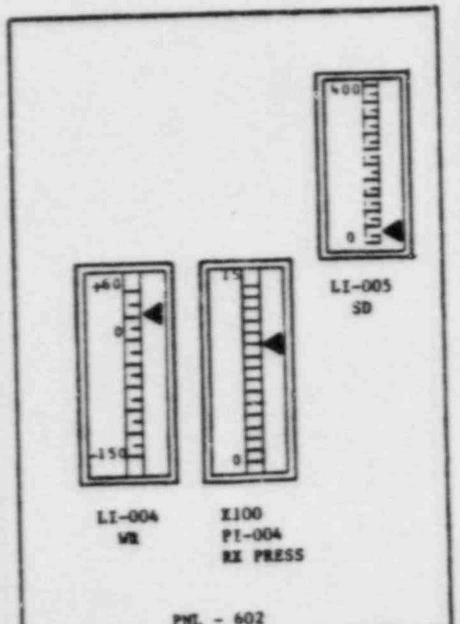
PNL-603

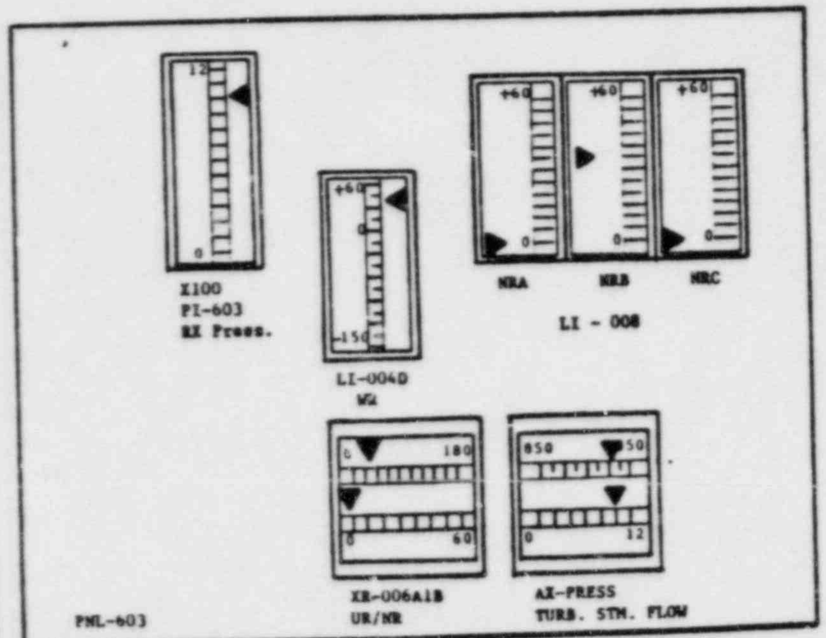
1206 RX VESSEL HI PRESS TRIP	1190 RX VESSEL HI PRESS TRIP	1193 RX AUTO TRIP CH B1
1207 RX VESSEL LO LEVEL TRIP	1191 RX VESSEL LO LEVEL TRIP	1214 RX AUTO TRIP CH B2
1308 RX WATER LEVEL LO/LO*	1246 RX WATER LEVEL HI/LO	
[illegible] RX AUTO TRIP CH A1	1213 RX AUTO TRIP CH A2	

PNL-MCB

0111 RFPT A TRIPPED	0337 RFPT B TRIPPED
0140 MAIN TURBINE TRIPPED	







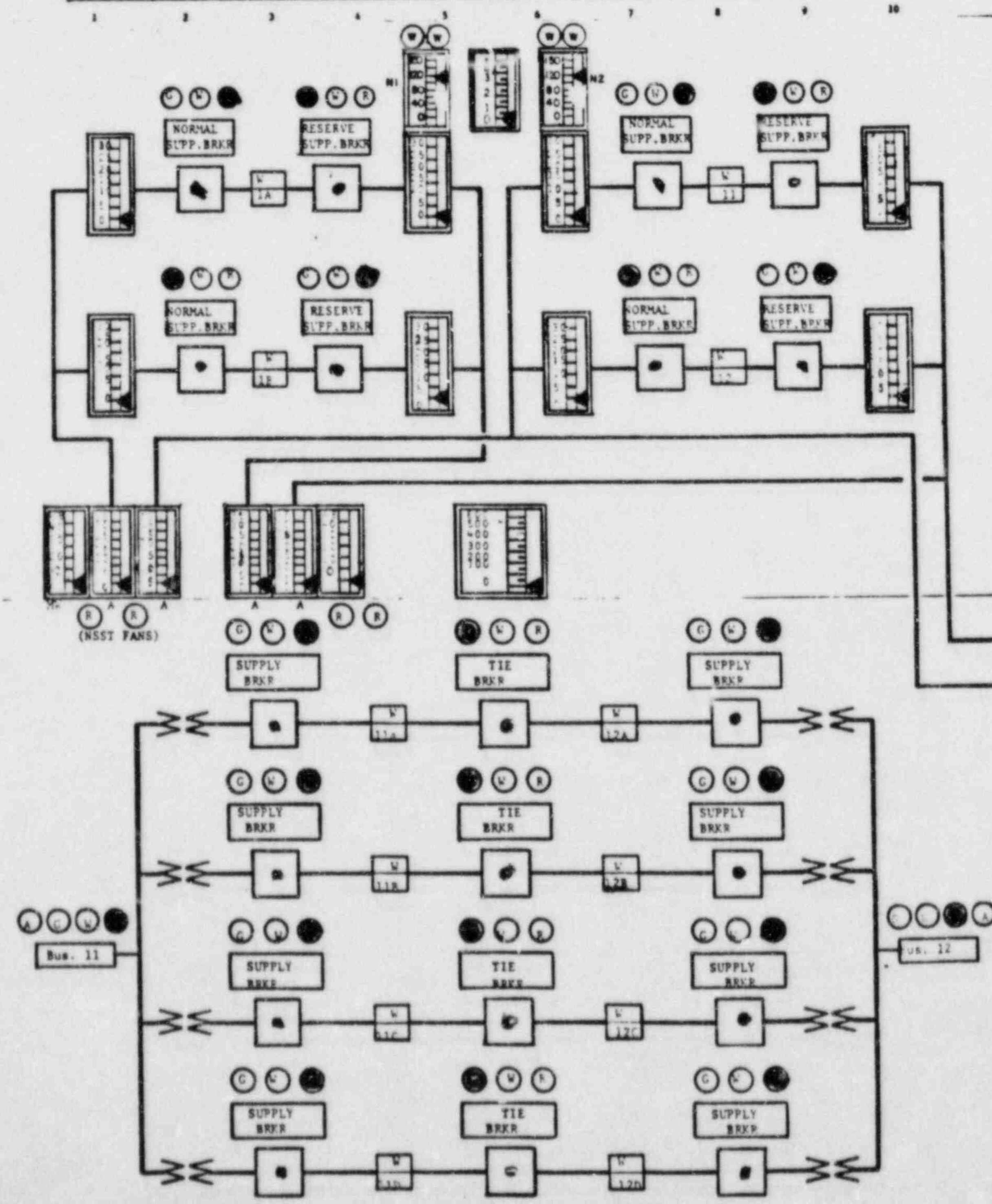
11. List the conditions including setpoints which must be met or satisfied in order for the ADS to actuate automatically.

(2.0)

12. Identify the existing status of the Normal Distribution system using the attached diagram which shows the status of system alarms and indications displayed in the control room.

(2.0)

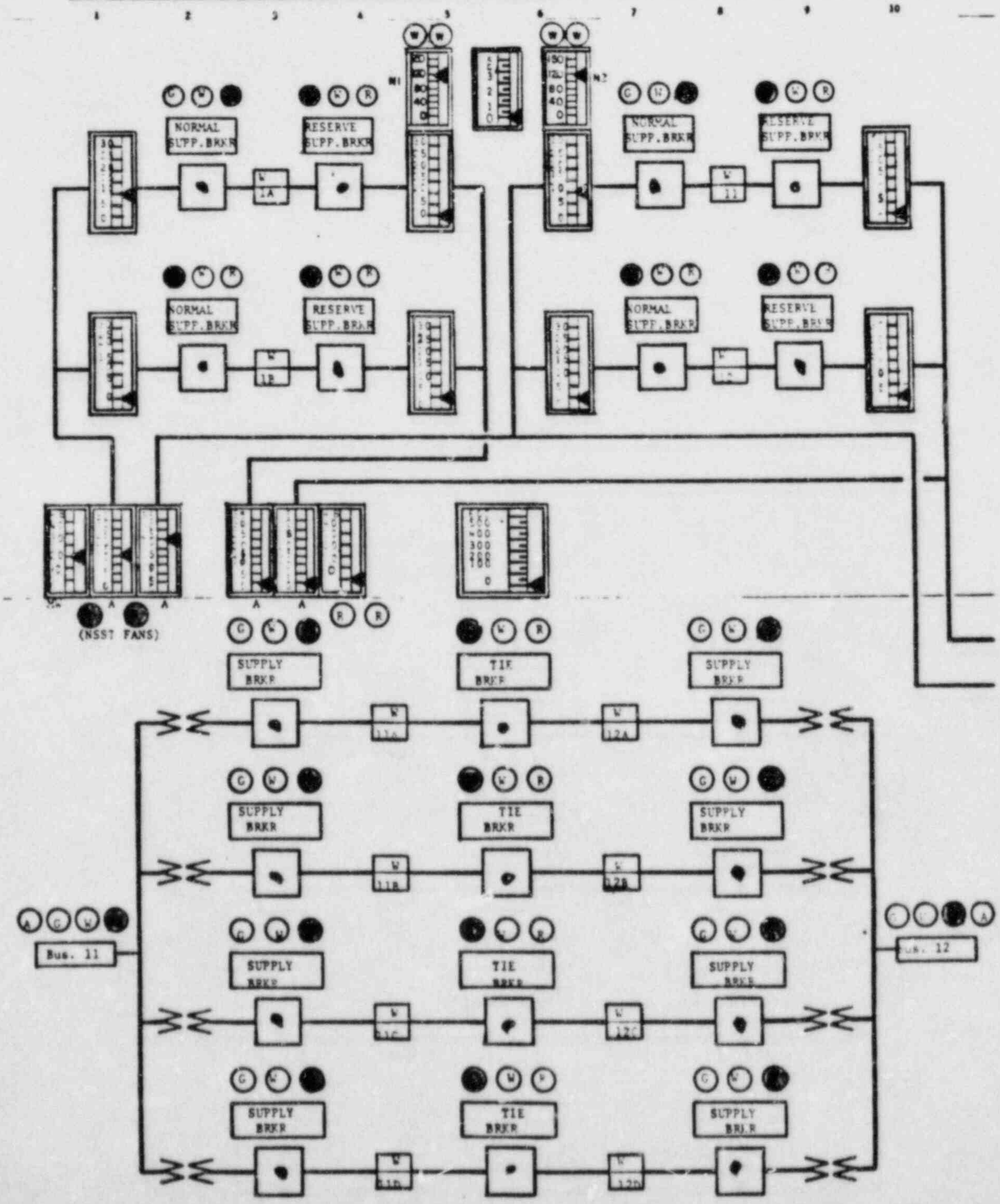
	1	2	3	4	5	6	7	8	9	10
A	0218 RSS XFMR PRI PROT TRIP	0219 RSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 NSS XFMR BACKUP PROT TRIP	0220 NSS XFMR PRI PROT TRIP	0685 4KV RSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV RSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
B	0404 SANITARY SEWAGE SUMP LEVEL HI-HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV RSS TIE BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
C	0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI-HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GRD	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
D	0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTN N2 HDR A PRESS HI/LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
E	0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTN N2 HDR B PRESS HI/LO	0360 BUS 11D-12D SPLY-TIE BKR PARALLELED



13. Identify the existing status of the Normal Distribution System using the attached diagram which shows the status of system alarms and indications displayed in the control room.

(2.0)

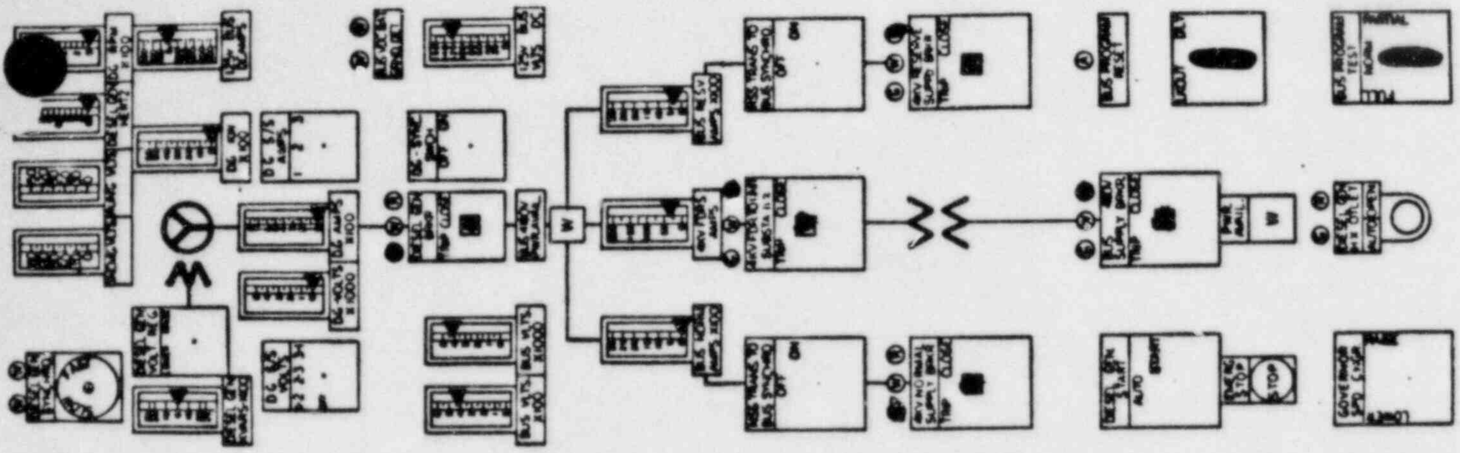
	1	2	3	4	5	6	7	8	9	10
A	0218 RSS XFMR PRI PROT TRIP	0219 RSS XFMR BACKUP PROT TRIP	0226 RSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	0220 RSS XFMR PRI PROT TRIP	0085 4KV RSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV RSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
B	0506 SANITARY [illegible] SUMP LEVEL HI-HI		0222 RSST/NSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
C	0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI-HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
D	0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTR N2 HDR A PRESS HI/LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
E	0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 [illegible] FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTR N2 HDR B PRESS HI/LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

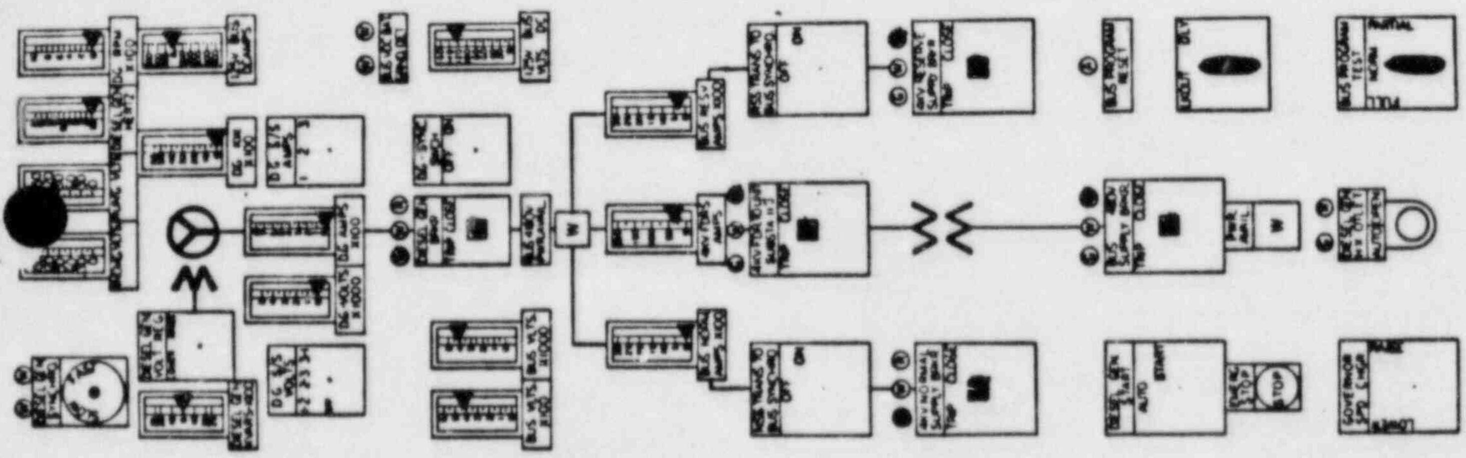


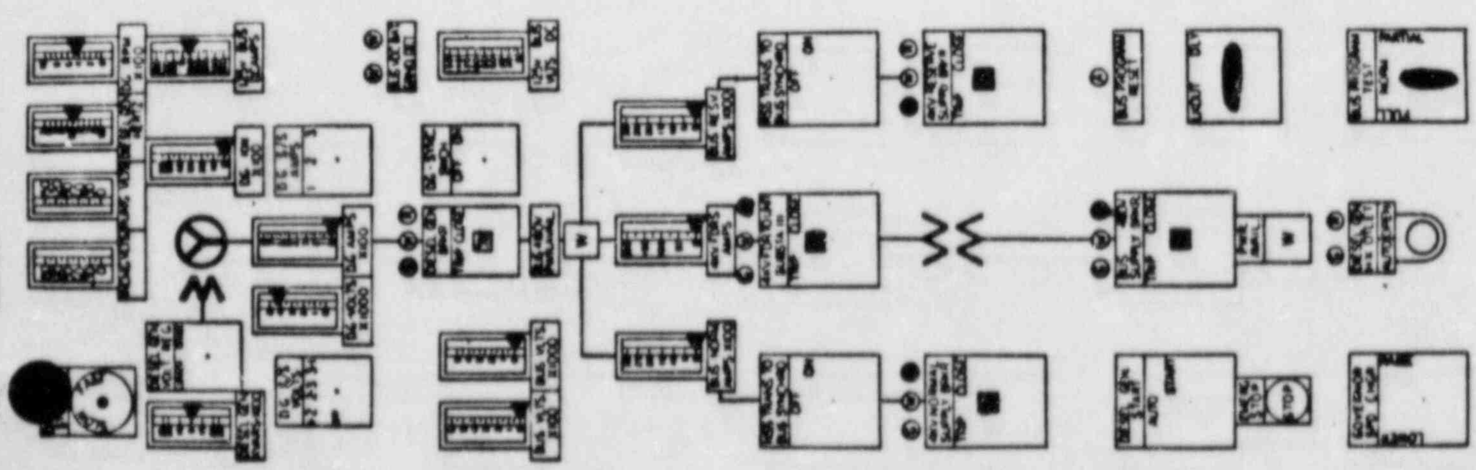
14. List the non-safety related loads supplied by the Emergency Distribution System which can be reenergized with a LOCA signal present.

(2.0)

15. Identify the existing emergency distribution system condition using the attached diagram which shows the status of system alarms and indications in the control room. Prior to this condition a normal electrical distribution system lineup existed with the plant operating in Condition 1. (2.0)







0218 RSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	[illegible] RSS [illegible] BACKUP PROT TRIP	0220 XFMR PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLED	0244 4KV NSS SPLY UV CKT LCTL	0441 REMOTE TRIP-SWYD RELAY OPER
0408 SANITARY SEWAGE SUMP LEVEL HI-HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	[illegible] 4KV NSS FDR BKR AUTO TRIP	0130 BUS 11A-12A SPLY-TIE BKR PARALLELED
0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI-HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR STRB GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI-HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V RSS SPLY BUS UV	0322 INSTR AI HDR A PRESS HI/LO	0278 480V RSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTR AI HDR B PRESS HI/LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED

0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL RM CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		[illegible] 125V BATT CHGR A1 TROUBLE
0349 EMER GEN 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	[illegible] DIESEL 1 SYS DEGRADED	0369 DIESEL 1 SYS INOP	0357 125V BATT A GND
0293 EMER GEN 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
0107 EMER GEN 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR FDR LCTL	[illegible] BUS 101 UV
0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

0339 DIESEL 3 LUBE OIL PRESS LO		0338 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL RM CONTROL DISABLED	0382 125 V BATT CHGR C1 TROUBLE
0351 EMER GEN 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0336 DIESEL 3 SYS DEGRADED	0337 DIESEL 3 SYS INOP	0359 125 V BATT C GND
0295 EMER GEN 3 VOLT REG POWER FAIL	[illegible] COMPUTER INV TROUBLE	[illegible] COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
0121 EMER GEN 3 GND OC	0346 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR FDR LCTL	0064 BUS 103
0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	[illegible] BUS 103 SPLY OR FDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL

0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL RM CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0381 125V BATT CHGR B1 TROUBLE
0350 EMER GEN 2 PT BLOWN FUSE	0378 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 SYS INOP	0358 125 V BATT B GND
0294 EMER GEN 2 VOLT REG POWER FAIL	0473 SEC-COMM INV TROUBLE	0474 SEC-COMM INV BATT/ ALT AC OPERATION	0475 125 V CHGR B1 TROUBLE	0404 125 V BUS B1 BKR OC TRIP
0091 EMER GEN 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR FDR LCTL	0063 BUS 102 UV
0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	[illegible] BUS 102 SPLY OR FDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

SHIFT ADVISOR TRAINING

WEEK #2 EXAMINATION

TOTAL POINTS: __26___

NAME: ______________________

SCORE: ________

PREPARED BY: ____________ 5/25/84
Training Instructor/Date

REVIEWED BY: KHR__________
Operations Training Specialist/Date

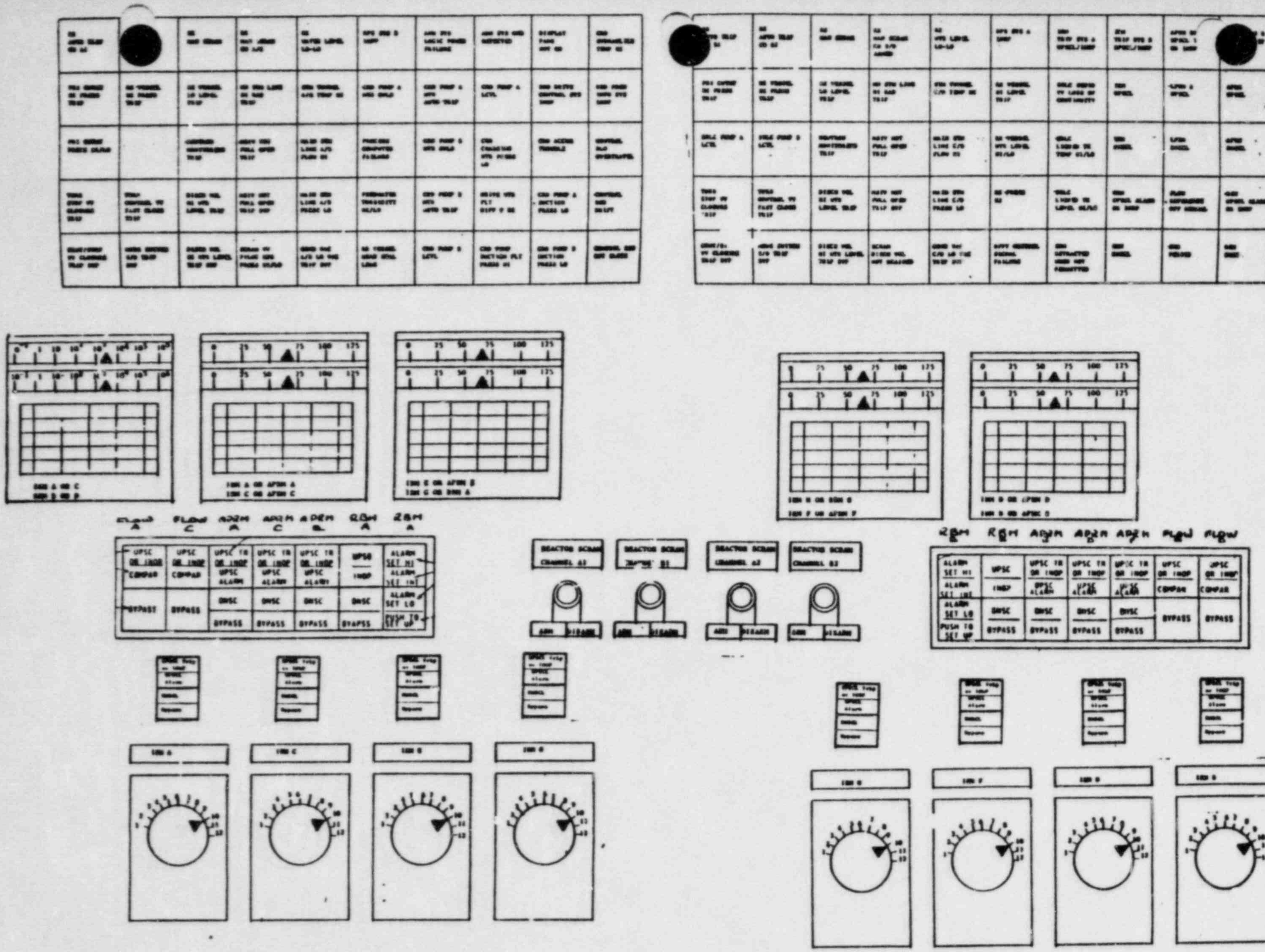
APPROVED BY: ____________ 5/25/84
Training Supervisor/Date

