NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS

LESSON PLAN

REACTOR RECIRCULATION SYSTEM

02-REQ-001-202-2-01-4

Prepared By: Nine Mile Point Unit 2
Operations Training Staff

APPROVALS	SIGNATURES	DATE AND INITIALS REVISION 4
Training Supervisor Unit #2 G. Weimer		4/28/88
Asst. Superintendent Training-Nuclear R.T. Seifried	R. T. Seifried	4/29/88
Operations Superintendent Unit #2 R. Smith		4/29/88

Summary of Pages

Revision: 4 (Effective Date: 4/29/88)

Number of Pages: 21

Date	Pages
September 1986	1 - 20
March 1988	1 - 20

NIAGARA MOHAWK POWER CORPORATION

26pp.
5/4/25

ATTACHMENT 6
LESSON PLAN TEMPORARY/PUBLICATION/ADDENDUM CHANGE FORM

The attached change was made to:

Lesson plan title: Reactor Recirculation

Lesson plan number: OJ-REQ-001-202-2-01

Name of instructor initiating change: Pat Walsh

Reason for the change: Add Obj 8-16 → This incorporates OP.-101D to the Procedure Review

Type of change:

1. Temporary change ____
2. Publication change X
3. Addendum change ____

Disposition:

X 1. Incorporate this change during the next scheduled revision.

____ 2. Begin revising the lesson plan immediately. Supervisor initiate the process.

____ 3. To be used one time only.

Approvals:

Instructor: P. Walsh /Date 5/9/91

Training Area Supervisor (or designee): /Date 5/9/91

Attachment "A"

OBJECTIVE APPROVAL

Author: J. Kaminski

Training Dept: U-2 OP's

Lesson Title: Reactor Recirculation System

Lesson Plan #: 8

Training Setting(s): Classroom

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

Trainee Job Title: RO/SRO Candidates

Approvals/Review	Signatures	Date
Training Supervisor		3/7/88
Plant Supervisor		4/29/88
Training Analysts Supervisor		4-27-88

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

I. TRAINING DESCRIPTION

A. Title: Reactor Recirculation System

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

C. Total Time: Approximately 4 hours

D. Training Methods:

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

E. References:

1. Technical Specifications
   a. 3.4.1.1 Recirculation Loops
   b. 3.4.1.2 Set Pumps
   c. 3.4.1.3 Recirculation Loop Flow
   d. 3.4.1.4 Idle Recirculation Loop Startup
   e. 3.3.4.1 ATWS Recirculation Pump Trip System Instrumentation
   f. 3.3.4.2 End of Cycle Recirculation Pump Trip System Instrumentation
2. Procedures
   a. N2-OP-29 Recirculation System
   b. N2-OP-101A Plant Startup
   c. N2-OP-101C Plant Shutdown
3. NMP-2 FSAR
   a. Design Basis Vol. 13 Chapter 5

II. REQUIREMENTS/PREREQUISITES

A. Requirements for Class:

1. AP-9, Rev. 2 Administration of Training
2. NTP- 10, Rev. 3 Training of Licensed Operator Candidates
3. NTP-11, Rev. 4 Licensed Operator Retraining and Continued Training
4. NTP-12, Rev. 2 Unlicensed Operator Training

B. Prerequisites:

1. Instructor

   a. Demonstrated knowledge and skills in the subject, at or above the level to be achieved by the trainees, as evidenced by previous training or education, or

   b. SRO license for Nine Mile Point Unit II, or a similar plant, or successful completion of SRO training including simulator certification at the SRO level for Nine Mile Point Unit II, and

   c. Qualified in instructional skills as certified by the Training Analyst Supervisor.

2. Students

   a. Meet eligibility requirements per 10CFR55, or

   b. Be recommended for this training by Operations Superintendent, his designee, or Training Superintendent.

III. TRAINING MATERIALS

A. Instructor Materials

1. Transparency Package
2. Overhead Projector
3. Whiteboard and Felt Tip Markers
4. N2-OLP-8
5. N2-OLT-8
6. See Section I.E.1
7. See Section I.E.2

B. Student Materials

1. N2-OLT-8
2. See Section I.E.1
3. See Section I.E.2

IV. EXAMINATIONS/QUIZZES AND ANSWER KEYS

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

V. OBJECTIVES

8-1 State the two purposes of the Reactor Recirculation System (RRS).

8-2 Given a drawing of the Reactor Recirculation System, locate and state the purpose of the following components.

a. RRS Suction Valve
b. RRS Pumps
c. RRS Discharge Valve
d. RRS Flow Elbow