(OBJECTIVE HL- 601 - 09)

1 . Prior to the commencement of a reactor startup the following SRM channel readings are observed. Channel A = 5 cps: Channel B = 2 cps, Channel C = 2 cps: Channel D = 6 cps. The signal-to-noise ratio for each channel was verified to be 2.0 within the previous 31 days. Using the Technical Specifications state any actions to be taken based on these conditions. (2.0)

(OBJECTIVE HL- 603 - 03)

2 . Identify the existing Power Range Neutron Monitoring System malfunction using the attached diagram which show$ the status of system alarms and indications displayed in the control room. (2.0)



FLOW A
FLOW C
APRM A
APRM C
APRM E
RBM A
UPSC OR INOP
COMPAR
BYPASS
UPSC TR OR INOP
UPSC ALARM
DNSC
UPSC
INOP
ALARM SET HI
ALARM SET INT
ALARM SET LO
PUSH TO SET UP
REACTOR SCRAM CHANNEL A1
REACTOR SCRAM CHANNEL B1
REACTOR SCRAM CHANNEL A2
REACTOR SCRAM CHANNEL B2
RBM
APRM
FLOW

(OBJECTIVE HL- 203 - 05)

3 . State the conditions which must exist in order to shut down the Core Spray System following automatic actuation of the system. (2.0)

(OBJECTIVE HL- 204 - 07)

4 . State the two methods which can be used to manually initiate the LPCI System if automatic initiation fails, and list the steps which are taken to complete each method of manual initiation. (2.0)

(OBJECTIVE HL- 204 - 10)

5 . During operation in CONDITION 1, a full flow surveillance test of the HPCI system is completed with the following results. Full flow is 4200 gpm against a discharge pressure of 1150 psig. Using the Technical Specifications, list any actions which must be taken based on these results. (2.0)

(OBJECTIVE HL- 119 - 9)

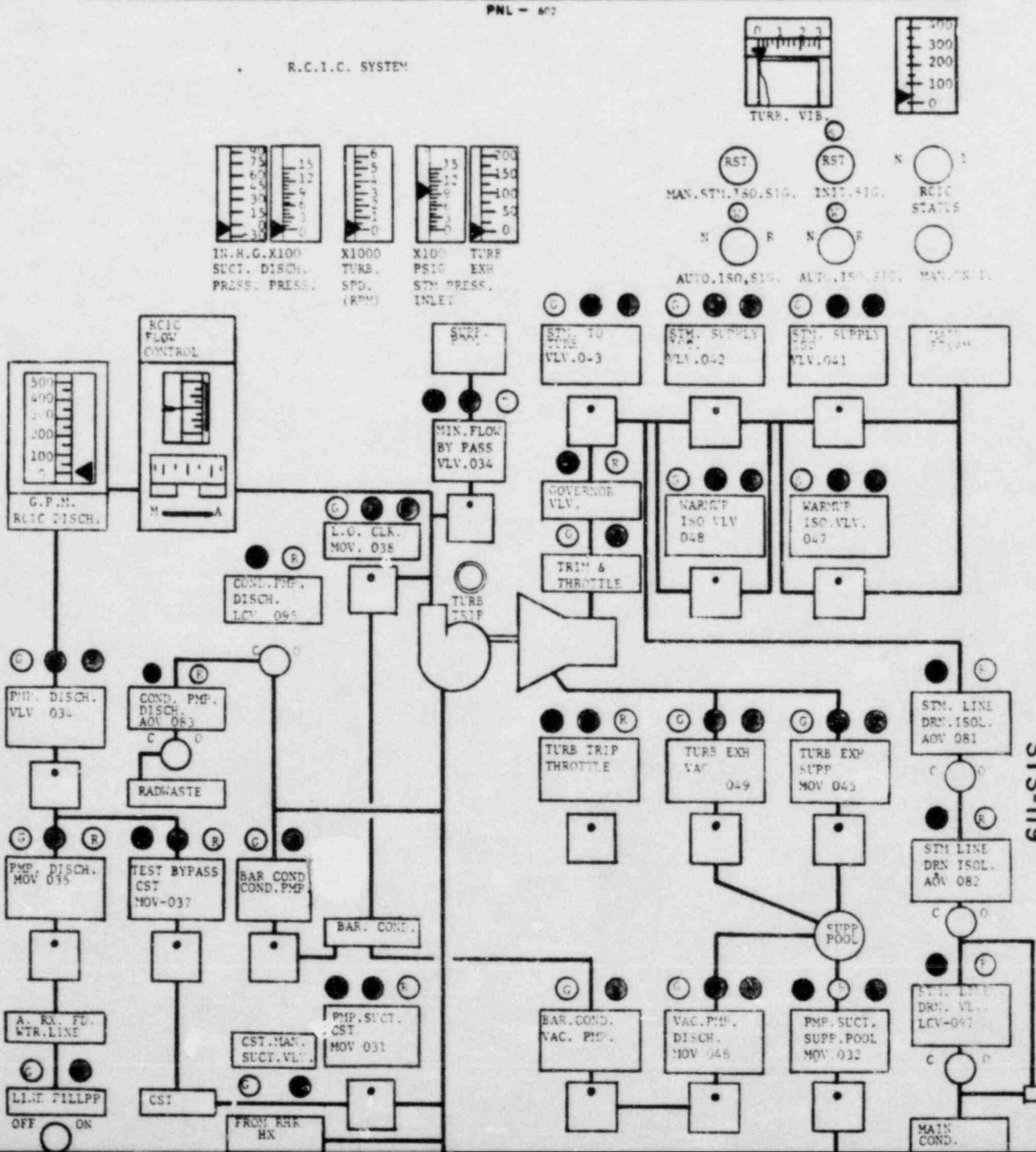
6 . Identify the existing RCIC system malfunction which has occurred following system actuation, using the attached diagram which shows the status of system alarms and indications displayed in the control room. (2.0)

ANNUNCIATOR – A6

	1	2	3	4	5	6	7	8	9	10
A	1067 RCIC ISOL SIGNAL (LOGIC A)	1064 RCIC POWER FAIL (BUS A)	1082 RCIC SYS DEGRADED	1083 RCIC SYS INOP	1063 RCIC STM LINE DIFF P A HI	1377 RCIC STM ISOL VV NOT A HI	1086 RCIC OUTBD WARMUP ISOL VV NOT FULL OPEN	1435 RCIC CST LO LEVEL	1052 RWCU SY CNDCT HI	1059 RWCU OUTBD ISOL HI LEAKAGE
B	1078 RCIC ISOL SIGNAL (LOGIC B)	1077 RCIC POWER RAIL (BUS B)	1093 RCIC MAN INIT SW ARMED	1092 RCIC INOP SW IN INOP	1076 RCIC STM LINE DIFF P B HI	1073 RCIC TURB OIL FLT DIFF P HI	1091 RCIC INBD WARMUP ISOL VV NOT FULL OPEN	1075 RCIC VAC TK LEVEL HI	1056 RWCU SYS FLT DEMIN FAIL	1058 RWCU INBD ISOL HI LEAKAGE
C	1371 RCIC ISOL RESET SW IN RESET (LOGIC B)	1066 RCIC CKT INVERTER POWER FAIL	1080 RCIC TURB EXH DIAPH PRESS A HI	1060 RCIC TURB EXH PRESS HI	1079 RCIC PUMP SUCTION PRESS HI	1072 RCIC TURB BRG TEMP HI	1071 RCIC TURB HI WTR LEVEL TRIP	1074 RCIC VAC TK LEVEL LO	1054 RWCU PUMP TRIP SEAL TEMP HI	1053 RWCU PUMP FLOW LO
D	1330 STM LEAK DIV I LOGIC POWER FAIL	1331 STM LEAK DIV II LOGIC POWER FAIL	1081 RCIC TURB EXH DIAPH PRESS B HI	1089 RCIC TRUB EXH VAC BKR VV NOT FULL OPEN	1061 RCIC PUMP SUCTION PRESS LO	1088 RCIC STM LINE WTR DRN POT LEVEL HI	1069 RCIC TURB OIL PRESS LO	1090 RCIC LINE FILL PUMP FLOW HI	1057 RWCU SYS FLT IN TEMP HI	1055 RWCU DISCH PRESS HI/LO
E	1326 STM LEAK LOGIC A IN TEST (RCIC)	1328 STM LEAK LOGIC B IN TEST (RCIC	1084 RCIC VAC PUMP DISCH VV SW IN CLSD POSN	1085 RCIC TURB EXH VV SW IN CLSD POSN	1065 RCIC PUMP SUCTION VV FULL OPEN	1062 RCIC TURB TRIPPED	1068 RCIC FLOW LO	1087 RCIC LINE FILL PUMP FLOW HI	1070 RCIC VAC TK PRESS HI TEMP HI	1378 RCIC ISOL RESET SW IN HI/LO (LOGIC A)

PNL – 602

R.C.I.C. SYSTEM



SYS-119

(OBJECTIVE HL- 409 - 12)

7 . List the conditions which will result in automatic initiation of the RBSVS. (2.0)

(OBJECTIVE HL- 204 - 14)

8 . Using the Technical Specifications state the plant conditions which must exist in order for all Emergency Core Cooling Systems to be inoperable without violating a limiting condition for operation. (2.0)

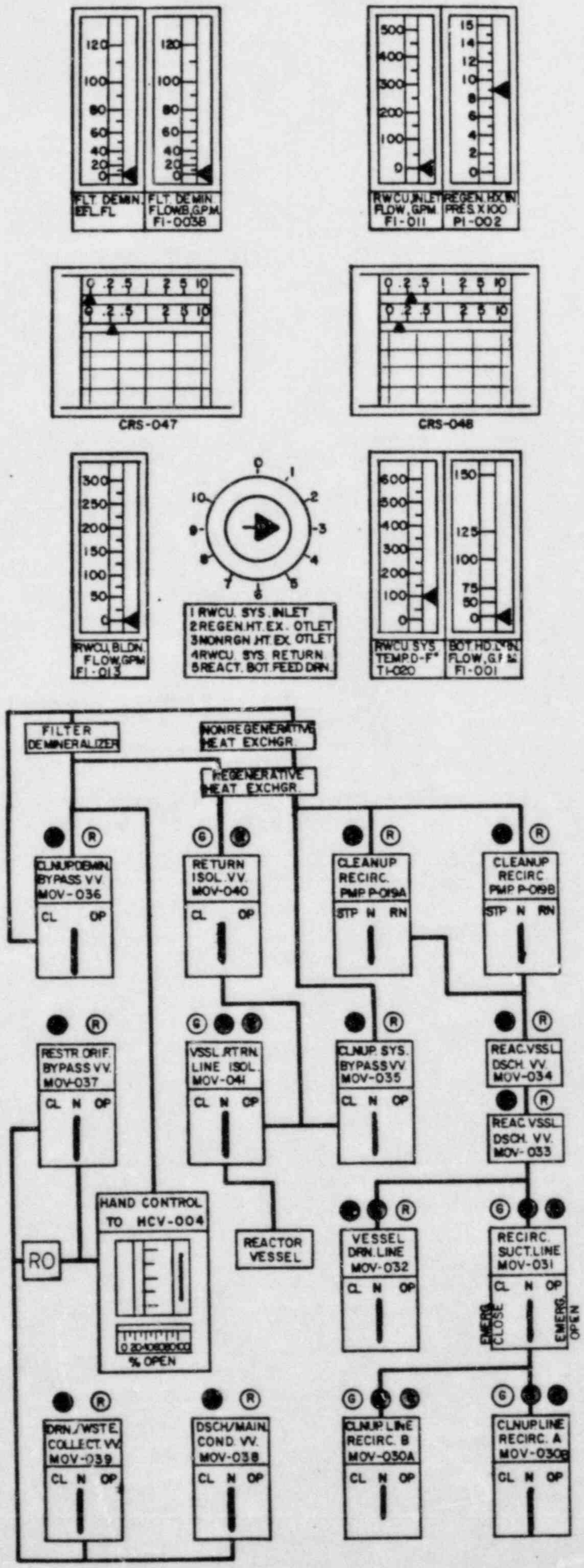
(OBJECTIVE HL- 119 - 8)

9 . During operation with the mode switch in shutdown and reactor coolant temperature at 500 F, and equipment operator discovers that the RCIC flow controller on the remote shutdown panel has been damaged during the outage just completed. A replacement controller cannot be made available for three weeks. Using the Technical Specifications, state any actions which must be taken under these conditions.

(2.0)

(OBJECTIVE HL- 709 - 4)

10 . Using the attached diagram which shows the status of RWCU control room controls and indications, identify the system malfunction. (2.0)



FLT. DEMIN. EFL. FL.
FLT. DEMIN. FLOW B, G.P.M. FI-003B
RWCU INLET FLOW, GPM FI-011
REGEN. HX. IN PRES. X 100 PI-002
CRS-047
CRS-048
RWCU BLDN. FLOW, GPM FI-013
1 RWCU. SYS. INLET
2 REGEN. HT. EX. OTLET
3 NONRGN. HT. EX. OTLET
4 RWCU. SYS. RETURN
5 REACT. BOT. FEED DRN.
RWCU SYS TEMP. 0-F° TI-020
BOT. HD. DRN. FLOW, G.P.M. FI-001
FILTER DEMINERALIZER
NONREGENERATIVE HEAT EXCHGR.
REGENERATIVE HEAT EXCHGR.
CLNUP DEMIN. BYPASS VV. MOV-036
RETURN ISOL. VV. MOV-040
CLEANUP RECIRC. PMP P-019A
CLEANUP RECIRC. PMP P-019B
RESTR. ORIF. BYPASS VV. MOV-037
VSSL. RTRN. LINE ISOL. MOV-041
CLNUP. SYS. BYPASS VV. MOV-035
REAC. VSSL. DSCH. VV. MOV-034
REAC. VSSL. DSCH. VV. MOV-033
HAND CONTROL TO HCV-004
% OPEN
RO
REACTOR VESSEL
VESSEL DRN. LINE MOV-032
RECIRC. SUCT. LINE MOV-031
EMERG. CLOSE
EMERG. OPEN
DRN./WSTE. COLLECT. VV. MOV-039
DSCH/MAIN COND. VV. MOV-038
CLNUP LINE RECIRC. B MOV-030A
CLNUP LINE RECIRC. A MOV-030B

A4

1061 HPCI ISOL SIGNAL (LOGIC A)	1017 HPCI POWER FAIL (BUS A)	1064 HPCI SYS DEGRADED	1065 HPCI SYS INOP	1015 HPCI STM LINE DIFF P A HI	1031 HPCI OIL CLR DISCH TEMP HI	1047 HPCI OUTBD WARM UP ISOL NOT FULL OPEN	1028 HPCI VAC TAK PRESS HI	1109 RWCU ISOL HX OUTLET TEMP HI	1313 NSSSS C/D MAN ISOL
1062 HPCI ISOL SIGNAL (LOGIC B)	1018 HPCI POWER FAIL (BUS B)	1046 HPCI MAN INIT SW ARMED	1049 HPCI INOP SW IN INOP	1016 HPCI STM LINE DIFF P B HI	1033 HPCI TURB OIL FLT DIFF P HI	1050 HPCI INBD WARM UP ISOL NOT FULL OPEN	1032 HPCI VAC TK LEVEL HI	1392 HPCI PUMP SUCTION XFER	1307 NSSSS C/D MAN ISOL SW ARMED
1039 HPCI LINE FILL PUMP PRESS LO	1040 HPCI CKT INVERTER POWER FAIL	1021 HPCI TURB EXH DIAPH PRESS A HI	1023 HPCI TURB EXH LINE PRESS HI	1029 HPCI PUMP SUCTION PRESS HI	1035 HPCI TURB OIL TK LEVEL HI/LO	1020 CNDS STOR TK LEVEL LO/LO	1034 HPCI VAC TK LEVEL LO	1125 NSSSS OUTBD SYS INOP SW IN INOP	1322 NSSSS OUTBD SYS DEGRADED
1043 HPCI LINE FILL PUMP FLOW HI	1019 HPCI LOGIC IN TEST	1022 HPCI TURB EXH DIAPH PRESS B HI	1030 HPCI TURB EXH VAC BKR NOT FULL OPEN	1024 HPCI PUMP SUCTION PRESS LO	1036 HPCI STM LINE WTR DRN POT LEVEL HI	1366 SUP PL LEVEL LO	1037 HPCI INBD STM ISOL VV NOT FULL OPEN	1183 GROUP I ISOL CH A TRIP	1358 NSSSS OUTBD SYS INOP
1027 HPCI TURB BRG OIL PRESS LO	1026 HPCI TURB TRIPPED	1038 HPCI TURB TRIP SOL ENERGIZED	1048 HPCI TURB EXH VV SW IN CLSD POSN	1367 HPCI ISOL RESET SW IN RESET (LOGIC A)	1372 HPCI ISOL RESET SW IN RESET (LOGIC B)	1025 HPCI FLOW LO	1382 SUP PL LEVEL HI	1184 GROUP I ISOL CH A TRIP	1233 SHEAR VV OUTBD SYS ABNORMAL

	1	2	3	4	5	6	7	8	9	10
A	1067 RCIC ISOL SIGNAL (LOGIC A)	1064 RCIC POWER FAIL (BUS A)	1082 RCIC SYS DEGRADED	1083 RCIC SYS INOP	1063 RCIC STM LINE DIFF P A HI	1377 RCIC STM ISOL VV NOT FULL OPEN	1086 RCIC OUTBD WARMUP ISOL VV NOT FULL OPEN	1435 RCIC CST LO LEVEL	1052 RWCU SYS CNDCT HI	1059 RWCU OUTBD ISOL HI LEAKAGE
B	1078 RCIC ISOL SIGNAL (LOGIC B)	1077 RCIC POWER FAIL (BUS B)	1093 RCIC MAN INIT SW ARMED	1092 RCIC INOP SW IN INOP	1076 RCIC STM LINE DIFF P B HI	1073 RCIC TURB OIL FLT DIFF P HI	1091 RCIC INBD WARMUP ISOL VV NOT FULL OPEN	1075 RCIC VAC TK LEVEL HI	1056 RWCU SYS FLT DEMIN FAIL	1058 RWCU INBD ISOL HI LEAKAGE
C	1371 RCIC ISOL RESET SW IN RESET (LOGIC B)	1066 RCIC CKT INVERTER POWER FAIL	1080 RCIC TURB EXH DIAPH PRESS A HI	1060 RCIC TURB EXH PRESS HI	1079 RCIC PUMP SUCTION PRESS HI	1072 RCIC TURB BRG TEMP HI	1071 RCIC TURB HI WTR LEVEL TRIP	1074 RCICI VAC TK LEVEL LO	1054 RWCU PUMP TRIP SEAL TEMP HI	1053 RWCU PUMP FLOW LO
D	1330 STM LEAK DIV I LOGIC POWER FAIL	1331 STM LEAK DIV II LOGIC POWER FAIL	1081 RCIC TURB EXH DIAPH PRESS B HI	1089 RCIC TURB EXH VAC BKR VV NOT FULL OPEN	1061 RCIC PUMP SUCTION PRESS LO	1088 RCIC STM LINE WTR DRN POT LEVEL HI	1069 RCIC TURB OIL PRESS LO	1090 RCIC LINE FILL PUMP FLOW HI	1057 RWCU SYS FLT IN TEMP HI	1055 RWCU DISCH PRESS HI/LO
E	1326 STM LEAK LOGIC A IN TEST (RCIC)	1328 STM LEAK LOGIC B IN TEST (RCIC)	1084 RCIC VAC PUMP DISCH VV SW IN CLSD POSN	1085 RCIC TURB EXH VV SW IN CLSD POSN	1065 RCIC PUMP SUCTION VV FULL OPEN	1062 RCIC TURB TRIPPED	1068 RCIC FLOW LO	1087 RCIC LINE FILL PUMP FLOW HI	1070 RCIC VAC TK PRESS HI TEMP HI	1378 RCIC ISOL RESET SW IN HI/LO (LOGIC A)

(OBJECTIVE HL- 650 - 5)

11 . Using the attached diagrams which show the status of NSSSS alarms and indications in the control room, identify the malfunction. (2.0)

☐ INDICATES VALVE CLOSED

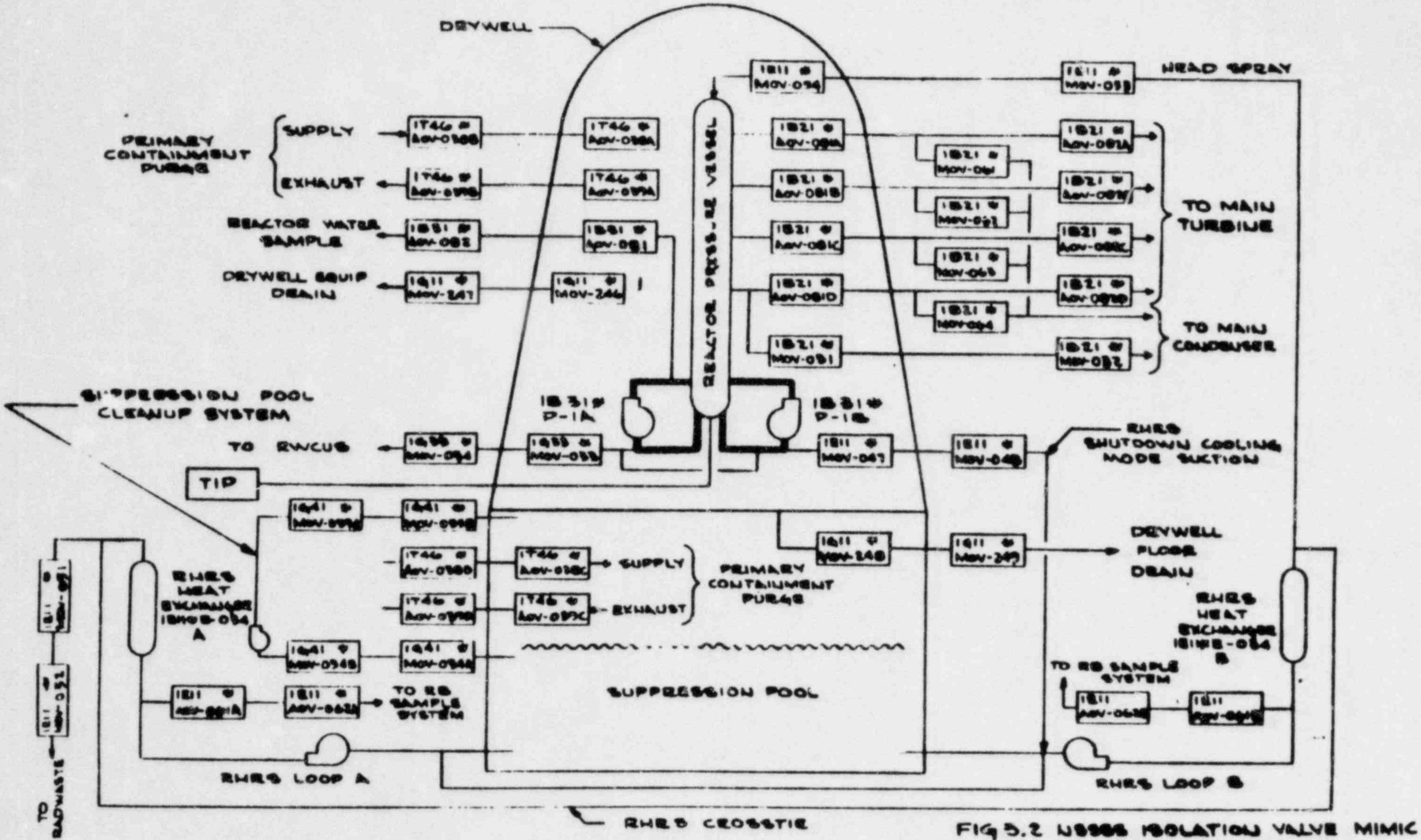
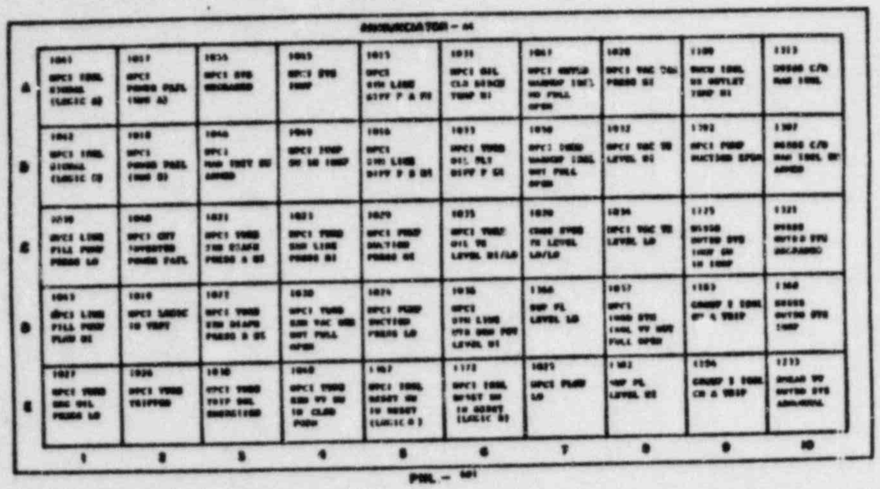
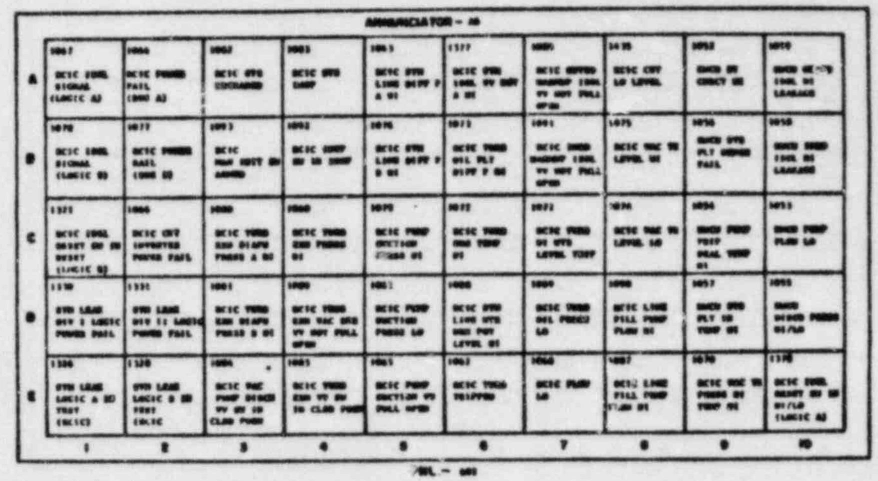
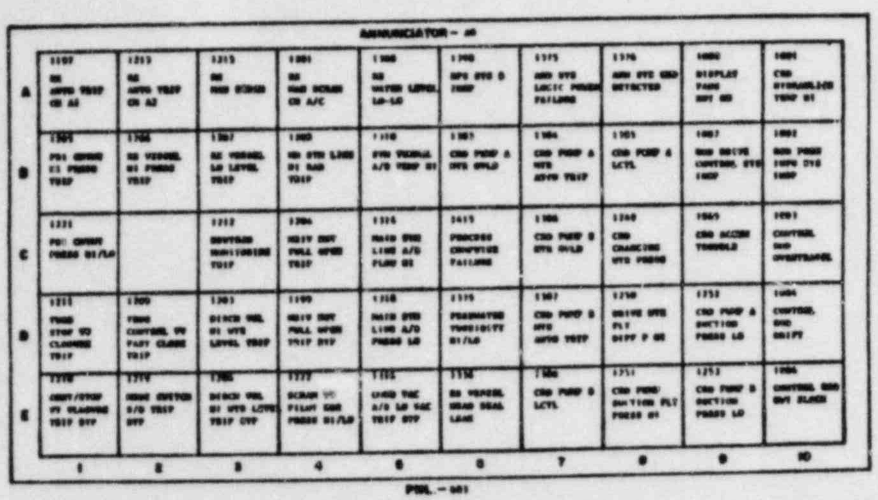
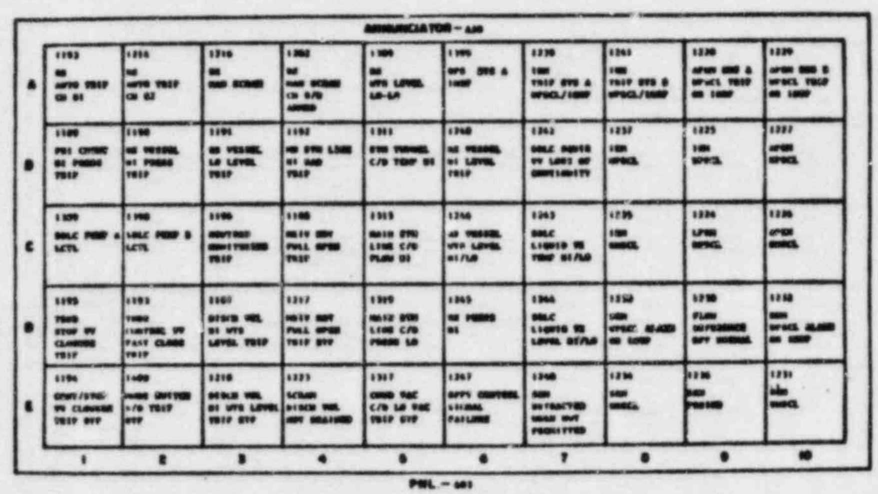


FIG 5.2 NSSSS ISOLATION VALVE MIMIC
SYS NO. 1020.650









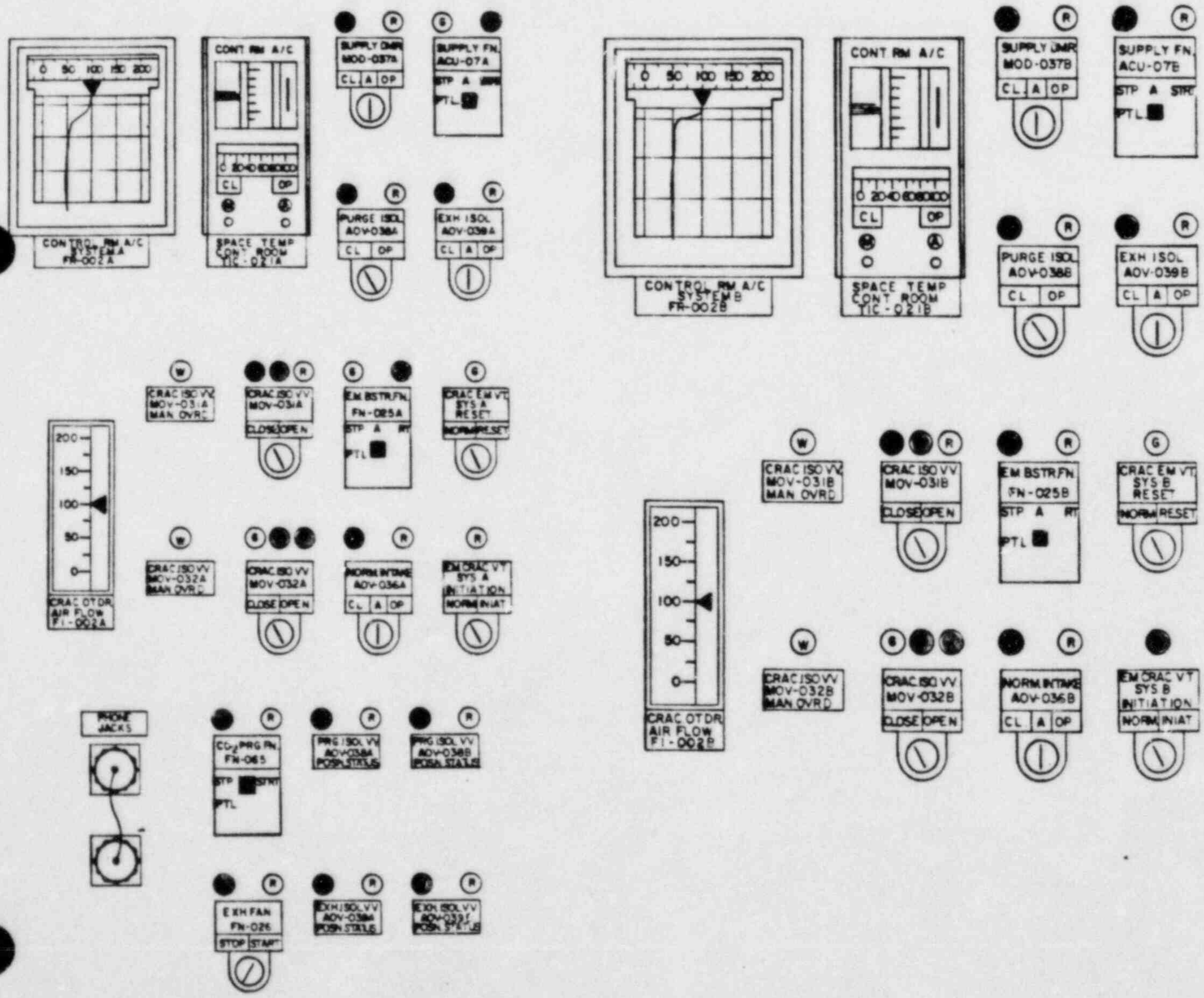
12. During operation at 40% reactor power it is determined that control rod 26-03 cannot be moved from notch position 16. After repeated attempts to move the rod it is electrically and hydraulically disarmed, and it is verified that there are no other inoperable control rods. Using the technical specifications, list all actions related to the disarmed control rod, which must be taken. (2.0)

13. Using the attached diagram which shows the existing status of the CRAC System controls and indications in the control room, identify the system operating mode. List the conditions which will result in the automatic alignment of the CRAC system to this operating mode. (2.0)

ANNUNCIATOR - 15

	1	2	3	4	5	6	7	8	9	10
A	3046 TB FANS AUTO TRIP	3066 TB VENT FAN MTR TEMP HI		3123 CHEM LAB VENT TROUBLE	3124 O&S BLDG VENT TROUBLE	3035 CRAC SYS A DEGRADED	3036 CRAC SYS B DEGRADED	3110 SCREENWELL BLDG SPACE TEMP HI/LO	3021 SCREENWELL BLDG VENT A INOP	3022 SCREENWELL BLDG VENT B INOP
B	3120 TB BSTR EXH FAN AUTO TRIP	3130 TB BSTR EXH FAN MTR TEMP HI		3121 RW BLDG VENT TROUBLE	3122 RW CONTROL RM VENT DIFF P HI	3127 EMER CRAC SYS A INIT	3128 CONTROL RM SYS B INIT	3031 CONTROL RM ACU-7A FLT DIFF P HI	3033 CONTROL RM ACU-7B FLT DIFF P HI	
C	3067 TURB OIL RM EXH FLOW LO			3126 RW RM VENT FLT DIFF P HI	3064 MTR GEN RM VENT FLOW LO	3034 CO_2 PURGE FAN AUTO TRIP	3037 CONTROL RM FAN-25A FLT DIFF P HI	3041 CONTROL RM FAN-25B FLT DIFF P HI	3129 CRAC AIR SPLY FLOW LO	

PNL - VC1



SHIFT ADVISOR TRAINING

WEEK #3 EXAMINATION

TOTAL POINTS 23

NAME ____________________

SCORE ____________________

Prepared by: 6/1/84
Training Instructor / Date

Reviewed by: Marvin R. Peckin J. 6/1/84
Operations Training Specialist / Date

Approved by: Ken Pettis 6/4/84
Training Supervisor / Date

1. State the maximum time that an instrument covered by Technical Specification section 3 can be removed from service for surveillance testing. State the action to be taken if the surveillance test exceeds this time limit.

(2.0)

2. State the action to be taken if it is determined through surveillance testing that the SDV vent valve is open but inoperable.

(2.0)

3. Using the Technical Specifications, list the surveillance tests which must be performed during tensioning of the reactor vessel head bolting studs. (2.0)

4. With the Reactor Mode Switch in the SHUTDOWN position and reactor coolant temperature at 210°F, flow rate surveillance testing according to ASME XI has just been completed for the B RHR pump. Maximum flow at a discharge pressure of 135 psig was determined to be 9850 gpm. Using the Technical Specifications, state the actions to be taken, if any, based on these conditions. (2.0)

5. With the reactor operating at 50% of rated thermal power, the I&C Section reports that the RBM channel A functional test just completed was unacceptable, and that attempts to calibrate the channel also were unacceptable. Using the Technical Specifications, state the actions to be taken, if any, and state how the actions would be taken. (2.0)

6. With the reactor in Condition 3 and average coolant temperature at 320°F, the I&C Section reports that the accumulator low pressure functional test and calibration for ADS valve "B" is unacceptable. Using the Technical Specifications, state the actions to be taken, if any, for this condition.

(2.0)

7. With the reactor operating at 75% power, the following equipment is noted to be out of service:

1. TBCLCW pump 4B discharge valve
2. Domestic hot water air compressor
3. Circulating water hypochlorination pump B
4. SLC normal heat tracing circuit
5. Reactor Building Service Water Pump 3A discharge valve

During an attempt to start Reactor Building exhaust fan 3A, the 4160/480 vac transformer to Bus 111 primary protection trip is actuated. A normal power lineup is restored in 90 minutes. Using the Technical Specifications, state any actions which must be taken with regard to the Standby Liquid Control System. (A power supply list is attached for your use).

(3.0)

STANDBY LIQUID CONTROL
SYSTEM COMPONENT POWER SUPPLIES

*** A second qualified operator should verify proper alignment

COMPONENT NUMBER	COMPONENT DESCRIPTION	POWER SUPPLY/ BREAKER NUMBER	REQUIRED POSITION	*** INITIALS	
1C41* P-Ø24A	STANDBY LIQUID CONTROL PUMP A	MCC - 1113/9CG	ON		
1C41* P-Ø24B	STANDBY LIQUID CONTROL PUMP B	MCC - 1123/4AE	ON		
1C41* H-ØØ9A	STANDBY LIQUID CONTROL TK. HTR. A	MCC - 112C/1EF	ON		
1C41* H-ØØ9B	STANDBY LIQUID CONTROL TK. HTR. B	MCC - 111C/1KM	ON		
1C41* EV-Ø1ØA	SQUIB VALVE POWER A	MCC - 1113/9CG	ON		
1C41* EV-Ø1ØB	SQUIB VALVE POWER B	MCC - 1123/4AE	ON		
1R81- Ø17F & H	NORMAL HEAT TRACING CIRCUITS	MCC - 112A/2HI(R)	ON		
1R81- Ø18 F & H	REDUNDANT HEAT TRACING CIRCUITS	MCC - 111A/2LM(R)	OFF		
1R81- Ø17F&H	NORMAL HEAT TRACING CIRCUITS	1R81-PNL-2B BKR 1	ON		
1R81- Ø17F&H	NORMAL HEAT TRACING CIRCUITS	1R81-PNL-2B BKR 2	ON		
1R81- Ø18F&H	REDUNDANT HEAT TRACING CIRCUITS	1R81-PNL-2A BKR 1	ON		
1R81- Ø18F&H	REDUNDANT HEAT TRACING CIRCUITS	1R81-PNL-2A BKR 2	ON		
1C41* TE-ØØ1	SBLC TANK TEMPERATURE ELEMENT	1R35-PNL-N29 BKR4	ON		

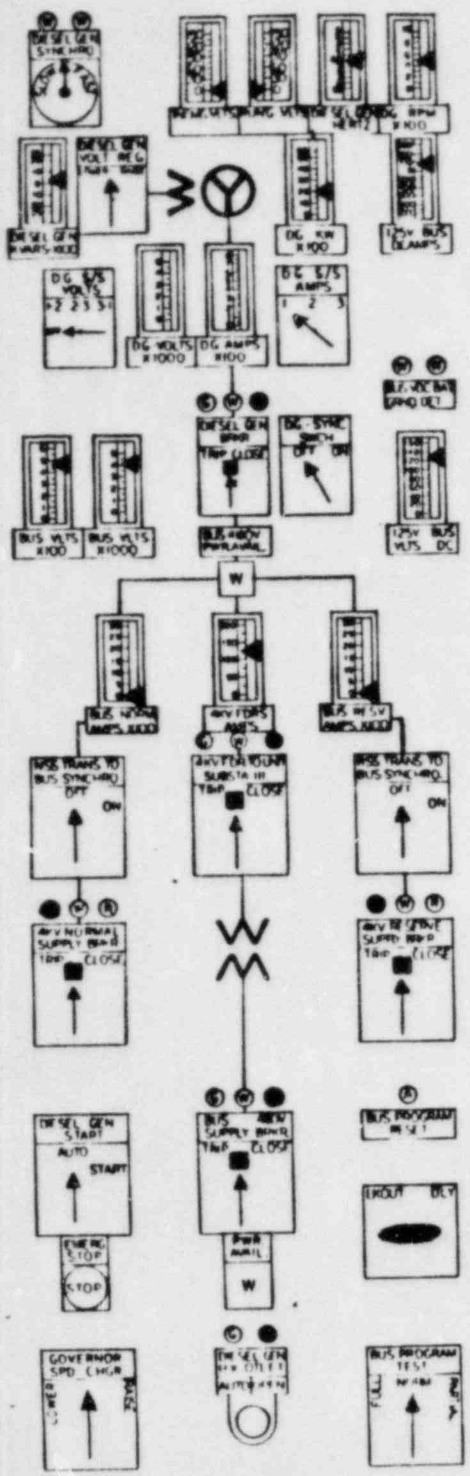
SPF23.123.Ø1-5, Rev. 5

7. With the plant operating at 75% reactor power a test of the main turbine bypass system is attempted. The test involves cycling each valve full open and full closed using the bypass jack. Bypass valve #3 fails to respond to all attempts to open the valve. State the actions which must be taken in order to allow continued operation at power.

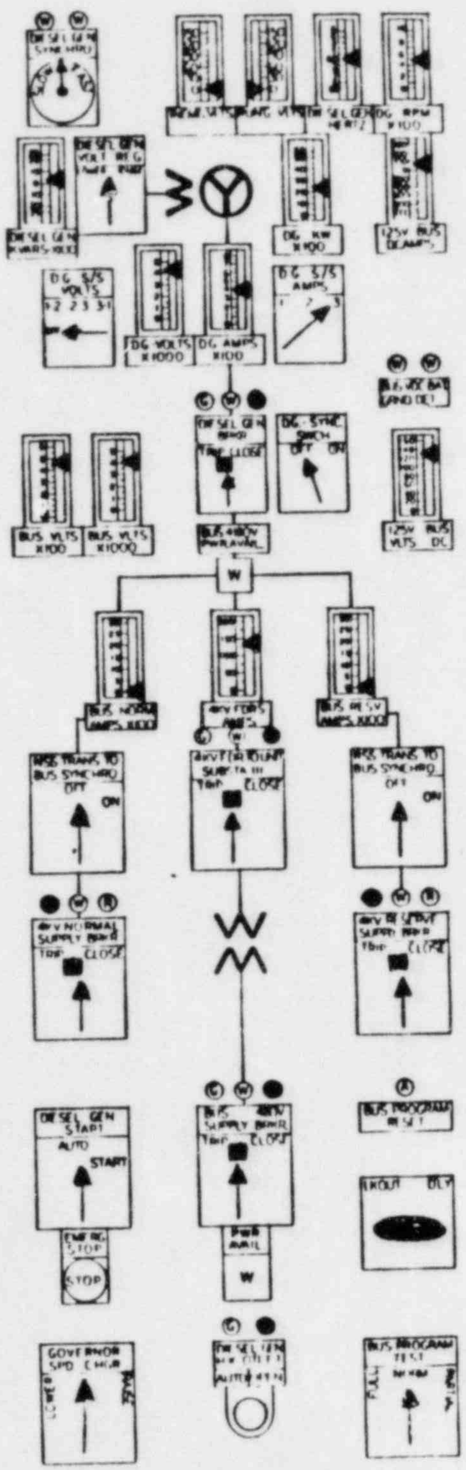
(2.0)

8. Using the attached diagrams which show the status of affected controls, indications and alarms in the control room, identify the event and state the required immediate operator actions. This event occurred during operation at 100% power and has been accompanied by a reactor scram and turbine trip.
(2.0)

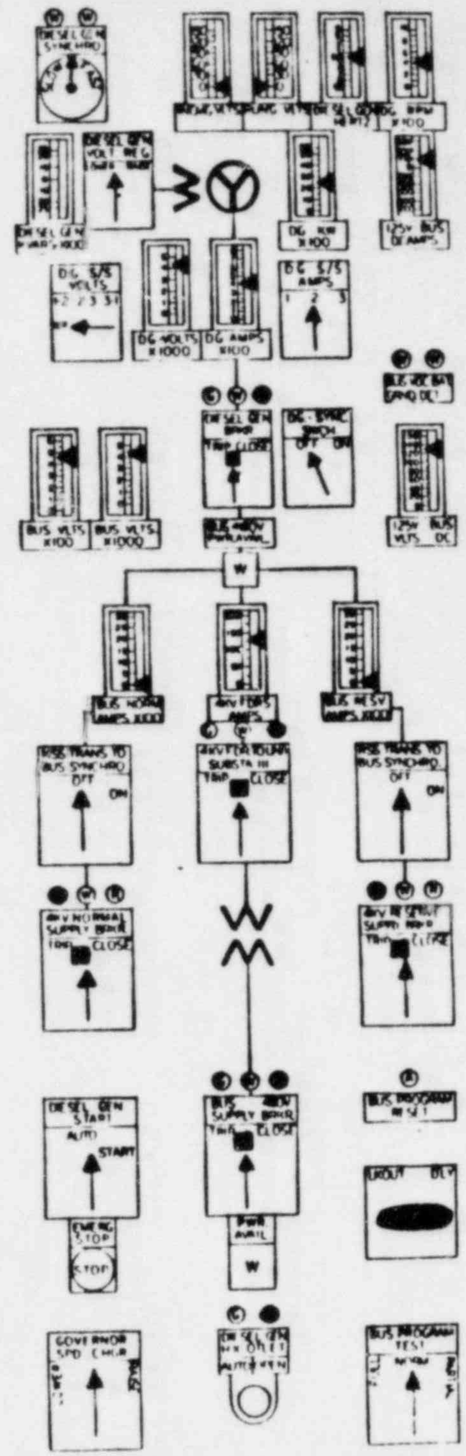
SYS-307



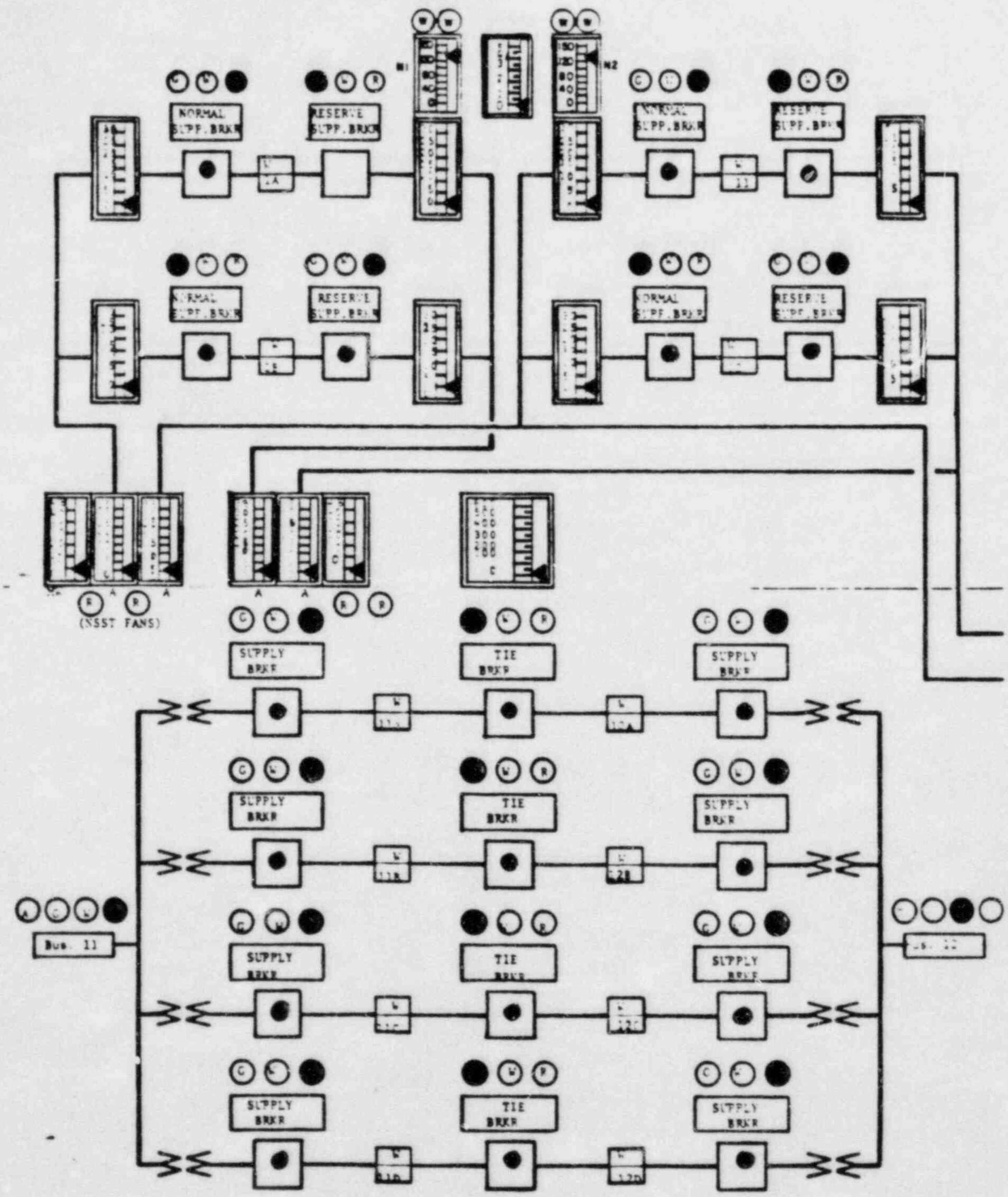
DIESEL GEN SYNCHRO
DIESEL GEN VOLT REG
DG KW X100
125V BUS DC AMPS
DG S/S VOLTS
DG S/S AMPS
DG VOLTS X1000
DG AMPS X100
DIESEL GEN BRKR
TRIP CLOSE
DG SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
4KV RESERVE SUPPLY BRKR
DIESEL GEN START
AUTO START
EMERG STOP
STOP
BUS PROGRAM RESET
LKOUT DLY
PWR AVAIL
GOVERNOR SPD CHGR
LOWER RAISE
BUS PROGRAM TEST
NORM
FULL PARTIAL



DIESEL GEN SYNCHRO
DIESEL GEN VOLT REG
DG KW X100
DG S/S VOLTS
DG S/S AMPS
DG VOLTS X1000
DG AMPS X100
DIESEL GEN BRKR
TRIP CLOSE
DG SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO START
EMERG STOP
STOP
BUS PROGRAM RESET
LKOUT DLY
PWR AVAIL
GOVERNOR SPD CHGR
BUS PROGRAM TEST
NORM



DIESEL GEN SYNCHRO
DIESEL GEN VOLT REG
DG KW X100
DG S/S VOLTS
DG S/S AMPS
DG VOLTS X1000
DG AMPS X100
DIESEL GEN BRKR
TRIP CLOSE
DG SYNC SWCH
OFF ON
BUS VLTS X100
BUS VLTS X1000
125V BUS VLTS DC
W
BUS NORM AMPS X100
4KV FDRS AMPS
BUS RESV AMPS X100
RSS TRANS TO BUS SYNCHRO
OFF ON
4KV NORMAL SUPPLY BRKR
TRIP CLOSE
DIESEL GEN START
AUTO START
EMERG STOP
STOP
BUS PROGRAM RESET
LKOUT DLY
PWR AVAIL
GOVERNOR SPD CHGR
BUS PROGRAM TEST
NORM



NORMAL SUPP. BRKR
RESERVE SUPP. BRKR
NORMAL SUPP. BRKR
RESERVE SUPP. BRKR
(NSST FANS)
SUPPLY BRKR
TIE BRKR
SUPPLY BRKR
Bus. 11

ANNUNCIATOR – 210A

	1	2	3	4	5
A	0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 CONTROL ON CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
B	0349 [illegible] 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 SYS DEGRADED	0369 DIESEL 1 SYS	0357 125V BATT GND
C	0293 [illegible] 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 TRB OC TRIP
D	0107 [illegible] 1 GND OC	0344 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT 2 SPLY BKR LCTL	0249 BUS 101 SPLY OR PDR LCTL	0062 BUS 101 UV
E	0171 BUS 111 SPLY XFMR GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY OR AUTO TRIP	0300 BUS 101 PROGRAM LCTL

PNL.– MCB

ANNUNCIATOR – 210B

	1	2	3	4	5
A	0139 DIESEL 3 LUBE OIL PRESS LO		0138 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL ON CONTROL DISABLED	0202 125 V BATT CHGR C1 TROUBLE
B	0351 [illegible] 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0136 DIESEL 3 SYS DEGRADED	0137 DIESEL 3 SYS INOP	0359 125 V BATT C GND
C	0295 [illegible] 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
D	0123 [illegible] 3 MCB OC	0146 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 2 SPLY BKR LCTL	0251 BUS 103 SPLY OR PDR LCTL	0064 BUS 103
E	0261 BUS 113 SPLY XFMR GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY OR PDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL

PNL.– MCB

ANNUNCIATOR – 210C

	1	2	3	4	5
A	0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL ON CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
B	0350 [illegible] 2 PT BLOWN FUSE	0178 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DEGRADED	0375 DIESEL 2 SYS INOP	0358 125V BATT B GND
C	0294 [illegible] 2 VOLT REG POWER FAIL	0673 SEC-COND INV TROUBLE	0674 SEC-COND INV BATT/ ALT AC OPERATION	0675 125V CHGR S1 TROUBLE	0404 125V BUS B1 BKR OC TRIP
D	0091 [illegible] 2 GND OC	0345 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY OR PDR LCTL	0063 BUS 102 UV
E	0260 BUS 112 SPLY XFMR GND TRIP	0255 BUS 112 SPLY BKR OC TRIP	0258 BUS 112 SPLY BKR LCTL	[illegible] BUS 102 SPLY OR PDR AUTO TRIP	0301 BUS 102 PROGRAM LCTL

PNL.– MCB

ANNUNCIATOR – 209B

	1	2	3	4	5	6	7	8	9	10
A	0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	0220 RSS XFMR PRI PROT TRIP	0085 4KV BUS BUS UV	0243 4KV BUS NSS & RSS PARALLELED	0244 4KV BUS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
B	0400 SANITARY SEWAGE SUMP LEVEL HI-HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV BUS SPLY BKR AUTO TRIP	0081 4KV BUS SPLY BKR AUTO TRIP	0084 4KV BUS PDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
C	0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V BUS SPLY BKR OC TRIP	0162 480V BUS SPLY BKR XFMR GND	0163 480V BUS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
D	0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI- HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V BUS SPLY BUS UV	0122 INSTR H2 HDR A PRESS HI/LO	0278 480V BUS SPLY UV CKT LCTL	0164 BUS 11C-12C SPLY-TIE BKR PARALLELED
E	0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0121 INSTR H2 HDR B PRESS HI/LO	0180 BUS 11D-12D SPLY-TIE BKR PARALLELED

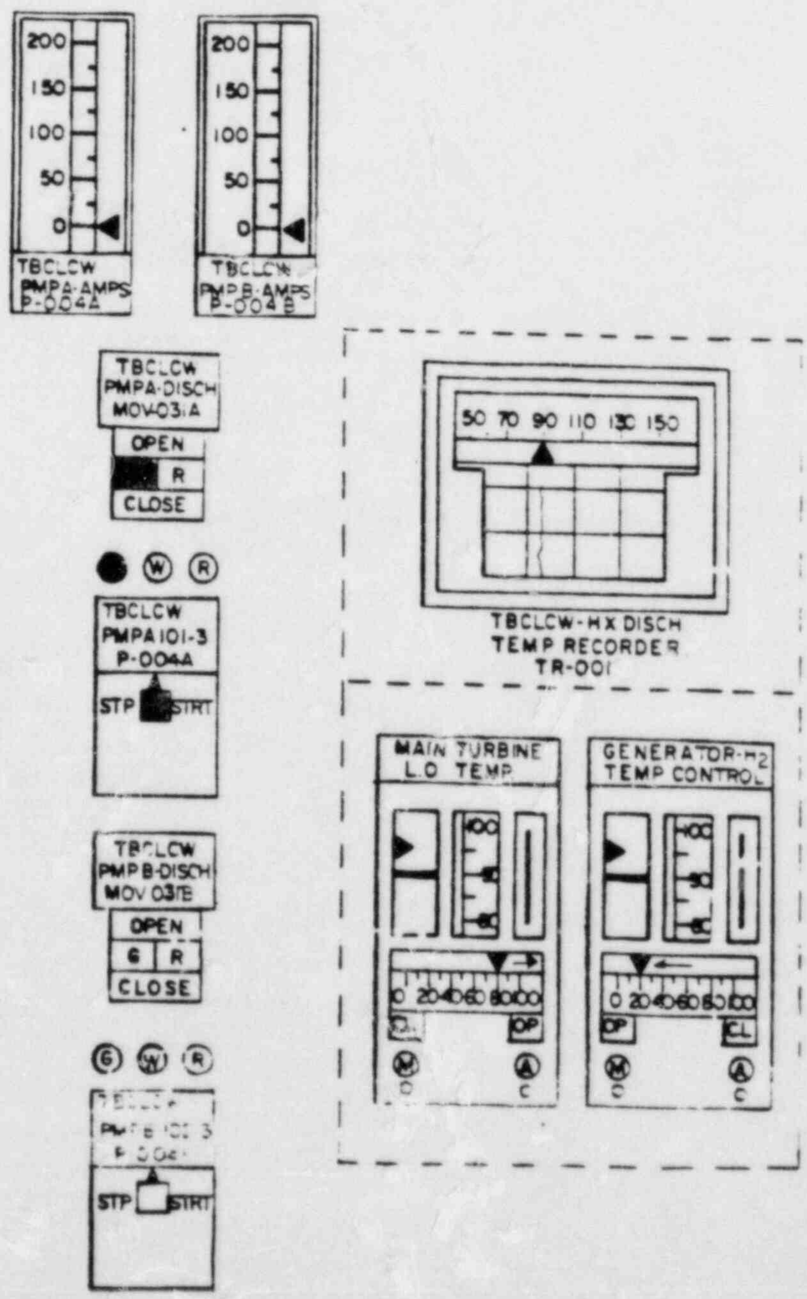
PNL – MCB

ALARM CLEARS AFTER ACKNOWLEGEMENT

9. Using the attached diagram which shows the status of affected controls, indications and alarms in the control room, identify the event and state the required immediate operator actions. This event has occurred during operation at 100% power.

(2.0)

0042 TBCLCW PUMP MTR OVLD	0049 TBCLCW PUMP AUTO TRIP	0048 TBCLCW PUMP SUCTION PRESS LO	0334 FDW HTR 6A LEVEL HI-HI	0335 FDW HTR 6B LEVEL HI-HI	0071 VAC PRIMING TK LEVEL HI	0051 SCREENWASH PUMP HDR PRESS LO	0013 SCREENWASH PUMP TROUBLE	0047 SCREENWASH PUMPS AUTO TRIP	0049 SCREENWASH STR DIFF P HI
0044 TBCLCW HDR PRESS HI	0083 TBCLCW SPLY TEMP HI	0088 TBCLCW SURGE TK LEVEL HI	0332 FDW HTR 6A LEVEL HI	0333 FDW HTR 6B LEVEL HI	0070 VAC PRIMING TK VAC LO	0116 DEMIN WTR STOR TK TEMP LO	0059 TRVLG WTR SCREEN DIFF LEVEL HI-HI	0038 TRVLG WTR SCREEN DIFF LEVEL HI	0039 TRASH RACK DIFF LEVEL HI
0067 TBCLCW HDR PRESS LO	0087 TBCLCW SPLY TEMP LO	0128 TBCLCW SURGE TK LEVEL LO	0296 TB SERVICE WTR PUMP MTR OVLD	0299 TB SERVICE WTR PUMP AUTO TRIP	0178 COND AIR REMOV PUMP AUTO TRIP	0047 CWP BRG CLG WTR PRESS HI	0037 CWP BRG CLG WTR FLOW LO	0036 CWP AUTO TRIP	0103 CWP MTR OVLD
0462 HYCHLOR SYS TROUBLE	0463 RESIDUAL CHLORINE CONC HI	0464 HYCHLOR TK LEVEL LO	0215 CNDS STOR TK LEVEL HI-HI	0179 AIR WTR SEP TK LEVEL HI	0186 COND VAC LO	0123 COND BACKWASH TROUBLE	0413 OFF GAS SYS TROUBLE	0203 HOTWELL LEVEL HI-HI	0434 CNDS STOR TK TEMP LO
0044 CNDS PUMP MTR OVLD	0043 CNDS PUMP AUTO TRIP	0155 CNDS TRANSFER PUMP MTR OVLD	0211 CNDS STOR TK LEVEL HI/LO	0291 AIR WTR SEP TK LEVEL LO	0049 DEMIN WTR TK LEVEL HI/LO	0048 DEMIN WTR HDR PRESS LO	0210 HOTWELL LEVEL HI/LO	0204 HOTWELL LEVEL LO-LO	0435 HOTWELL EMER MAKEUP OPEN



10. Using the attached diagram which shows the status of affected controls, indications and alarms in the control room, identify the event and state the required immediate operator actions. This event has occurred during operation at 75% power.

(2.0)

ANNUNCIATOR – 209H

A	0218 NSS XFMR PRI PROT TRIP	0219 NSS XFMR BACKUP PROT TRIP	0226 NSS XFMR TROUBLE	0227 RSS XFMR TROUBLE	0221 RSS XFMR BACKUP PROT TRIP	0220 RSS XFMR PRI PROT TRIP	0085 4KV NSS BUS UV	0243 4KV BKR NSS & RSS PARALLELED	0244 4KV NSS SPLY UV CKT LCTL	0461 REMOTE TRIP-SWYD RELAY OPER
B	0408 SANITARY SEWAGE SUMP LEVEL HI-HI		0222 NSST/RSST PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV RSS SPLY BKR AUTO TRIP	0081 4KV NSS SPLY BKR AUTO TRIP	0084 4KV NSS FDR BKR AUTO TRIP	0330 BUS 11A-12A SPLY-TIE BKR PARALLELED
C	0449 CNDS DEMIN INF CNDCT HI-HI/HI	0456 CNDS DEMIN EFL CNDCT HI-HI/HI	0451 CNDS PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE TROUGHS CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V NSS SPLY BKR OC TRIP	0162 480V NSS SPLY BKR XFMR GND	0163 480V NSS TIE BKR OC TRIP	0331 BUS 11B-12B SPLY-TIE BKR PARALLELED
D	0457 CNDS DEMIN INF SAMPLE CNDCT HI-HI/HI	0450 CNDS DEMIN EFL SAMPLE CNDCT HI-HI/HI	0452 CNDS PUMP DISCH SAMPLE CNDCT HI- HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 RW SAMPLE PNL TROUBLE	0459 TB SAMPLE PNL TROUBLE	0279 480V NSS SPLY BUS UV	0322 INSTM N2 HDR A PRESS HI/LO	0278 480V NSS SPLY UV CKT LCTL	0364 BUS 11C-12C SPLY-TIE BKR PARALLELED
E	0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 RW FLT PNL TROUBLE	0460 RB SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN LO	0323 INSTM N2 HDR B PRESS HI/LO	0380 BUS 11D-12D SPLY-TIE BKR PARALLELED
	1	2	3	4	5	6	7	8	9	10

PNL –

SHIFT ADVISOR TRAINING

WEEK _4_ EXAMINATION

TOTAL POINTS: _48.5_

NAME: ________________________

SCORE: ________

PREPARED BY: _____________ 6/8/84
Training Instructor/Date

REVIEWED BY: _____________ 6/8/84
Operations Training Specialist/Date

APPROVED BY: _____________ 6/8/84
Training Supervisor/Date

(OBJECTIVE HL- 950 - 1)

1 . Plant Administrative procedures provide evidence of safe dependable operations. True/False. (1.0)

(OBJECTIVE HL- 950 - 1)

2 . Each plant section has its own procedure using a single alpha numeric listing code. True/False. (1.0)

(OBJECTIVE HL- 950 - 1)

3 . The Administrative Procedures are prepared under the approval signature of the Plant Administrative Coordinator. True/False. (1.0)

(OBJECTIVE HL- 950 - 1)

4 . The Administrative Procedures contain detailed information on plant operations during a LOCA. True/False. (1.0)

(OBJECTIVE HL- 950 - 1)

5 . There is no approved method for changing a plant operating procedure. True/False. (1.0)

(OBJECTIVE HL- 950 - 1)

6 . Operations Section personnel can write and submit a report of abnormal condition after approval to do so by the W.E. True/False. (1.0)

(OBJECTIVE HL- 950 - 1)

7 . The originator of a RAC brings it directly to the attention of the W.E. True/False. (1.0)

(OBJECTIVE HL- 950 - 1)

8 . The ROC has sole authority to order corrective actions as the result of a RAC. True/False. (1.0)

(OBJECTIVE HL- 950 - 1)

9 . The Procedure for Station Equipment Clearance Permit establishes the methods for isolating equipment following its removal from service. (1.0)

(OBJECTIVE HL- 950 - 1)

10 . The W.E. may cancel an RWP if radiological conditions change. True/False. (1.0)

(OBJECTIVE HL- 950 - 1)

11 . M.W.R's are written to alert the Operations Manager of potential plant design changes. True/False. (1.0)

(OBJECTIVE HL- 950 - 1)

12 . An LDR may be issued by any LILCO employee when equipment performance deviates from specification. True/False. (1.0)

(OBJECTIVE HL- 950 - 1)

13 . Routine changing an oil filter for equipment not covered by the Technical Specifications would normally be considered part of the Preventive Maintainance Program. True/False. (1.0)

(OBJECTIVE HL- 950 - 1)

14 . Non safety related components should be accorded at the same safety significance as safety related components. True/False (1.0)

(OBJECTIVE HL- 950 - 1)

15 . Surveillance SAWS time limits for job completion are assigned by the Chief Maintenance Engineer as per a Tech Spec LCO's. True/False (1.0)

(OBJECTIVE HL- 950 - 1)

16 . A procedure may be temporarily changed if the change does not alter the intent of the procedure. True/False (1.0)

(OBJECTIVE HL- 950 - 1)

17 . It is not necessary to get the W.E. approval for placing valves in abnormal conditions if a SAWS has been issued for the Work. True/False (1.0)

(OBJECTIVE HL- 950 - 1)

18 . The W.E. may call out selected individuals as needed for station operations. True/False. (1.0)

(OBJECTIVE HL- 950 - 1)

19 . After a scram the W.E. should direct the senior EO to prepare a scram report. True/False (1.0)

(OBJECTIVE HL- 950 - 1)

20 . After the scram report is filed the Operations Engineer must review it before startup can begin. True/False (1.0)

(OBJECTIVE HL- 950 - 1)

21 . The Watch Engineer is out of the CR and the W.S. is at a back panel when alarms indicate that the RFPT has been lost. Which of the following is the first correct action for the NSO at the controls? a. Page the W.E. to the CR on the page party line, b. Go to the back panels to find the W.S., C. Check redundant instrument./take indep. action, d.Record incident-notify the NRC. (1.0)

(OBJECTIVE HL- 950 - 1)

22 . A floor drain hi-level reading appears on the control board in the area of a condens. booster pump What is the first correct action that the W.E. should take? a. Send EO out to check the situation, b. Station an NSO (NASO) at the proper control panel and review the possible actions if a loss of the pump occurs,C. Fill out an MWR and tag the pump, D. Fill out RWP/ have HP do a survey before making any decision (1.0)

(OBJECTIVE HL- 950 - 1)

23 . It is three AM and you notice that one of the NSO's is almost dozing in his chair. It appears that the others in the CR are somewhat inattentive. What action should the SO advisor take?

A. Rap a book on the desk loudly to wake them up, B. Take up a position at the controls/monitor operation, C. Threaten to report incident to NRC and lecture the operators, D. Speak to the W.S. or W.E. about remaining vigilant (1.0)

(OBJECTIVE HL- 950 - 1)

24 . It is decided that certain valves affecting the stations availability need to be taken out of service for routine repacking. Which of the following is the last administrative action to be done before work begins? a. W.E. notified, b. RWP approval, c. Check with system operations for approval, d. Fill in MWR. (1.0)

(OBJECTIVE HL- 950 - 1)

25 . You have seen the W.E. fill out fifteen RWPs in the past month for what appears to be the same routine repetitive work. Which of the following actions could be recommended? a. Request an extended RWP be issued. b. Issue a TPCN, c. Rewrite the procedure, d. Perform surveillances activities using existing RWPs. (1.0)

(OBJECTIVE HL- 950 - 1)

26 . During shift turnover an oncoming NASO reports that he has a fever and chills. What actions should be taken? a. None b. He should be sent home and an outgoing NASO should be retained until someone can be called in, c. The shift should be turned over and then he is sent home, d. An equipment operator should be asked to fill in for the sick man. (1.0)

(OBJECTIVE HL- 950 - 1)

27 . The W.E. receives an RWP for signature before actual work begins. He is not certain that conditions will permit the work to be done safely but the work must be completed this week. What is his best option? a. Sign off the RWP and hope for the best, b. Say nothing and don't sign off, c. Call H.P & Mant. Supervision for a conference, d. Refer the RWP to the Op. Eng. with an explanation of the problem. (1.0)

(OBJECTIVE HL- 950 - 1)

28 . Which of the following plant condition(s) allow a watch engineer to leave the CR for a conference with H.P leaving an RO in charge. a. Condition 1, b. Condition 1,2,3, c. Condition 3,4,5. d. Condition 4,5. (1.0)

(OBJECTIVE HL- 950 - 1)

29 . Which of the following is the best reason for controlling lifted leads and jumpers? a. Avoiding NRC inspection, b. Prevent issuance of SAWS, c. Supervisory awareness of abnormal conditions - prevent increased - I&C reworks. (1.0)

(OBJECTIVE HL- 950 - 1)

30 . Which of the following should cause a RAC to be issued? a. Trash and other litter on the floor of reactor building elevation 78.7", b. Puddle of water under leaking fire main pipe at elevation 8'00", c. A General Electric service bulletin points out a potential problem on RPS relays, d. Two MWR's were issued for the same work by the operations section. (1.0)

(OBJECTIVE HL- 950 - 1)

31 . Which of the following is not a reason for issuing an MWR ? a. Equipment does not operate properly, B. Equipment needs to be inspected following failure of a surveillance test C. Integrated testing of safety related equipment D. A schedule surveillance has been missed on a piece of equipment. (1.0)

(OBJECTIVE HL- 950 - 1)

32 . Which of the following would not be included in the preventive maintenance program, a. Repair of a heat exchanger tube leak, b. Repacking valve every 18 mos, c. Cleaning and lubricating relays every six months, d. Rotating a pump shaft every week. (1.0)

(OBJECTIVE HL- 950 - 1)

33 . The Instrument and Control Section is going to lift leads to test a pressure switch on the HPCI system. All of the documentation is in order for work to begin. What independent verification should the W.E. be making? a. Work start time, b. Work completion time, c. LL&J tag placements, d. MWR man hour estimates. (1.0)

(OBJECTIVE HL- 950 - 1)

34 . The WE asks the SO Advisor to check on LL&J tagout on the RPS high flux trip logic. Under what conditions should the SO Advisor comply? a. Control room is adequately manned, b. No one else is available, c. He knows the system design and its relation to safety, d. Control room indications will reveal if the system was returned to service properly. (1.0)

(OBJECTIVE HL- 950 - 1)

35 . The I&C technician requests an LL&J permit to lift a lead for simulating a trip signal. The lead will be replaced immediately after the trip signal initiation. What should the W.E. do? a. Deny the permit as not necessary, b. Issue the permit and perform independent verification, c. Check the SAWS log to see if the work has already been done, d. Check tech specs to see if the work is necessary. (1.0)

(OBJECTIVE HL- 950 - 1)

36 . A TPCN is written and submitted for approval. The W.S. is busy but gives his verbal ok. Which of the following actions is to be done next? a. Start work under the TPCN, b. File the TPCN with the appropriate section head, c. Seek another approval in written form from appropriate plant management, d. Ask the NASO for his verbal ok and issue the appropriate instructions. (1.0)

(OBJECTIVE HL- 950 - 1)

37 . All of the following are reasons for review of station procedures except. a. System modifications, b. ROC committee recommendation, c. One year has elapsed since the last review, d. NRC issues new guidelines or regulations. (1.0)

(OBJECTIVE HL- 950 - 1)

38 . The SO Advisor has a differing professional opinion from the W.E. and feels very strongly that his view should be adopted. What is the next administrative step he can take? a. File a grievance with the union rep, b. Call the NRC, c. Try to pursuade the other operators to his side, d. Explain the situation in writing to the Ops Engineer. (1.0)

(OBJECTIVE HL- 950 - 1)

39 . A surveillance test is moved ahead by two weeks. What documentation must be completed? a. MWR, b. TPCN, c. SPCN, d. SAWS. (1.0)

(OBJECTIVE HL- 950 - 1)

40 . When it is not possible to complete a surveillance procedure due to pre-fuel load or initial plant startup conditions the step in question may be omitted if a. W.E. and section head agree to omit the step b. W.E. approves the omissiom and writes a footnote to the SAWS explaining the reason, c. An LDR is issued, d. The appropriate section head gives his approval and issues a RAC. (1.0)

(OBJECTIVE HL- 290 - 1)

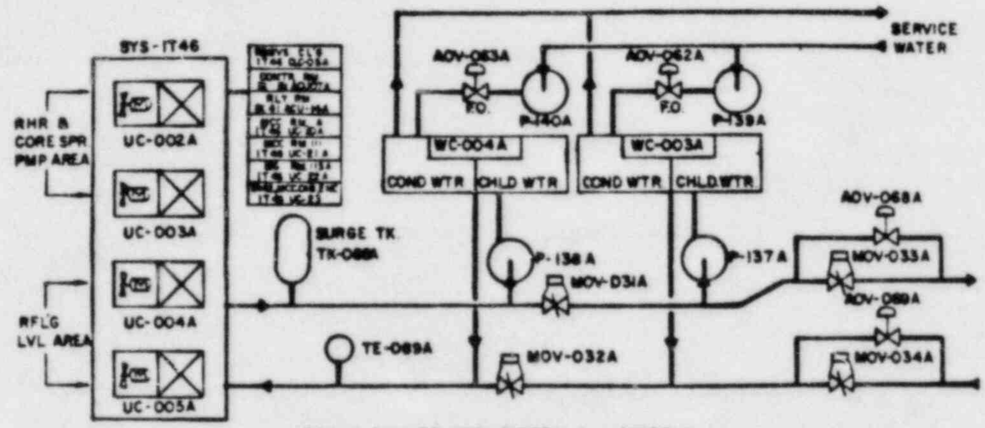
41 . List the conditions which require entry into the Level Control emergency procedure: SP 29.023.01. For isolation conditions which require entry, list the parameter and setpoint. (4.0)

(OBJECTIVE HL- 290 - 1)

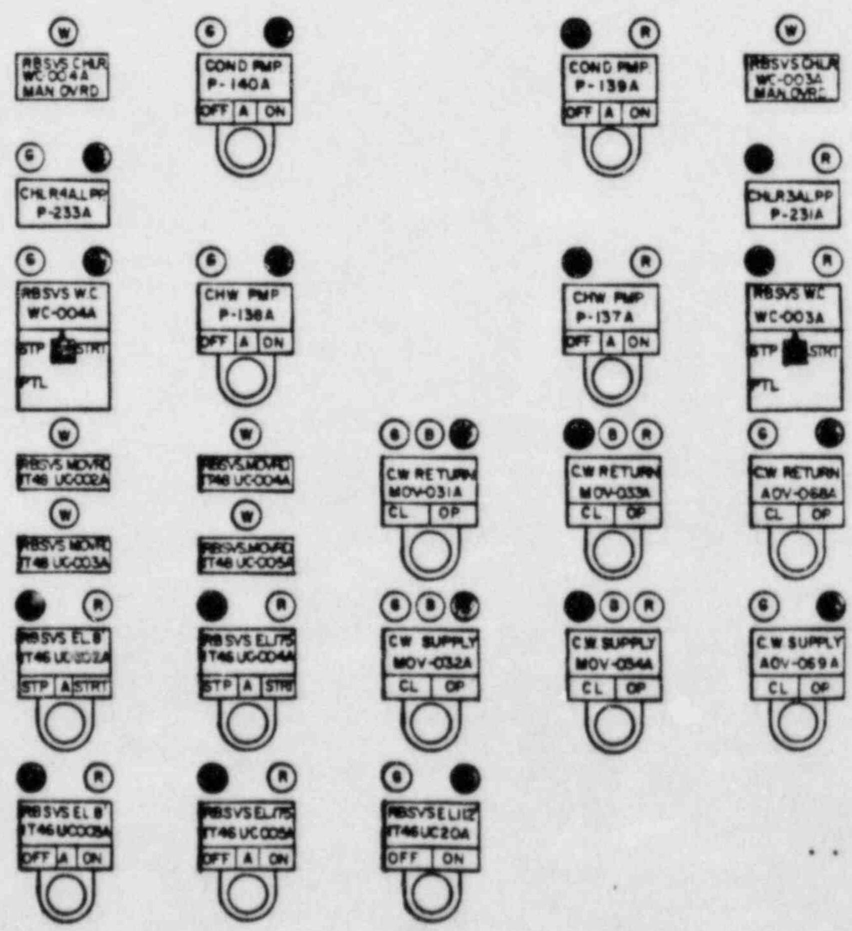
42 . List the conditions which require entry into the Containment Control emergency procedure: Sp 29.023.03 (2.5)

(OBJECTIVE HL- 421 - 12)

43 . Using the attached diagram which shoes the status of RBSVS/CRAC Chilled Water System controls and indications in the control room, identify the mode of operation. (2.0)



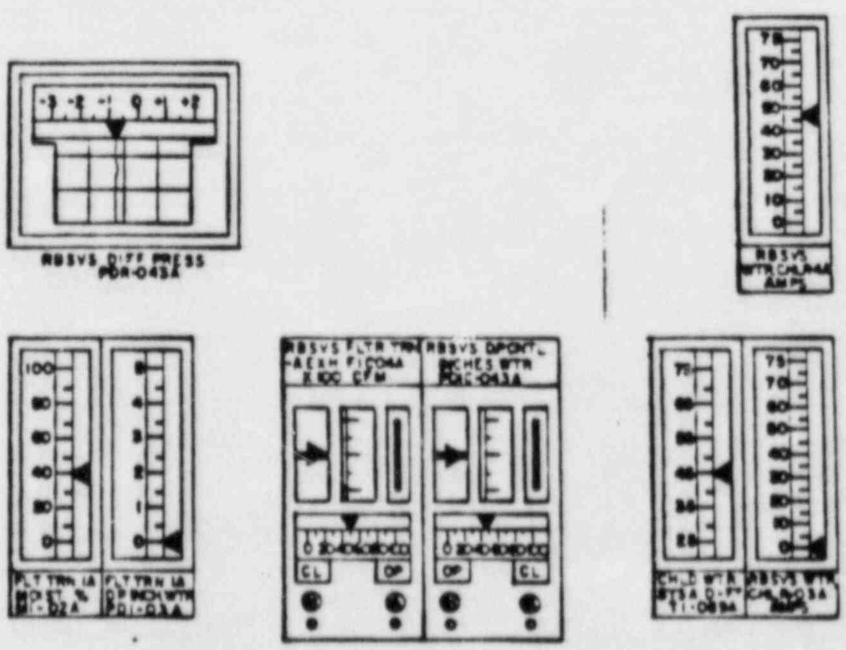
RBSVS CHILLED WTR. SYSTEM-A (IM50)#



SYS 421

[illegible] CNTMT PURGE FLT DIFF P HI	3058 PRI CNTMT HI PRESS ALERT	3106 RB HCC RM A TEMP HI/LO	3107 RB HCC RM B TEMP HI/LO	3017 RBSVS SYS A CHILL WTR DEGRADED	3018 RBSVS SYS B CHILL WTR DEGRADED	[illegible] RBSVS SYS A CHLR WTR OFLD	3014 RBSVS SYS B CHLR WTR OFLD	[illegible] [illegible] SYS TROUBLE	[illegible] DRYWELL UNIT CLR [illegible] TROUBLE
3076 CNTMT PURGE SYS A VV LCTL	3077 CNTMT PURGE SYS B VV LCTL	3108 RB HCC RM A VENT DROP	3109 RB HCC RM B VENT DROP	3019 RBSVS SYS A CHILL WTR DROP	3020 RBSVS SYS B CHILL WTR DROP	3102 RBSVS SYS A CHILL WTR SPLY/RTN VV CLSD	3103 RBSVS SYS B CHILL WTR SPLY/RTN VV CLSD	[illegible] RBSVS CLR DRYWELL PURGE FLOW HI	[illegible] DRYWELL UNIT CLR DIFF P HI
[illegible] DRYWELL UNIT CLA-17A FLOW HI	[illegible] DRYWELL UNIT CLA-17B FLOW HI	3110 RBSVS CHILL WTR SURGE TK A TROUBLE	3111 RBSVS CHILL WTR SURGE TK B TROUBLE	3112 RBSVS SYS A CHILL WTR SPLY TEMP HI	3037 RBSVS SYS B CHILL WTR SPLY TEMP HI	3104 RBSVS SYS A CHILL WTR CROSSOVER VV OPEN	3105 RBSVS SYS B CHILL WTR CROSSOVER VV OPEN	[illegible] RBSVS CLR DRYWELL PURGE [illegible] HI	[illegible] DRYWELL AREA TEMP HI
1	2	3	4	5	6	7	8	9	10

[illegible]



SHOREHAM NUCLEAR POWER STATION
SHIFT OPERATIONS ADVISOR
CERTIFICATION EXAMINATION

June 21, 1984

Prepared By ____________

Reviewed By ____________

Approved By ____________

		Pt. Value	Score	% Score
1.	Plant Systems	18.0		
2.	Procedures: Normal and Emergency	17.0		
3.	Administrative Procedures & Technical Specifications	18.0		

NAME ____________________

FINAL SCORE ________________

SECTION 1 Plant Systems

1. For each of the following systems, list the signals and setpoints which will result in automatic actuation of the system:

   a. Low Pressure Coolant Injection System (1.0)

   b. Automatic Depressurization System (1.0)

   c. Reactor Building Standby Ventilation System (1.0)

2. Using the attached diagram which shows the status of the ADS control room annunciators, controls and indications, identify the condition of the system at the time this "snapshot" was taken. If the system condition indicates that all required automatic actions have not occurred, state the immediate actions required of the operator.

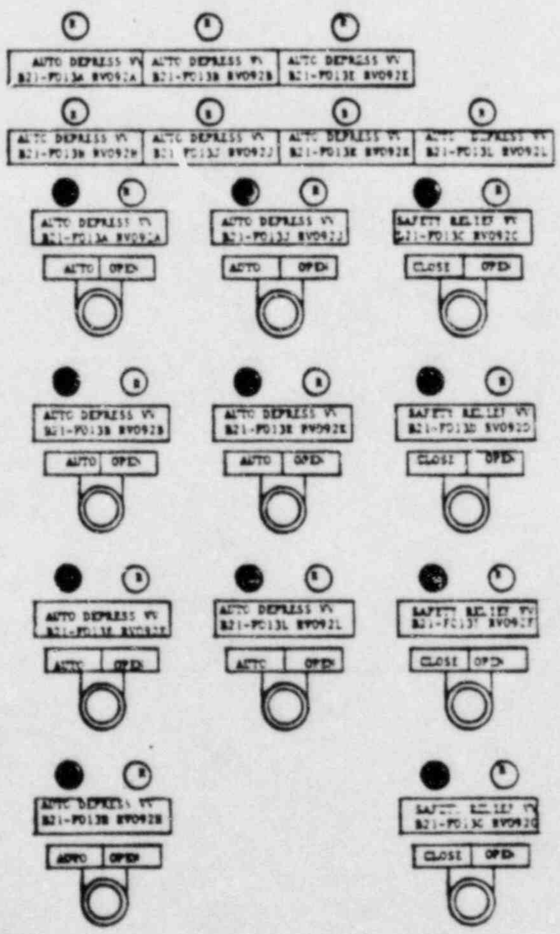
(2.0)

-5 of 2

ANNUNCIATOR – A5

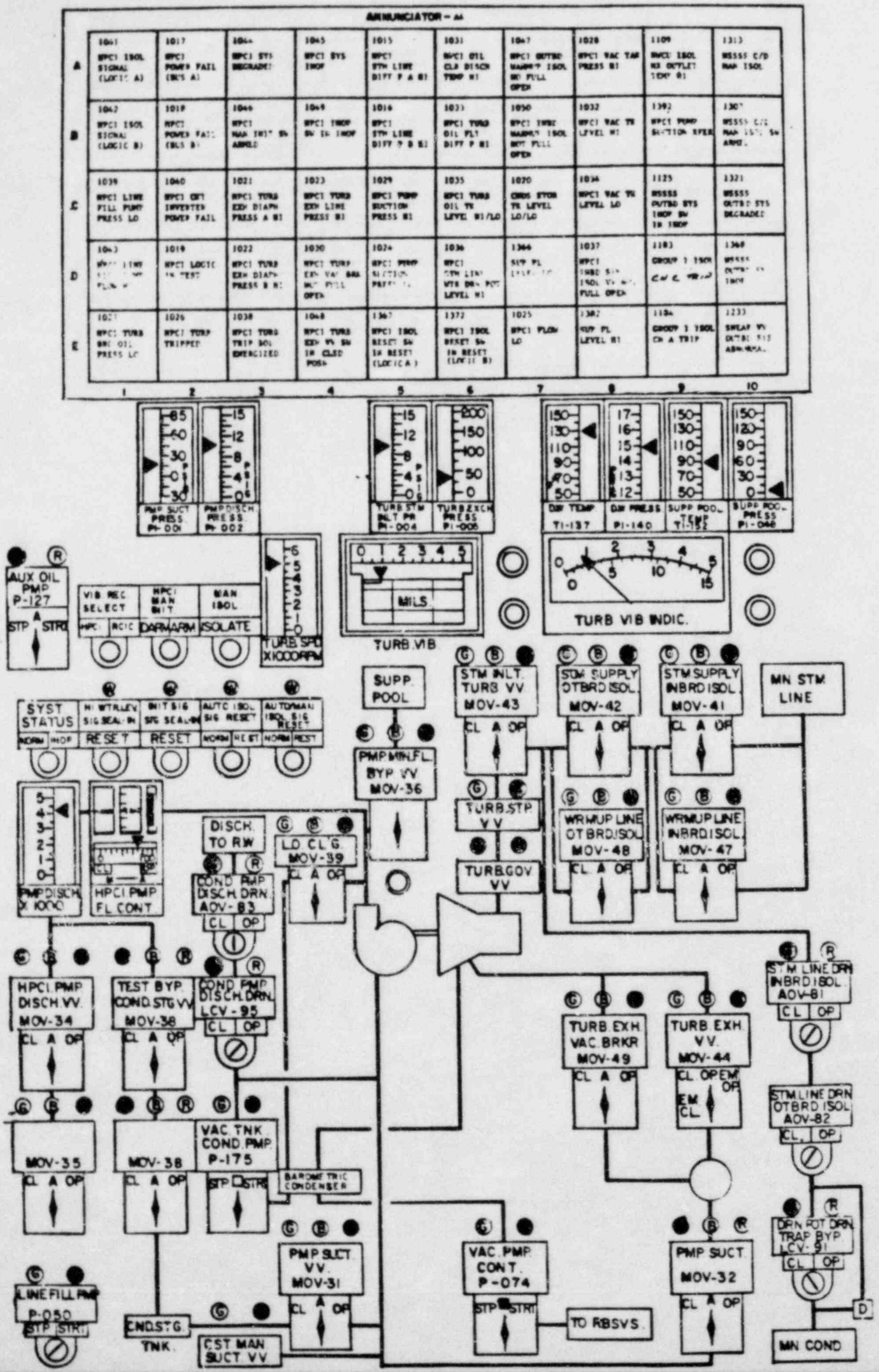
	1	2	3	4	5	6	7	8	9	10
A	1312 NSSSS A/B RHR ISOL		1342 ADS SYS A TIMER INIT	1352 ADS INIT (LOGIC A)	1353 ADS INIT (LOGIC C)	1343 ADS SYS B TIMER INIT	1354 ADS INIT (LOGIC B)	1355 ADS INIT (LOGIC D)		
B	1306 NSSSS A/B RHR ISOL SW ARMED		1360 ADS SYS A LOGIC POWER FAIL	1346 ADS SYS A FAULTY TEST PROCEDURE	1344 ADS SYS A INOP	1361 ADS SYS B LOGIC POWER FAIL	1347 ADS SYS B FAULTY TEST PROCEDURE	1345 ADS SYS B INOP		
C	1320 NSSSS INBD SYS DEGRADED		1350 ADS SYS A SRV OPEN ON POWER FAIL	1358 ADS SYS A IN TEST	1340 ADS SYS A AUTO INIT INHIBIT SW IN INHIBIT	1351 ADS SYS B SRV OPEN ON POWER FAIL	1359 ADS SYS B IN TEST	1341 ADS SYS B AUTO INIT INHIBIT SW IN INHIBIT		
D	1369 NSSSS INBD SYS TRIP	1105 GROUP I ISOL CH A TRIP	1356 ADS SYS A RHR INIT SW ARMED	1338 RHR OR CS SYS A PUMPS RUNNING	1348 RX SYS A LEVEL LO CONFIRMED	1357 ADS SYS B RHR INIT SW ARMED	1339 RHR OR CS SYS B PUMPS RUNNING	1349 RX SYS B LEVEL LO CONFIRMED		
E	1124 NSSSS INBD SYS INOP SW IN	1106 GROUP I ISOL CH D TRIP			1337 SRV LEAKING		1156 MSIV LCS INBD SYS TROUBLE	1157 MSIV LCS OUTBD SYS TROUBLE		

PNL – 607



3. Using the attached diagram which shows the status of the HPCI System control room annunciators, controls and indications, identify the condition of the system at the time this "snapshot" was taken. <u>If</u> the system condition indicates that all required automatic actions have <u>not</u> occurred, state the immediate actions required of the operator.

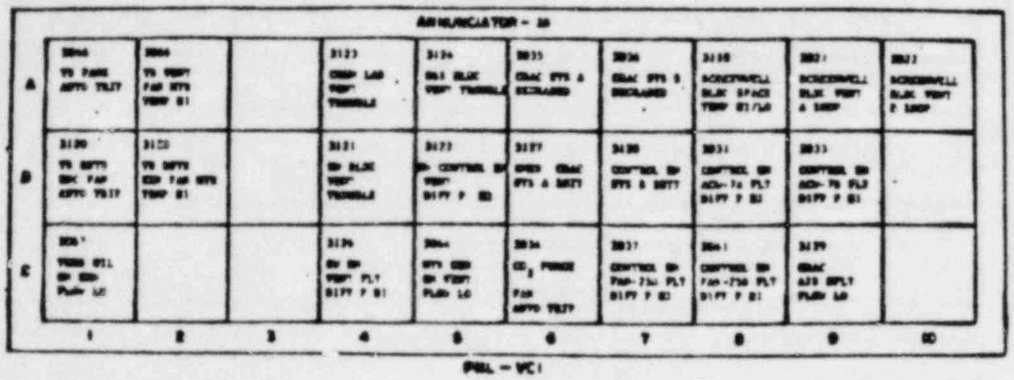
(2.0)



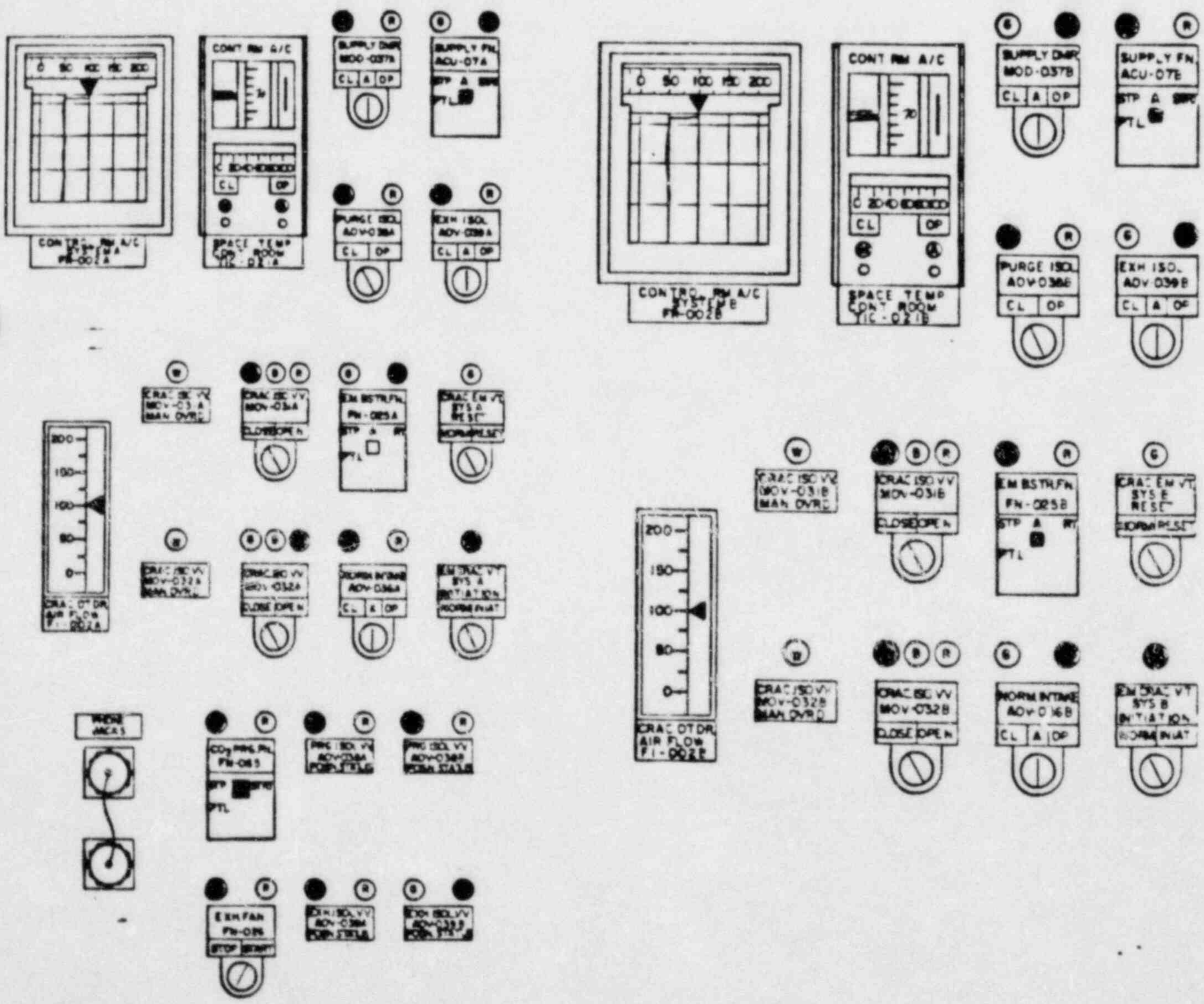
AUX OIL PMP P-127
STP A STRT
VIB REC SELECT
HPCI MAN INIT
MAN ISOL
ISOLATE
TURB SPD X1000RPM
PMP SUCT PRESS PI-001
PMP DISCH PRESS PI-002
TURB STM INLT PR PI-004
TURB EXCH PRESS PI-005
DW TEMP TI-137
DW PRESS PI-140
SUPP POOL TEMP TI-132
SUPP POOL PRESS PI-046
MILS
TURB VIB
TURB VIB INDIC.
SYST STATUS
NORM INOP
RESET
RESET
SUPP POOL
STM INLT TURB VV MOV-43
STM SUPPLY OTBRD ISOL MOV-42
STM SUPPLY INBRD ISOL MOV-41
MN STM LINE
PMP MIN FL BYP VV MOV-36
TURB STP VV
WRMUP LINE OTBRD ISOL MOV-48
WRMUP LINE INBRD ISOL MOV-47
TURB GOV VV
PMP DISCH X 1000
HPCI PMP FL CONT
DISCH TO RW
LO CL'G MOV-39
COND PMP DISCH DRN AOV-83
CL OP
HPCI PMP DISCH VV MOV-34
TEST BYP COND STG VV MOV-38
COND PMP DISCH DRN LCV-95
STM LINE DRN INBRD ISOL AOV-81
TURB EXH VAC BRKR MOV-49
TURB EXH VV MOV-44
STM LINE DRN OTBRD ISOL AOV-82
MOV-35
MOV-38
VAC TNK COND PMP P-175
BAROMETRIC CONDENSER
PMP SUCT VV MOV-31
VAC PMP CONT P-074
PMP SUCT MOV-32
DRN POT DRN TRAP BYP LCV-91
LINE FILL PMP P-050
STP STRT
CND STG TNK
CST MAN SUCT VV
TO RBSVS
MN COND
SYS-202

4. Using the attached diagram which shows the status of the Control Room Air Conditioning System controls, indications and annunciators, identify the condition of the system at the time this "snapshot" was taken. If the system condition indicates that all req 'red automatic actions have <u>not</u> occurred, state the immediate actions required of the operator.

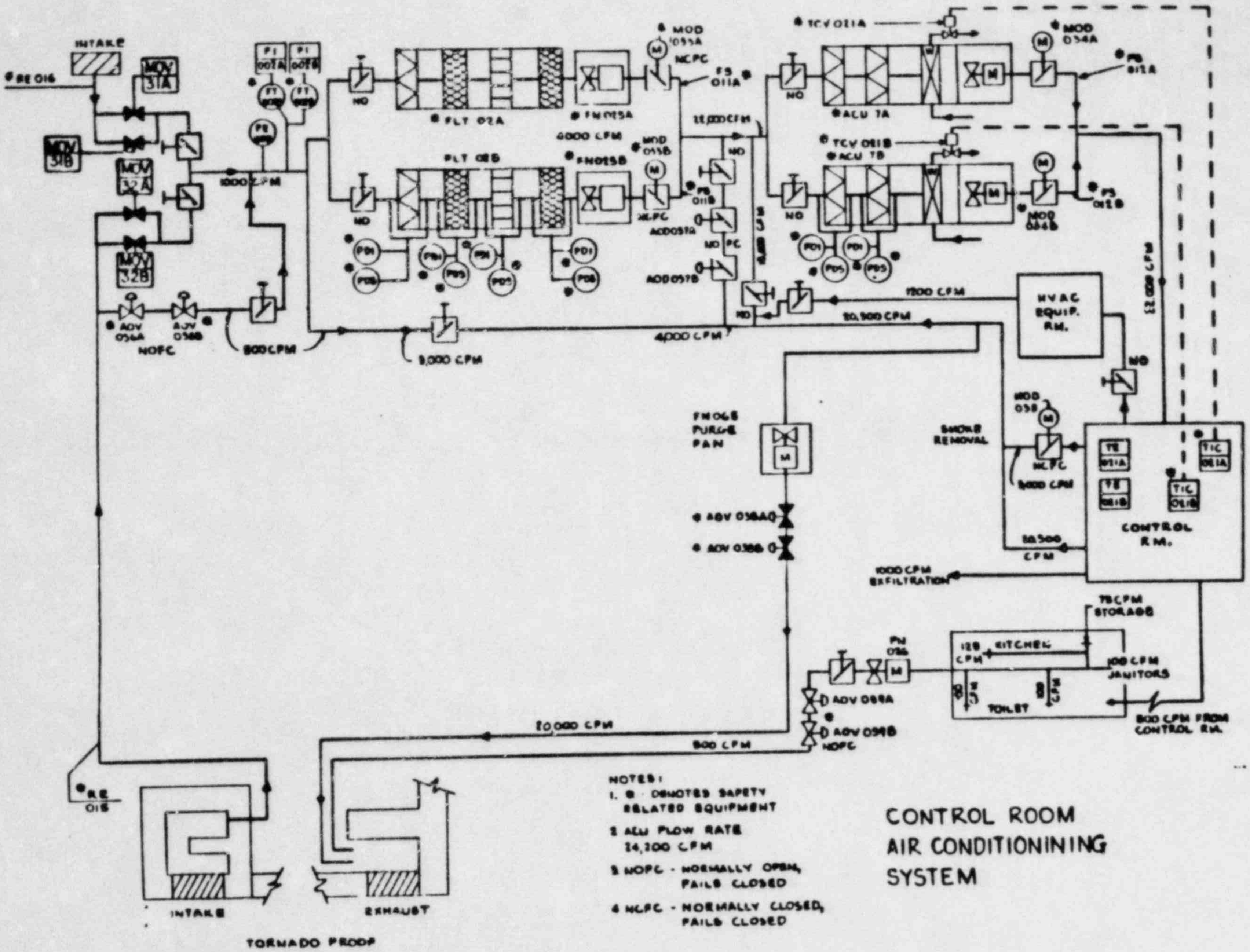
(2.0)



A
B
C
1
2
3
4
5
6
7
8
9
10



CONT RM A/C
SUPPLY DMPR MOD-037B
SUPPLY FN ACU-07B
CL A OP
STP A STRT
PTL
PURGE ISOL AOV-038B
EXH ISOL AOV-039B
CONTROL RM A/C SYSTEM B FR-002B
SPACE TEMP CONT ROOM TIC-021B
CRAC ISO VV MOV-031B MAN OVRD
CRAC ISO VV MOV-031B
CLOSE OPEN
EM BSTR FN FN-025B
CRAC EM VT SYS B RESET
NORM RESET
CRAC OTDR AIR FLOW FI-002B
CRAC ISO VV MOV-032B MAN OVRD
CRAC ISO VV MOV-032B
NORM INTAKE AOV-016B
EM CRAC VT SYS B INITIATION
NORM INIT
EXH FAN
STOP START
PHONE JACKS



CONTROL ROOM
AIR CONDITIONINING
SYSTEM

NOTES:
1. ⊛ DENOTES SAFETY RELATED EQUIPMENT
2 ACU FLOW RATE 24,200 CFM
3 NOFC - NORMALLY OPEN, FAILS CLOSED
4 NCFC - NORMALLY CLOSED, FAILS CLOSED

5. For each of the following systems or components, list the signals and setpoints which will result in automatic isolation of the systems or components:

a. Main Steam Lines (1.0)

b. Reactor Core Isolation Cooling System (1.0)

c. Reactor Water Cleanup System (1.0)

6. Using the attached diagram which shows the status of the Reactor Core Isolation Cooling System control room annunciators controls and indications, identify the condition of the system at the time this "snapshot" was taken. <u>If</u> the system condition indicates that all required automatic actions have not occurred, state the immediate actions required of the operator.

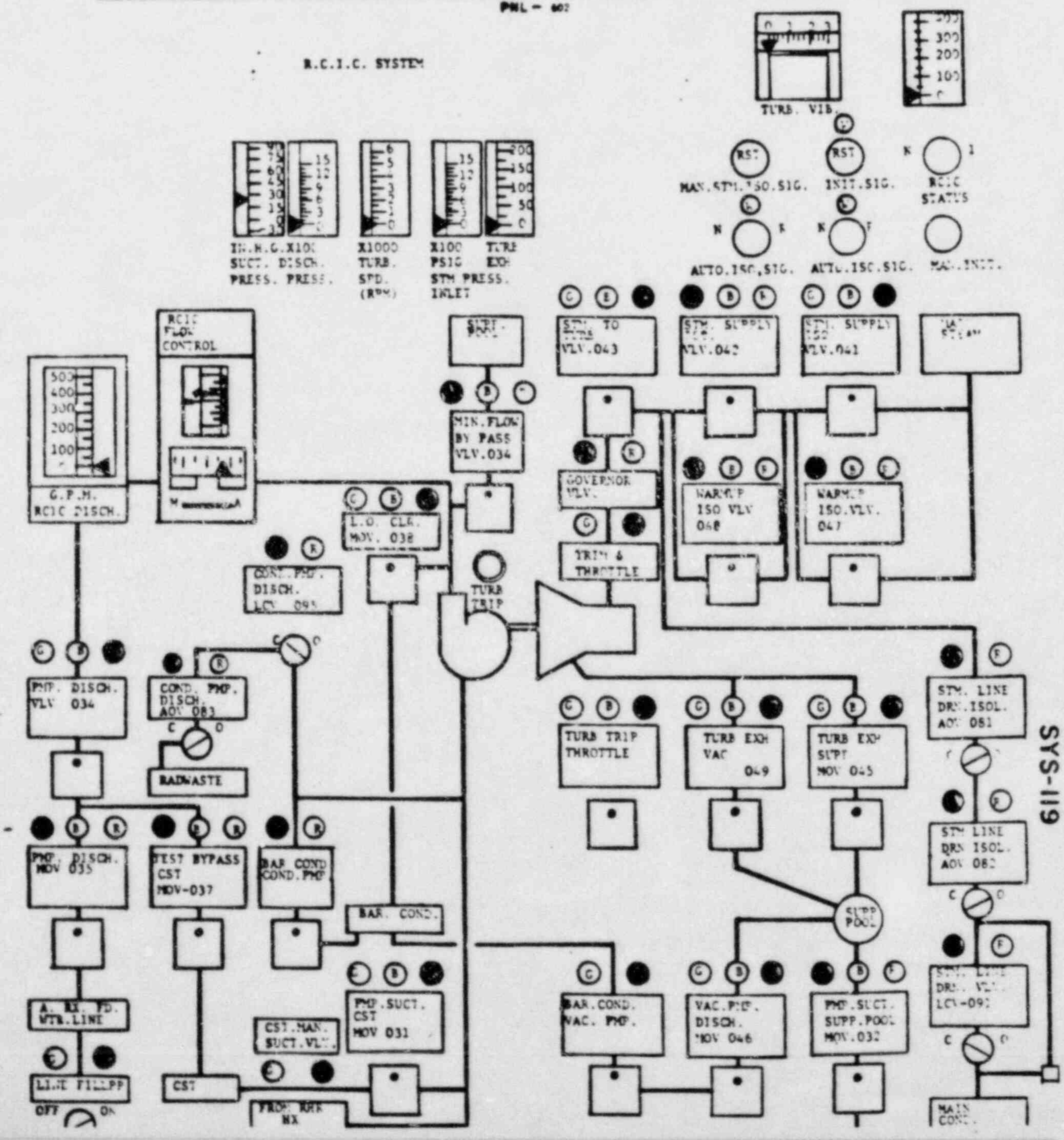
(2.0)

ANNUNCIATOR - A6

	1	2	3	4	5	6	7	8	9	10
A	1067 RCIC ISOL SIGNAL (LOGIC A)	1064 RCIC POWER FAIL (BUS A)	1082 RCIC SYS DEGRADED	1083 RCIC SYS INOP	1063 RCIC STM LINE DIFF P A HI	1377 RCIC STM ISOL VV NOT	1086 RCIC OUTBD WARMUP ISOL VV NOT FULL OPEN	1435 RCIC CST LO LEVEL	1052 RWCU ST CNDCT HI	1059 RWCU OUTB ISOL HI LEAKAGE
B	1078 RCIC ISOL SIGNAL (LOGIC B)	1077 RCIC POWER FAIL (BUS B)	1093 RCIC MAN INIT SW ARMED	1092 RCIC INOP SW IN INOP	1076 RCIC STM LINE DIFF P B HI	1073 RCIC TURB OIL FLT DIFF P HI	1091 RCIC INBD WARMUP ISOL VV NOT FULL OPEN	1075 RCIC VAC TK LEVEL HI	1056 RWCU SYS FLT DEMIN FAIL	1058 RWCU INBD ISOL HI LEAKAGE
C	1373 RCIC ISOL RESET SW IN RESET (LOGIC B)	1066 RCIC CKT INVERTER POWER FAIL	1080 RCIC TURB EXH DIAPH PRESS A HI	1060 RCIC TURB EXH PRESS HI	1079 RCIC PUMP SUCTION PRESS HI	1072 RCIC TURB BRG TEMP HI	1071 RCIC TURB HI WTR LEVEL TRIP	1074 RCIC VAC TK LEVEL LO	1054 RWCU PUMP TRIP SEAL TEMP HI	1053 RWCU PUMP FLOW LO
D	1330 STM LEAK DIV I LOGIC POWER FAIL	1331 STM LEAK DIV II LOGIC POWER FAIL	1081 RCIC TURB EXH DIAPH PRESS B HI	1089 RCIC TURB EXH VAC BKR VV NOT FULL OPEN	1061 RCIC PUMP SUCTION PRESS LO	1088 RCIC STM LINE WTR DRN POT LEVEL HI	1069 RCIC TURB OIL PRESS LO	1090 RCIC LINE FILL PUMP FLOW HI	1057 RWCU SYS FLT IN TEMP HI	1055 RWCU DISCH PRESS HI/LO
E	1326 STM LEAK LOGIC A IN TEST (RCIC)	1328 STM LEAK LOGIC B IN TEST (RCIC	108- RCIC VAC PUMP DISCH VV SW IN CLSD POSN	1085 RCIC TURB EXH VV SW IN CLSD POSN	1065 RCIC PUMP SUCTION VV FULL OPEN	1062 RCIC TURB TRIPPED	1068 RCIC FLOW LO	1087 RCIC LINE FILL PUMP FLOW HI	1070 RCIC VAC TK PRESS HI TEMP HI	1378 RCIC ISOL RESET SW IN HI/LO (LOGIC A)

PNL - 602

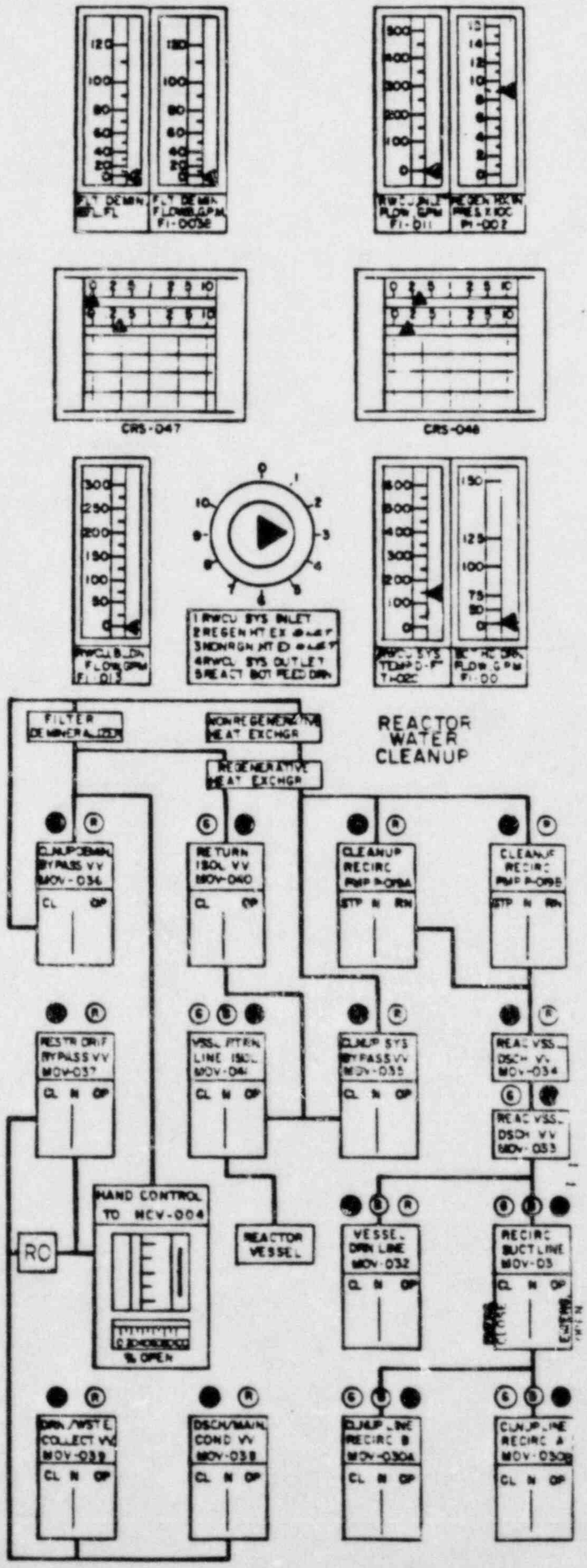
R.C.I.C. SYSTEM



SYS-119

7. Using the attached diagram which shows the status of the Reactor Water Cleanup System control room annunciators, controls and indications, identify the condition of the system at the time this "snapshot" was taken. <u>If</u> the system condition indicates that all required automatic actions have <u>not</u> occurred, state the immediate actions required of the operator.

(2.0)



CRS-047
CRS-048
1 RWCU SYS INLET
4 RWCL SYS OUTLET
FILTER DEMINERALIZER
NONREGENERATIVE HEAT EXCHGR
REGENERATIVE HEAT EXCHGR
REACTOR WATER CLEANUP
CLNUP DEMIN BYPASS VV MOV-036
RETURN ISOL VV MOV-040
CLEANUP RECIRC
CL N OP
HAND CONTROL TO MCV-004
% OPEN
RC
REACTOR VESSEL
VESSEL DRN LINE MOV-032
DSCH/MAIN COND VV MOV-038
CLNUP LINE RECIRC B
CL N OP

ANNUNCIATOR - A4

	1	2	3	4	5	6	7	8	9	10
A	1061 HPCI ISOL SIGNAL (LOGIC A)	1017 HPCI POWER FAIL (BUS A)	1044 HPCI SYS DEGRADED	1045 HPCI SYS INOP	1015 HPCI STM LINE DIFF P A HI	1031 HPCI OIL CLR DISCH TEMP HI	1047 HPCI OUTBD WARMUP ISOL NO FULL OPEN	1028 HPCI VAC TAN PRESS HI	1109 RWCU ISOL HX OUTLET TEMP HI	1313 MSSSS C/D MAN ISOL
B	1042 HPCI ISOL SIGNAL (LOGIC B)	1018 HPCI POWER FAIL (BUS B)	1046 HPCI MAN INIT SW ARMED	1049 HPCI INOP SW IN INOP	1016 HPCI STM LINE DIFF P B HI	1033 HPCI TURB OIL FLT DIFF P HI	1056 HPCI INBD WARMUP ISOL NOT FULL OPEN	1032 HPCI VAC TK LEVEL HI	1392 HPCI PUMP SUCTION XFER	1307 MSSSS C/D MAN ISOL SW ARMED
C	1039 HPCI LINE FILL PUMP PRESS LO	1040 HPCI CKT INVERTER POWER FAIL	1021 HPCI TURB EXH DIAPH PRESS A HI	1023 HPCI TURB EXH LINE PRESS HI	1029 HPCI PUMP SUCTION PRESS HI	1035 HPCI TURB OIL TK LEVEL HI/LO	1020 CNDS STOR TK LEVEL LO/LO	1034 HPCI VAC TK LEVEL LO	1125 MSSSS OUTBD SYS INOP SW IN INOP	1321 MSSSS OUTBD SYS DEGRADED
D	1043 HPCI LINE FILL PUMP FLOW HI	1019 HPCI LOGIC IN TEST	1022 HPCI TURB EXH DIAPH PRESS B HI	1030 HPCI TURB EXH VAC BKR NOT FULL OPEN	1024 HPCI PUMP SUCTION PRESS LO	1036 HPCI STM LINE WTR DRN POT LEVEL HI	1366 SUP PL LEVEL LO	1037 HPCI INBD STM ISOL VV NOT FULL OPEN	1183 GROUP I ISOL OR A TRIP	1369 MSSSS OUTBD SYS INOP
E	1027 HPCI TURB BRG OIL PRESS LO	1026 HPCI TURB TRIPPED	1038 HPCI TURB TRIP SOL ENERGIZED	1048 HPCI TURB EXH VV SW IN CLSD POSN	1367 HPCI ISOL RESET SW IN RESET (LOGIC A)	1372 HPCI ISOL RESET SW IN RESET (LOGIC B)	1025 HPCI FLOW LO	1382 SUP PL LEVEL HI	1184 GROUP I ISOL CH A TRIP	1233 SHEAR VV OUTBD SYS ABNORMAL

PNL - 601

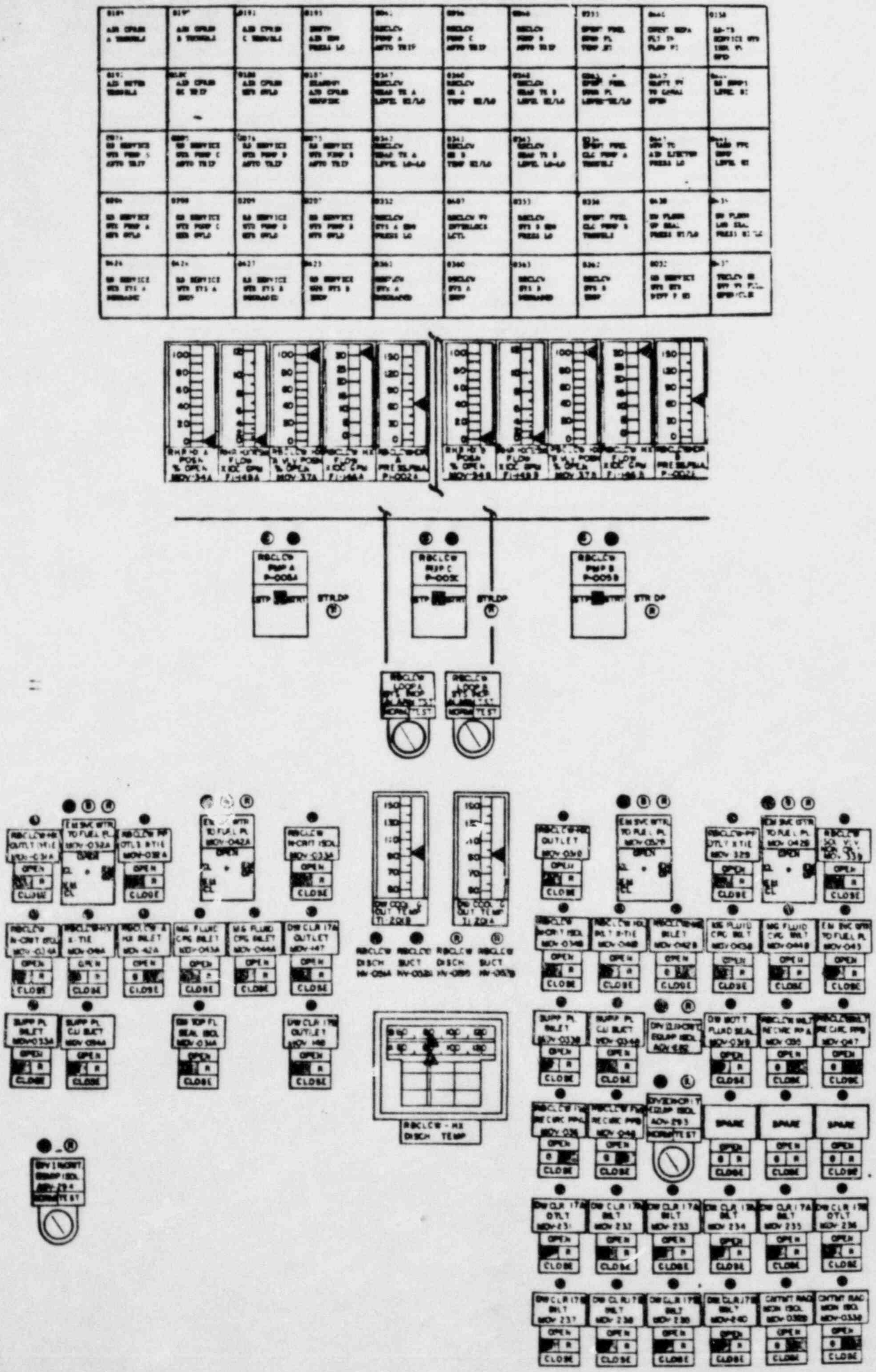
ANNUNCIATOR - A6

	1	2	3	4	5	6	7	8	9	10
A	1067 RCIC ISOL SIGNAL (LOGIC A)	1064 RCIC POWER FAIL (BUS A)	1082 RCIC SYS DEGRADED	1083 RCIC SYS INOP	1063 RCIC STM LINE DIFF P A HI	1377 RCIC STM ISOL VV NOT A HI	1086 RCIC OUTBD WARMUP ISOL VV NOT FULL OPEN	1435 RCIC CST LO LEVEL	1052 RWCU ST CNDCT HI	1059 RWCU OUTBD ISOL HI LEAKAGE
B	1078 RCIC ISOL SIGNAL (LOGIC B)	1077 RCIC POWER FAIL (BUS B)	1093 RCIC MAN INIT SW ARMED	1092 RCIC INOP SW IN INOP	1076 RCIC STM LINE DIFF P B HI	1073 RCIC TURB OIL FLT DIFF P HI	1091 RCIC INBD WARMUP ISOL VV NOT FULL OPEN	1075 RCIC VAC TK LEVEL HI	1056 RWCU SYS FLT DEMIN FAIL	1358 RWCU INBD ISOL HI LEAKAGE
C	1371 RCIC ISOL RESET SW IN RESET (LOGIC B)	1066 RCIC CKT INVERTER POWER FAIL	1080 RCIC TURB EXH DIAPH PRESS A HI	1060 RCIC TURB EXH PRESS HI	1079 RCIC PUMP SUCTION PRESS HI	1072 RCIC TURB BRG TEMP HI	1071 RCIC TURB HI WTR LEVEL TRIP	1074 RCIC VAC TK LEVEL LO	1054 RWCU PUMP TRIP SEAL TEMP HI	1053 RWCU PUMP FLOW LO
D	1330 STM LEAK DIV I LOGIC POWER FAIL	1331 STM LEAK DIV II LOGIC POWER FAIL	1081 RCIC TURB EXH DIAPH PRESS B HI	1089 RCIC TURB EXH VAC BKR VV NOT FULL OPEN	1061 RCIC PUMP SUCTION PRESS LO	1088 RCIC STM LINE WTR DRN POT LEVEL HI	1069 RCIC TURB OIL PRESS LO	1090 RCIC LINE FILL PUMP FLOW HI	1057 RWCU SYS FLT IN TEMP HI	1055 RWCU DISCH PRESS HI/LO
E	1326 STM LEAK LOGIC A IN TEST (RCIC)	1328 STM LEAK LOGIC B IN TEST (RCIC	1084 RCIC VAC PUMP DISCH VV SW IN CLSD POSN	1085 RCIC TURB EXH VV SW IN CLSD POSN	1065 RCIC PUMP SUCTION VV FULL OPEN	1062 RCIC TURB TRIPPED	1068 RCIC FLOW LO	1087 RCIC LINE FILL PUMP FLOW HI	1070 RCIC VAC TK PRESS HI TEMP HI	1378 RCIC ISOL RESET SW IN HI/LO (LOGIC A)

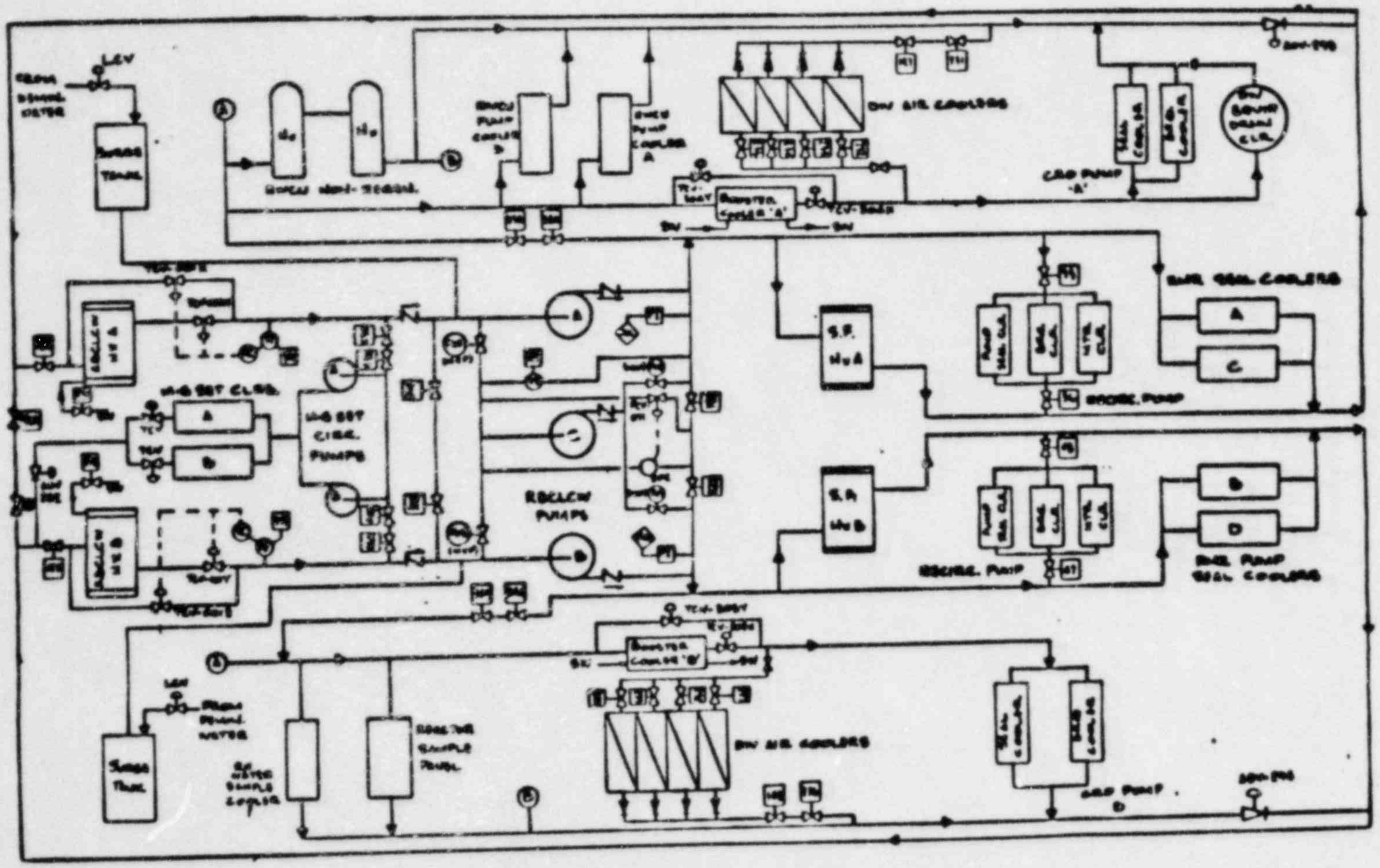
PNL - 602

8. Using the attached diagram which shows the status of the Reactor Building Closed Loop Cooling Water System control room annunciators, controls and indications, identify the condition of the system at the time this "snapshot" was taken. If the system condition indicates that all required automatic actions have <u>not</u> occurred, state the immediate actions required of the operator. (A system diagram is provided to aid you in formulating your answers).

(2.0)



RBCLCW PMP A P-005A
RBCLCW PMP C P-005C
RBCLCW PMP B P-005B
STR DP
RBCLCW-HX DISCH TEMP
SPARE
SPARE
SPARE

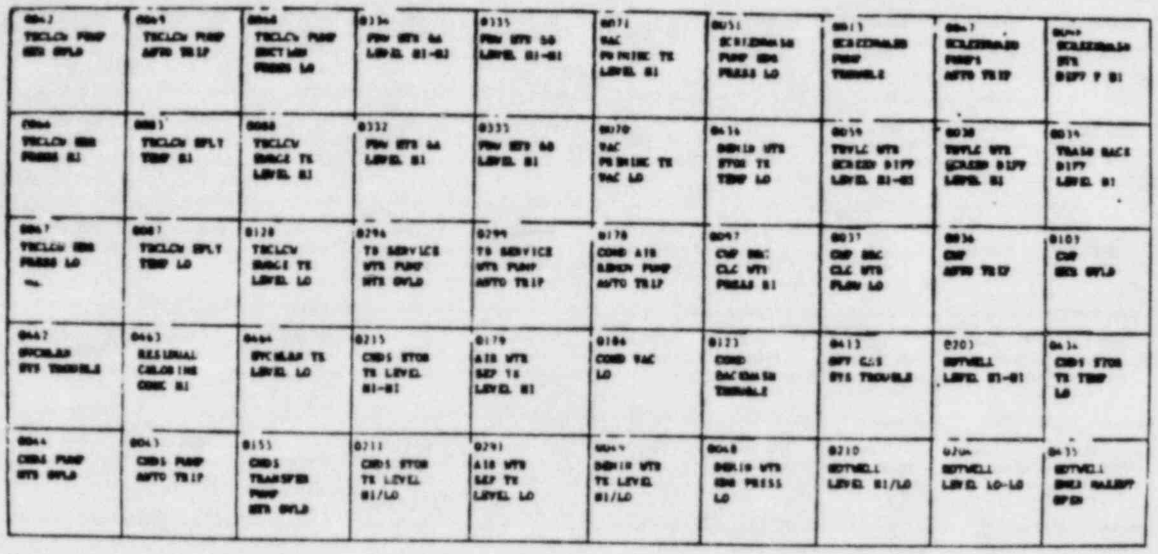


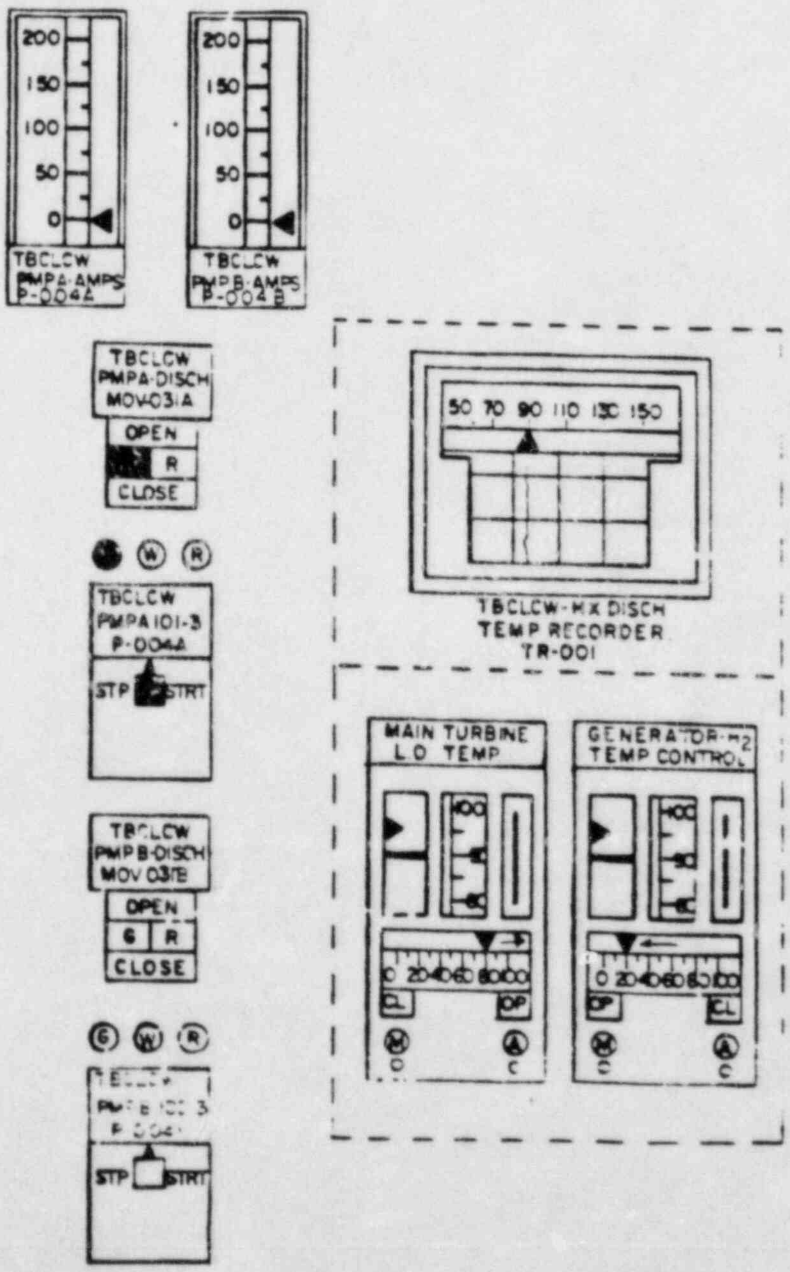
SURGE TANK
DW AIR COOLERS
BOOSTER COOLER 'A'
BOOSTER COOLER 'B'
CRD PUMP 'A'
CRD PUMP D
S.P. HX A
S.P. HX B
RBCLCW PUMPS
M-G SET CLRS.
M-G SET CIRC. PUMPS
RECIRC. PUMP
RHR SEAL COOLERS

SECTION 2 Procedures Normal and Emergency

1. During operation at 75% power the TBCLCW System is aligned in the following manner: Pump A is in service, Pump B is tagged out for maintenance and is expected to be out of service for 4 hours. While operating in this condition, the malfunction indicated on the attached diagram occurs. State the immediate actions to be taken by the operator.

(2.0)

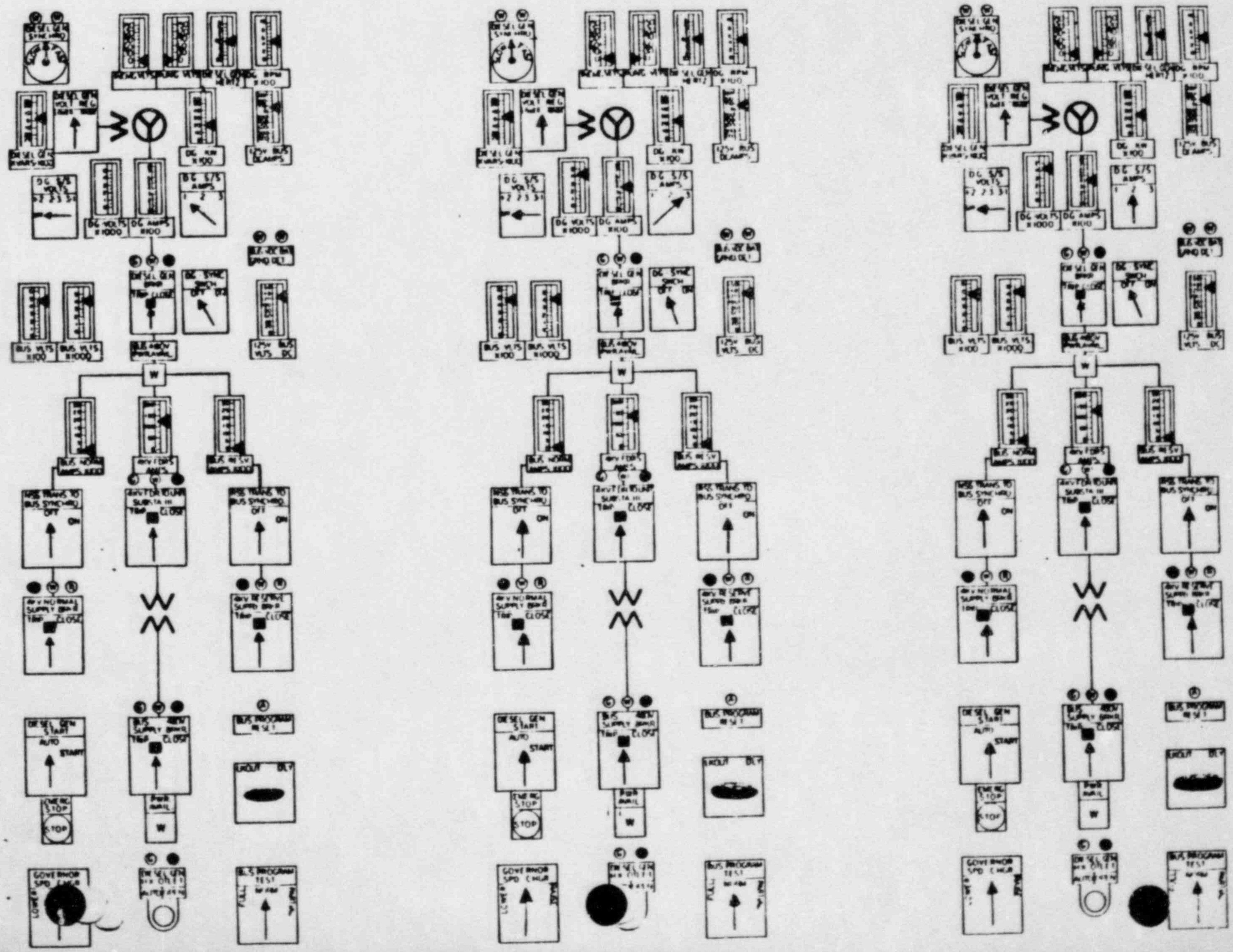


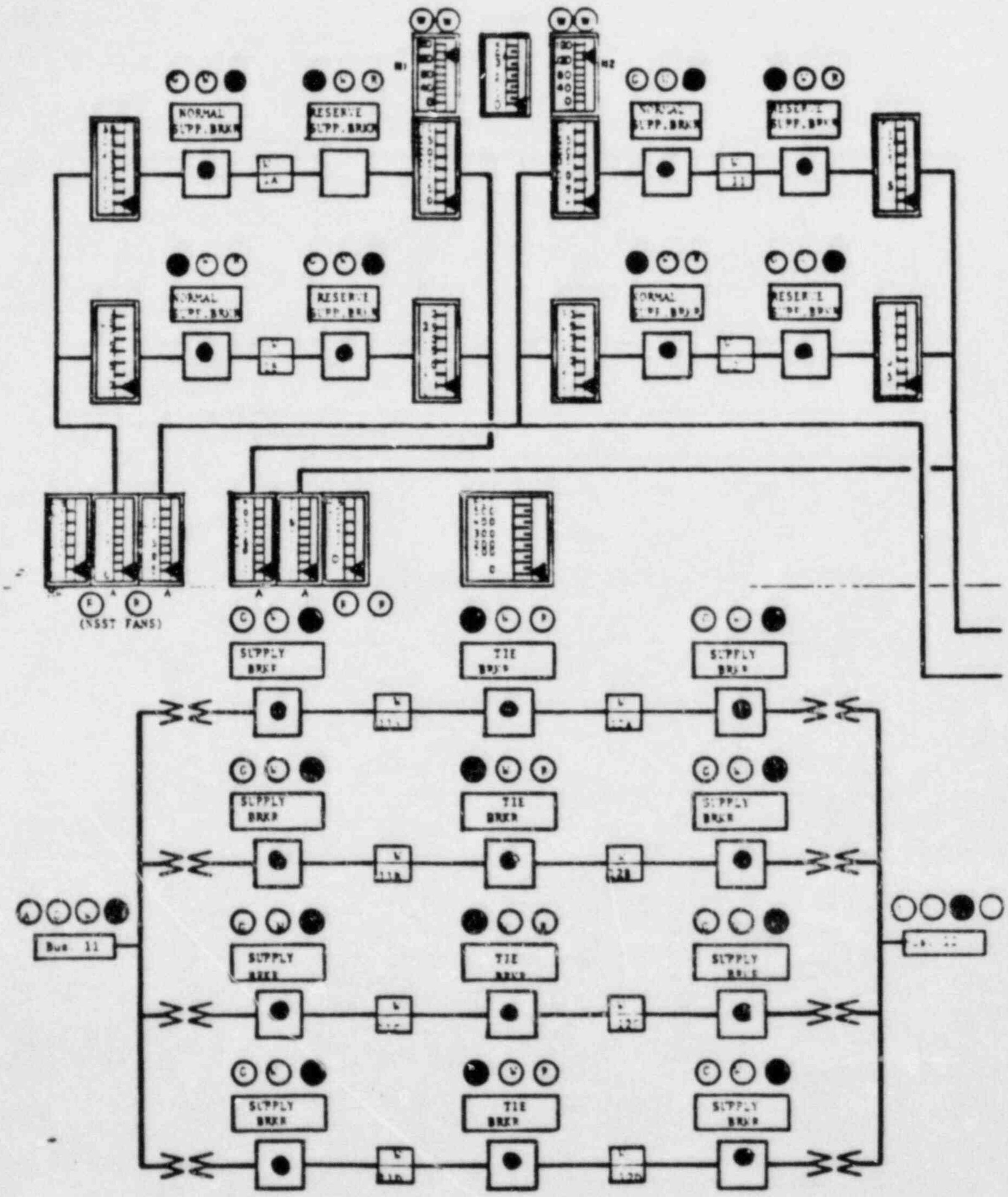


200
150
100
50
0
TBCLCW
PMPA-AMPS
P-004A
200
150
100
50
0
TBCLCW
PMP B-AMPS
P-004B
TBCLCW
PMPA-DISCH
MOV-031A
OPEN
R
CLOSE
W
R
TBCLCW
PMPA 101-3
P-004A
STP
STRT
TBCLCW
PMP B-DISCH
MOV 031B
OPEN
G
R
CLOSE
G
W
R
TB
STP
STRT
50 70 90 110 130 150
TBCLCW-HX DISCH
TEMP RECORDER
TR-001
MAIN TURBINE
L O TEMP
100
80
60
0 20 40 60 80 100
CL
OP
GENERATOR-H2
TEMP CONTROL
100
80
60
0 20 40 60 80 100
OP
CL

2. Using the attached diagrams which show the status of affected controls, indications and alarms in the control room, identify the event and state the required immediate operator actions. This event occurred during operation at 100% power and has been accompanied by a reactor scram and turbine trip. (2.5)

SYS-307


DIESEL GEN START
AUTO
START
EMERG STOP
STOP
GOVERNOR SPD CHGR
BUS PROGRAM TEST
FULL
BUS PROGRAM RESET
LKOUT
DLY
PWR AVAIL
W
OFF
ON
TRIP
CLOSE
DG VOLTS X1000
DG AMPS X100
DG S/S AMPS
DG S/S VOLTS
DG KW X100
DG RPM X100
DIESEL GEN VOLT REG
DIESEL GEN SYNCHRO
DG SYNC SWCH
BUS VLTS X100
BUS VLTS X1000
125V BUS VLTS DC
DIESEL GEN BRKR
BUS TRANS TO BUS SYNCHRO


NORMAL SUPP. BRKR
RESERVE SUPP. BRKR
NORMAL SUPP. BRKR
RESERVE SUPP. BRKR
NORMAL SUPP. BRKR
RESERVE SUPP. BRKR
NORMAL SUPP. BRKR
RESERVE SUPP. BRKR
(NSST FANS)
SUPPLY BRKR
TIE BRKR
SUPPLY BRKR
Bus 11

ANNUNCIATOR - [illegible]

	1	2	3	4	5
A	0371 DIESEL 1 LUBE OIL PRESS LO	0373 DIESEL 1 [illegible] CONTROL DISABLED	0370 DIESEL 1 ENGINE TROUBLE		0200 125V BATT CHGR A1 TROUBLE
B	0349 [illegible] 1 PT BLOWN FUSE	0372 DIESEL 1 ENGINE OVERSPEED	0368 DIESEL 1 SYS DISCHARGED	0369 DIESEL 1 CTS	0317 125V BATT GND
C	0293 [illegible] 1 VOLT REG POWER FAIL	0286 VITAL BUS INV TROUBLE	0287 VITAL BUS INV BATT OPERATION	0288 VITAL BUS INV ALT C OPERATION	0403 125V BUS A1 BKR OC TRIP
D	0107 [illegible] 1 GND OC	0364 BUS 101 SPLY BKR PARALLELED	0077 BUS 101 TRIP CKT [illegible] SPLY BKR LCTL	0269 BUS 101 SPLY BKR PDR LCTL	0062 BUS 101 UV
E	0171 BUS 111 SPLY SYNC GND TRIP	0170 BUS 111 SPLY BKR OC TRIP	0257 BUS 111 SPLY BKR LCTL	0105 BUS 101 SPLY BKR AUTO TRIP	[illegible] BUS 101 PROGRAM LCTL

PNL.- [illegible]

ANNUNCIATOR - [illegible]

	1	2	3	4	5
A	0139 DIESEL 3 LUBE OIL PRESS LO		0138 DIESEL 3 ENGINE TROUBLE	0367 DIESEL 3 CONTROL BY CONTROL DISABLED	0202 125 V BATT CHGR C1 TROUBLE
B	0151 [illegible] 3 PT BLOWN FUSE	0366 DIESEL 3 ENGINE OVER SPEED	0136 DIESEL 3 SYS DISCHARGED	0137 DIESEL 3 SYS [illegible]	0159 125 V BATT C GND
C	0295 [illegible] 3 VOLT REG POWER FAIL	0289 COMPUTER INV TROUBLE	0290 COMPUTER INV BATT OPERATION	0292 COMPUTER INV ALT AC OPERATION	0405 125V BUS C1 BKR OC TRIP
D	0121 [illegible] 3 PCB OC	0146 BUS 103 SPLY BKR PARALLELED	0079 BUS 103 TRIP CKT 3 SPLY BKR LCTL	0251 BUS 103 SPLY BKR PDR LCTL	0064 BUS 103
E	0261 BUS 113 SPLY SYNC GND TRIP	0256 BUS 113 SPLY BKR OC TRIP	0259 BUS 113 SPLY BKR LCTL	0093 BUS 103 SPLY BKR PDR AUTO TRIP	0302 BUS 103 PROGRAM LCTL

PNL.- [illegible]

ANNUNCIATOR - [illegible]

	1	2	3	4	5
A	0377 DIESEL 2 LUBE OIL PRESS LO	0379 DIESEL 2 CONTROL BY CONTROL DISABLED	0376 DIESEL 2 ENGINE TROUBLE		0201 125V BATT CHGR B1 TROUBLE
B	0150 [illegible] 2 PT BLOWN FUSE	0178 DIESEL 2 ENGINE OVER SPEED	0374 DIESEL 2 SYS DISCHARGED	0375 DIESEL 2 SYS [illegible]	0318 125V BATT B GND
C	0294 [illegible] 2 VOLT REG POWER FAIL	0473 [illegible] INV TROUBLE	0474 [illegible] INV BATT/ ALT AC OPERATION	0475 125V CHGR B1 TROUBLE	0404 125V BUS B1 BKR OC TRIP
D	0091 [illegible] 2 [illegible] OC	0145 BUS 102 SPLY BKR PARALLELED	0078 BUS 102 TRIP CKT 2 SPLY BKR LCTL	0250 BUS 102 SPLY BKR PDR LCTL	0063 BUS 102 UV
E	[illegible] BUS 112 SPLY SYNC GND TRIP	[illegible] BUS 112 SPLY BKR OC TRIP	[illegible] BUS 112 SPLY BKR LCTL	[illegible] BUS 102 SPLY BKR PDR AUTO TRIP	[illegible] BUS 102 PROGRAM LCTL

PNL. - [illegible]

ANNUNCIATOR - [illegible]

	1	2	3	4	5	6	7	8	9	10
A	0218 BUS SYNC PRI PROT TRIP	0219 BUS SYNC BACKUP PROT TRIP	0226 BUS SYNC TROUBLE	0227 BUS SYNC TROUBLE	0221 BUS SYNC BACKUP PROT TRIP	0220 BUS SYNC PRI PROT TRIP	0085 4KV BUS BUS UV	0243 4KV BUS [illegible] & BUS PARALLELED	0244 4KV BUS SPLY UV CKT LCTL	0461 REMOTE TRIP-[illegible] [illegible] OPEN
B	0400 SANITARY SEWAGE SUMP LEVEL HI-HI		0222 [illegible] PROT LCTL			0406 BREATHING AIR CO CONTENT HI	0082 4KV BUS SPLY BKR AUTO TRIP	0081 4KV BUS SPLY BKR AUTO TRIP	0084 4KV BUS PDR BKR AUTO TRIP	0130 BUS 11A-12A SPLY-TIE BKR PARALLELED
C	0449 COND [illegible] INF CNDCT HI-HI/HI	0456 COND [illegible] EFL CNDCT HI-HI/HI	0451 COND PUMPS DISCH CNDCT HI- HI/HI	0453 COND TUBE [illegible] CNDCT HI-HI/HI	0455 HOTWELL CNDCT HI-HI/HI	0476 BLACK BATT TROUBLE	0161 480V BUS SPLY BKR OC TRIP	0162 480V BUS SPLY BKR SYNC GND	0163 480V BUS TIE BKR OC TRIP	0131 BUS 11B-12B SPLY-TIE BKR PARALLELED
D	0457 COND [illegible] INF SAMPLE CNDCT HI-HI/HI	0450 COND [illegible] EFL SAMPLE CNDCT HI-HI/HI	0452 COND PUMP DISCH SAMPLE CNDCT HI- HI/HI	0454 COND SAMPLE CNDCT HI-HI/HI	0458 [illegible] SAMPLE PNL TROUBLE	0459 [illegible] SAMPLE PNL TROUBLE	0279 480V BUS SPLY BUS UV	0122 INSTR AIR HDR A PRESS HI/LO	0278 480V BUS SPLY UV CKT LCTL	0164 BUS 11C-12C SPLY-TIE BKR PARALLELED
E	0196 24V BATT CHGR A2-1 TROUBLE	0197 24V BATT CHGR A2-2 TROUBLE	0198 24V BATT CHGR B2-1 TROUBLE	0199 24V BATT CHGR B2-2 TROUBLE	0177 [illegible] PLT PNL TROUBLE	0460 [illegible] SAMPLE PNL TROUBLE	0253 CNDS OXYGEN HI	0254 CNDS OXYGEN [illegible]	0123 INSTR AIR HDR B PRESS HI/LO	0100 BUS 11D-12D SPLY-TIE BKR PARALLELED

PNL. - [illegible]

ALARM CLEARS AFTER
ACKNOWLEGEMENT

3. With the plant operating at 1% power during low power physics testing following initial fuel loading, the Watch Engineer is informed by the System Operator that a severe weather warning has been issued for the Shoreham area. State the required immediate operator actions.

(2.0)

4. Using the appropriate Symptomatic Emergency Procedure(s) list the required operator actions for each event in the following scenario:

Event #1: During plant operation at 100% power a transfer of RBCLCW coolers results in a Division I lo-lo head tank level.

(1.0)

Event #2: After 5 minutes head tank level has not been restored, weighted average drywell temperature has risen to 145°F and is rising at a rate of 1°F/minute. Indicated drywell pressure is 16.1 psia and increasing.

(1.0)

Event #3: After 15 minutes weighted average drywell temperature has risen to 155°F and drywell pressure is 16.3 psia and increasing.

(1.0)

Event #4: After 25 minutes weighted average drywell temperature has risen to 165°F and drywell pressure has risen to 16.4 psia. A reactor scram has occurred and the appropriate isolations for these conditions have occurred.

(1.0)

5. Using the appropriate Symptomatic Emergency Procedure(s), list the required operator actions to be taken following the events listed in the scenario below:

Scenario: With the plant operating at 100% power and HPCI out of service, condensate booster pump "B" trips on motor overload resulting in a trip of both RFPT's on low suction pressure. Within 15 seconds, feedwater flow has decreased to 0 gpm and reactor vessel water level has decreased to -38 inches. In the next 15 seconds, the MSIV's close, Group 1 SRV's open to relieve pressure and then fail to close, and water level decreases to -130 inches.

(4.0)

6. List the plant conditions which require the initiation of Standby Liquid Control. (2.5)

SECTION 3 Administrative Procedures and Technical Specifications

1. With the reactor operating at 45% power following a rod sequence exchange and the completion of control rod scram time testing to satisfy tech spec surveillance 4.1.3.2.c; it is determined that the average scram insertion time to notch 39 of all operable control rods is .87 seconds. Using the Technical specifications, state the actions to be taken with regard to:

   A. Minimum critical power ratio (1.0)

   B. Control rod average scram insertion times (1.0)

   C. Linear heat generation rate (1.0)

2. With the plant operating at 100% power, the oncoming crew arrives for relief of the 4:00-12:00 pm shift crew. The relieving crew complement is the following:

1. WE (SRO licensed)

2. WS - absent

3. NSO - absent

4. NASO (RO licensed)

5. NASO (RO licensed)

6. EO (2)

7. STA (1)

The crew being relieved has the following complement with each just completing a double shift because of a major winter storm:

1. WE (SRO licensed)

2. WS (SRO licensed)

3. NSO (RO licensed)

4. NASO (RO licensed)

5. NASO (RO licensed)

6. EO (2)

7. STA (1)

State the action to be taken to allow continued operation in Condition 1.

(2.5)

2. With the plant operating at 100% power a turbine trip occurs which results in a reactor scram. State the location to which each member of the operating crew reports and list the primary responsibility of each person at that location. (Assume a normal shift complement).

(2.5)

4. The attached TPC is submitted to allow a change to be made to K_f in the process computer calculation of MCPR. The computer engineer requests that the TPC be approved so that the program change can be made during the present shift. State whether this TPC should be approved or disapproved by the SRO on shift and state the reason why is should be approved or disapproved.

(2.0)

TEMPORARY PROCEDURE CHANGE NOTICE

: 6/13/84 — TPC No. XXX (Yr-Seq No.)

..ocedure No. 54 6407 — Rev. 1 — Title THERMAL LIMITS PROCESS COMPUTER EVALUATION

Procedure Section 3.3 — TPC Effective Date 6/13/84

Procedure Page 2 — TPC Expiration Date 7/13/84

Procedure Change:

PAGE 2 ; 3.3 : CHANGE LINE #7 TO READ 107 % INSTEAD OF 105 %

PAGE 6 ; THE K_f VALUES SHALL CORRESPOND TO THE CURVE FOR 107 % SCOOP TUBE CALIBRATION SETTING

PAGE 6	% FLOW	K_f
	90	1.0
	80	1.0
	70	1.0529
	60	1.0971
	50	1.1286
	40	1.1692
	30	1.2159

(Use reverse side if necessary) — Non-ROC

Reason for Change: TO ALLOW K_f USED BY PROCESS COMPUTER TO COMPUTE MCPR TO BE ADJUSTED TO MATCH TECH SPEC CURVE CORRESPONDING TO 107 % SCOOP TUBE POSITION. PRESENTLY THE K_f CORRESPONDS TO A SCOOP TUBE POSITION FOR WHICH THERE IS NO TECH SPEC CURVE (105 %)

Recommended for permanent procedure change Yes No

Tech Spec Evaluation

Does this change, revision, or deletion:

1. Alter the intent of the original procedure? ___ Yes X No
2. Create a condition or conduct an operation which exceeds, or could result in exceeding, the Tech. Spec. Limits? ___ Yes X No

If the answer to either of the above two questions is YES, do not approve the use of this form. An SPCN must be submitted in order to make this procedure change.

Plant Management Staff review and approval J. Alexander RE Date 6/15/84

SRO review and approval ________________ Date ________

Safety Evaluation:

Does this change, revision, or deletion:

1. Change the facility as described in the FSAR? ___ Yes ___ No
2. Change the procedures as described in the FSAR? ___ Yes ___ No
3. Conduct tests/experiments not described in the FSAR? ___ Yes ___ No

If the answer to any of the above three questions is YES, then a Safety Evaluation Checksheet (Appendix 12.1.6) must be used.

ROC Committee Review: Approved-No longer required — Not Approved-Discontinue use — Approved for ________ days. — Approved for procedure revision.

Chief Engineer/ROC Chairman ________________ Date ________ Meeting No. ________

Plant Manager Approval ________________ Date ________

Submitted JKSkalice

Reviewed/QQA Engr. AR Miller

Approved/Plant Mgr. J Ruello

MC-1

SP Number 54.6Ø4.Ø7
Revision 1
Date Eff. 7/8/83
TPC
TPC
TPC

THERMAL LIMITS PROCESS COMPUTER EVALUATION
MAPLHGR, RGAF, MCPR, MLHGR

1.0 PURPOSE

This procedure shall be used to satisfy the Surveillance Requirements of Reference 11.2, 11.4 and 11.6. The process computer method of obtaining the MAPLHR, RGAF, MCPR and MLHGR values is given. The BUCLE of PIB calculational methods (Ref. 11.13 and 11.4) are specified to be used if the Process Computer is unavailable. The MCPR checks required for a change in the status of the Main Turbine Bypass System is also given. <1

2.0 RESPONSIBLITY

The Reactor Engineer shall be responsible for insuring proper implementation of this procedure.

SR2-1021.5ØØ-6.421

3.0 DISCUSSION

The following topics will be discussed in this procedure:

1) MAPLHGR determination
2) RGAF determination
3) MCPR determination
4) MLHGR determination

3.1 The current value of MAPLHGR, Maximum Average Planar Linear Generation Rate, is obtained on the edit of the P-1 Process Computer Program which indicated the MAPLHGR value for the 12 most limiting bundles. It is compared to limiting value obtained in Reference 11.1.

The computer edited quantity of concern is MAPRAT, which is the ratio of a bundle MAPLHGR value to its limiting Average Planar Linear Heat Generation Rate (APLHGR). A MAPRAT value >1.Ø indicates that the MAPLHGR limit has been exceeded.

3.2 The current value of RGAF, Required Gain Adjustment Factor, is obtained on the edit of the P-1 Process Computer Program. It represents the lowest value of the ratio of the Fraction of Rated Thermal Power (FRTP) to the Maximum Fraction of Limiting Power Density (MFLPD). The value of RGAF is used in SP 54.6Ø4.1Ø to determine whether or not the APRM gain and/or the APRM flow biased trip setpoint needs to be adjusted.

3.3 The current value of MCPR, Minimum Critical Power Ratio, is obtained on the edit of the P-1 Process Computer Program which edits the MCPR value for the 12 most limiting fuel bundles. It is compared to the limiting value obtained in Reference 11.5. The computer edited quantity of concern is MRLCPR, which is the ratio of the operating limit CPR to the CPR for a bundle times Kf, a flow adjustment factor. Kf corresponding to Flow Maximum Scoop Tube Setpoint at 105% is used from Figure 3.2.3-2 of Technical Specifications. A MFLCPR value >1.Ø indicates that a limit has been exceeded. 107%

NOTE: If the Main Turbine Bypass System has been declared inoperable, the CPRLIM and MFLCPR values edited by P-1 are not valid until the proper CPR operating limits (CPRLM) are obtained and manually entered into the Process Computer Megastore memory by completion of SPF 54.6Ø4.Ø7-3. After this action, P-1 should be demanded and the correct CPRLIM and MFLCPR values will be edited.

3.4 The current value of MLHGR, Maximum Linear Heat Generation Rate, is obtained on the edit of the P-1 Process Computer Program (edited as (MRPD) which indicates the MLHGR value for the 12 most limiting fuel bundles. It is compared to the limiting value obtained in Reference 11.7. The computer edited quantity of concern is MFLPD, the Maximum Fraction of Limiting Power Density. A MFLPD value >1.Ø indicates that a limit has been exceeded.

3.5 Appendix 12.1 shall be performed whenever Process Computer Data Classes 1, 2 or 3 are changed (which occurs at least at the beginning of each fuel cycle) or when Section 3/4.2 of Technical Specifications is changed. The Appendix is designed to ensure that data pertinent to Thermal Limits calculations is correctly stored in the Process Computer.

4.0 PRECAUTIONS

The Watch Engineer shall be notified immediately whenever a procedural step cannot be completed as stated or if any other problem develops during this test.

5.0 PREREQUISITES

5.1 If this procedure is being used to satisfy the surveillance requirements of Reference 11.2, 11.4 or 11.6, obtain permission in accordance with Reference 11.8 before starting the test. <1

5.2 Verify that the revision numbers on the SPF's being used are current.

5.3 The Process Computer shall be available. If not, Reference 11.13 or 11.14 shall be used at the direction of the Reactor Engineer. <1

5.4 The reactor should be operating at a stable power level during the data taking. The P-1 program requires approximately the first 10 seconds for data acquisition.

6.0 LIMITATIONS AND ACTIONS

6.1 Technical Specification Limit

6.1.1 During power operation (Condition I) the Limiting Conditions for Operations (L.C.O's) of Reference 11.1, 11.3 and 11.5 shall apply. <1

7.0 MATERIALS OR TEST EQUIPMENT

7.1 Process Specifications Limit

8.0 PROCEDURE

8.1 SPF 54.604.07-1 shall be completed for the conditions specified below to verify that certain Process Computer parameters listed in Table 12.1 and specified in Data Classes 1, 2 and 3, agree with Technical Specification Power Distribution Limits contained in Reference 11.1, 11.3 and 11.5. <1

.1 Prior to the start of each new fuel cycle after the New Data Classes 1 thru 3 have been received from the fuel vendor or anytime the parameters listed in Appendix 12.1 are changed.

.2 Whenever Technical Specifications in the above references change regardless of whether new Data Classes were loaded into the Process Computer.

Perform either of the following:

8.2 SPF 54.6Ø4.Ø7-2 shall be completed when performing a Thermal Limits check in compliance with surveillance requirements of reference 11.2, 11.4, 11.6.

8.3 SPF 54.6Ø4.Ø7-3 shall be completed to perform a MCPR check whenever the status of the Main Turbine Bypass Valve System changes (Operable to Inoperable and vice versa) <1

9.0 ACCEPTANCE CRITERIA

9.1 The Average Planar Linear Heat Generation Rates (APLHGRs) shall be within the limits specified in Reference 11.1.

9.2 The Minimum Critical Power Ratio (MCPR) shall be within the limits specified in Reference 11.3.

9.3 The Linear Heat Generation Rate (LHGR) shall be within the limits specified in Reference 11.5.

10.0 FINAL CONDITIONS

10.1 If the LCO's specified in Reference 11.1, 11.3, or 11.5 cannot be met, the action specififed therein shall be taken.

10.2 Upon completion, forward the completed forms in accordance with Reference 11.8.

11.0 REFERENCE

11.1 Technical Specifications, Section 3.2.1
11.2 Technical Specifications, Section 4.2.1
11.3 Technical Specifications, Section 3.2.3
11.4 Technical Specifications, Section 4.2.3
11.5 Technical Specifications, Section 3.2.4
11.6 Technical Specifications, Section 4.2.4
11.7 SP 54.6Ø4.1Ø, ARPM GAF and Trip Setpoint Determination
11.8 SP 12.Ø16.Ø1, Surveillance Program
11.9 Technical Specifications, Figure 3.2.3-1
11.10 Technical Specifications, Figure 3.2.3-2
11.11 SP 51.651.Ø4, Process Computer Program Changes
11.12 SP 54.1Ø6.Ø1, Scram Time Testing
11.13 SP 56.6Ø3.Ø3, LPRM GAF, MAPLHGR, MLHGR, MTPF and MCPR Determs-BUCLE <1
11.14 SP 54.6Ø4.Ø1, PI Manual Backup

12.0 APPENDICES

12.1 SPF 54.6Ø4.Ø7-1, Process Computer Thermal Limits Data Check

12.2 SPF 54.6Ø4.Ø7-2, Thermal Limits Check Data Sheet

12.3 SPF 54.6Ø4.Ø7-3, MCPR Check Data Sheet (Main Turbine Bypass System Status Change)

PROCESS COMPUTER THERMAL LIMITS DATA CHECK

This Appendix is designed to ensure that data pertinent to Thermal Limits Calculations listed in Table 12.1 is correctly stored in the Process Computer Data Classes 1, 2 and 3. This Appendix shall be performed whenever Data Classes 1, 2 and 3 are changed (which occurs at least at the beginning of each fuel cycle) or when Section 3/4.2 of Technical Specifications is changed. Computer values shall be obtained from Section 8.1.4.8 of the Reactor Engineer's Data Book which lists the Process Computer parameters alphabetically.

If the right hand column below reads "NO" for any parameter, the correct value for that parameter shall be inserted into the Computer Megastore Memory in accordance with SP 51.651.Ø4. Data Classes, Megastore Addresses, and the appropriate Memory Change Program to use are provided in Table 12.1

1. MCPR Data

Parameter	Tech. Spec. Value (1)	Computer Value	Exact Agreement (Yes or No)
CPRLM	1.23		
CPRLM	1.23		
CPRLM	1.23		
CPRLM	N/A		
CPRLM	N/A		
CPRLM	N/A		
CPRLM	N/A		
WTR	77.0 Mlb/hr		

The K_f values shall correspond to the curve for 105% 107% Scoop Tube Calibration Setting (2).

%FLOW [FRW]	Kf	EKFLO (3)	Agreement <1% Yes or No
90	1.Ø		
80	1.Ø		
70	~~1.Ø44~~ 10529		
60	~~1.Ø86~~ 10941		
50	~~1.121~~ 1288		
40	~~1.161~~ 11642		
30	~~1.2Ø4~~ 12154		

SPF 54.6Ø4.Ø7-1, Rev. Ø

(1) CPRLM Technical Specifications value obtained from Figure 3.2.3-1 with τ = 1.0 and with Main Turbine Bypass System operable.

(2) Kf Technical Specifications values obtained from Figure 3.2.3-2 via linear interpolation between the 102.5% and 107% Scoop Tube Setpoints.

(3) EKFLO values should be obtained from Table 12.2. The equations therein are taken from the FORTRAN listing of Process Computer Program, P1-3, Segment 4, Section K. If EKFLO does not agree with Kf values, the CP (XX,X) values stored in Data Class 3 are probably incorrect.

2. MLHGR Data

Parameter	Tech. Spec. Value	Computer Value	Exact Agreement (Yes or No)
PLIM	13.4 kw/ft		
PLIM	13.4 kw/ft		
PLIM	13.4 kw/ft		
PLIM	N/A		
PLIM	N/A		
PLIM	N/A		
PLIM	N/A		

3. MALPHGR Data

NIT =Number of fuel types ________ NITMAX =Max Number of NITs =_____

NLQ =Number of Exposure/APLHGR pairs for each fuel type =_________

Value of MAPLHGR (kw/ft) for each fuel type * (NIT)

ELQ (MWD/STU) (Nodal Exposure)	1		2		3		4		5		6		7	
	T.S.	FLQ	TS.S	FLQ	T.S.	FLQ	T.S.	FLQ	T.S.	FLQ	T.S.	FLQ	T.S	FLQ
0	11.8		11.8		11.5		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,000	11.8		11.9		11.4		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5,000	12.0		12.0		11.4		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10,000	11.9		12.0		11.5		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15,000	11.9		12.0		11.5		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20,000	11.8		11.9		11.0		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25,000	11.6		11.7		10.4		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30,000	11.2		10.8		9.7		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A														
N/A														

T.S. =Technical Specification value given in Technical Specifications, Section 3.2.1
Computer value obtained from Reactor Engineer's Data Book, Section 8.1.4.8

SPF 54.604.07-1, Rev. 0

*Fuel types designated as follows:

1. 8CR233 (initial core, high power)
2. 8CR183 (initial core, low power)
3. 8CR711 (initial core, natural)
4. ________
5. ________
6. ________
7. ________

4. MISCELLANEOUS Data

Parameter	Tech. Spec. Value	Computer Value	Exact Agreement (Yes or No)
RATCTP	2436 Mwt		
REFCTP	2436 Mwt		
REFRAP (APRMA)	100.0		
REFRAP (APRMC)	100.0		
REFRAP (APRME)	100.0		
REFRAP (ARPMB)	100.0		
REFRAP (ARPMD)	100.0		
REFRAP (ARPMF)	100.0		

SPF 54.604.07-1, Rev. 0

TABLE 12.1

Parameter	Program	Class	Address	Length	Pin
CP(25,1)	F	3	3Ø2273	1	2A
CP(26,1)	F	3	3Ø2274	1	2A
CP(25,2)	F	3	3Ø2331	1	2A
CP(26,2)	F	3	3Ø2332	1	2A
CPRLM	F	3	3Ø6673	3	2A
ELQ	F	3	3Ø2351	30	2A
FLQ	F	3	3Ø2457	30	2A
NIT	D	1	233257	1	1T
NITMAX	D	3	277514	1	1X
NLQ	D	3	3Ø235Ø	1	2A
PLIM	F	2	252223	3	1V
RATCTP	F	1	233213	1	1T
REFCTP	F	3	2556ØØ	1	1V
REFRAP	F	3	2556Ø1	6	1V
WTR	F	2	24Ø7ØØ	1	1U

Use DMCHG program to change Computer Megastore Memory
F Mode 2
D Mode Ø, Scale 23

TABLE 12.2

EkFLO Values

EkFLO value is computed by Process Computer Program P1-3. Equations are clarified in the software of Program P1-3, Segment 4.

EkFLO = MAX (1.0, FL 1, FL 2)

FL 1 = 1.0 + CP(25,1) [CP(25,2) - FRW]

FL 2 = 1.0 + CP(26,1) [CP(26,2) - FRW]

NOTE: 1) If CP(25,1) and CP(25,2) are each equal to 0.0 and CP(26,1) and CP(26,2) are not equal to 0.0, then EkFLO will equal MAX (1.0, FL 2).

2) If CP(26,1) and CP(26,2) are each equal to 0.0 and CP(25,1) and CP(25,2) are not equal to 0.0, then EkFLO will equal MAX (1.0, FL 1).

EXAMPLE: For the beginning of the 1st fuel cycle at Shoreham, the following points were obtained for 107% flow max scoop tube setpoint.

	4010 Data Book Value
CP(25,1)	0.0
CP(25,2)	0.0
CP(26,1)	0.441
CP(26,2)	0.800

% Rated Flow (FRW)	Kf Tech Spec	EkFLO (4010)	Δ (T.S-4010)	(%) TS-4010
>0.80	1.0	1.0	0.0	
0.70	1.0529	1.0441	0.0088	0.84
0.60	1.0941	1.0882	0.0059	0.54
0.50	1.1288	1.1323	-0.0035	-0.31
0.40	1.1692	1.1764	-0.0072	-0.62
0.30	1.2154	1.2205	-0.0051	-0.42

4010 is within ± 1% of the Technical Specification Value, ie.

EkELO ± 0.01 = K_f (TS)

THERMAL LIMITS CHECK DATA SHEET

	Signature	Time	Date
Initiated by	________	________	________
Completed by	________	________	________
Reviewed by	________	________	________

Step	Procedure	Initials
1.	Verify the prerequisites have been met.	________
2.	Indicate below the method used to compute the RGAF, MFLCPR, MFLPD and MAPRAT values. Process Computer _____ BUCLE _____ PIB _____ NOTE: Proceed to step 4 if BUCLE or PIB is used.	________
3.	Demand P1 (Function 20, Operator Computer Console) and obtain the edit.	________
4.	Record the RGAF value below. This value shall be used in SP 54.6Ø4.1Ø (APRM GAF and Trip Setpoint Determination) immediately upon completion of this procedure. RGAF = ________ NOTE: P1 calculates and edits (lower right hand side, page 1) the RGAF value.	________
5.	Record the maximum MFLCPR, MFLPD and MAPRAT values and respective locations below: Highest MFLCPR value ________ Location ___-___ (MCPR) Highest MFLPD value ________ Location ___--___ (MRPD) Highest MAPRAT value ________ Location ___--___ (MAPLHGR) NOTE: P1 edits the maximum values and locations on Page 1 under the "THE 12 MOST LIMITING BUNDLES" section.	________

<1

SPF 54.6Ø4.Ø7-2, Rev. 1

6. Verify that the values of MFLCPR, MFLPD, and MAPRAT are each ≤ 1.0. <1

NOTE: If either of the thermal limits, MAPRAT, MFLCPR or MFLPD, are > 1.0 then the L.C.O's of Reference 11.1, 11.3 or 11.5 apply and the Watch Engineer shall be notified.

7. Take the value of RGAF obtained in Step 3 above and use it to perform SP 54.604.10 (APRM GAF and Trip Setpoint Determination).
1

8. Attach the P-1 on BUCLE edit or PIB calculations to this procedure and forward it to the Reactor Engineer.

SPF 54.604.07-2, Rev. 1

MINIMUM CRITICAL POWER RATIO CHECK DATA SHEET
(MAIN TURBINE BYPASS SYSTEM STATUS CHANGE)

	Signature	Time	Date
Initiated by	______________	______	_______
Completed by	______________	______	_______
Reviewed by	______________	______	_______

Step	Procedure	Initials
1.	Main Turbine Bypass System status has been changed to: OPERABLE ________ INOPERABLE ________	_______
2.	Go to Section 8.1.4.22 of the Reactor Engineer's Data Book and record the current MCPR operating limit for the status (OP/INOP) indicated in step 1 above. MCPR operating limit (CPRLM) = ________	_______
3.	Load this new value of the MCPR limit (CPRLM) onto the computer Megastore memory using DMCHG (MODE=2) in accordance with SP 51.651.04.	_______
	NOTE: 1. Pull drum memory protection pin 2A and change values in drum addresses 306673B, 306674B, 306675B. Be sure to replace pin after changing memory. 2. Go to step 5 if the Processor Computer is unavailable.	
4.	Run P1 and obtain the edit. Verify that MFLCPR $\leq$1.0	_______
	NOTE: If the value of MELCPR >1.0, then the LCO of Reference 11.3 applies and the Watch Engineer shall be notified.	
5.	Load the new MCPR Limit (step 2) into the BUCLE Data base.	_______
	NOTE: 1. If a MFLCPR value was succesly obtained in step 4, go directly to step 9 after completing step 5. 2. Go to step 8 if BUCLE and the 4010 is unavailable, otherwise go to step 9.	

<1

SPF 54.604.07-3, Rev. 1

6. Run a P1[1] on BUCLE and obtain the edit. Verify that MFLCPR ≤ 1.0 ______ <1

<u>NOTE</u>: If the value of MFLCPR >1.0, then the LCO of Reference 11.3 applies and the Watch Engineer shall be notified.

7. Go to step 9 ______

8. Perform a PI calculation via P1B (Reference 11.14). Verify that MFLCPR $\leq$ 1.0 ______

<u>NOTE</u>: If the value of MFLCPR > 1.0, then the LCO of Reference 11.3 applies and the Watch Engineer shall be notified.

9. Attach the P-1 and BUCLE edits on the P1B[1] calculations and forward to the Reactor Engineer. ______

<u>NOTE</u>: 1. Attach SPF 51.651.04-1 documenting the memory change of step 3, if performed at this time; otherwise update the 4010 as soon as the 4010 is available.

2. Update BUCLE as soon as it is available, if step 5 was not performed at this time.

SPF 54.604.07-3, Rev. 1

5. With the plant operating in Cond.tion 3, a 1 hour load test of EDG 103 is in progress (EDG paralleled with NSST and loaded to 3500 KW). Upon completion of the test, the NASO in error opens the EDG 103 breaker without first unloading the diesel generator. Bus 103 voltage is maintained at 4160 volts by the NSST but EDG 103 trips on overspeed. Using the Technical Specifications state any actions which must be taken following this event.

(2.0)

6. During operation in Condition 1, the Equipment Operator reports from elevation 8' in the Reactor Building that a standpipe and float assembly used to measure water level on that elevation has been damaged. The standpipe has been bent near its base and the float is jammed below the bend. The EO also reports that the other standpipe and float assembly on this elevation appears to be in good working order. Using the Technical Specifications, state any actions which must be taken based on these conditions.

(2.0)

7. With the plant in Condition 3, the "FULL IN" position indicator for control rod 22-03 deenergizes. The indicator lamps are replaced but the position indicator fails to illuminate. Using the Technical Specifications, state the actions to be taken.

(2.0)

8. Using the Technical Specifications, list all required actions for the scenario below. Assume that plant conditions change as necessary to comply with the Technical Specifications.

Initial Conditions (2/1/84 at 3:30 PM)

- Reactor operating at 35% power; withdrawing control rods to 100% rod pattern. Startup was commenced from a refuel outage at 10 AM on 1/31/84.

Scenario

2/1/84 at 4:15 PM - With all the condensate demineralizers in operation, the "D" cond demin outlet conductivity monitor suddenly pegs upscale. A chemistry sample on the outlet of the bed indicate all chemistry in spec.

(0.5)

2/1/84 at 6:00 PM - While reviewing the results of the MSIV surveillances performed during the recent outage, the Operating Engineer notes the "A" MSIV inboard valve closure time 5.8 seconds.

(0.5)

2/2/84 at 3:00 AM - The conductivity monitor at the combined condensate demineralizer outlet reads 0 umho/cm. A sample at this point reveals actual conductivity is 0.06 umho/cm.

(0.5)

2/2/84 at 10:00 AM - While performing a surveillance on the EOC RPT system, it is noted that the low pressure EHC trip from the turbine control valves will not send a trip signal to the "A" RPT circuit.

(0.5)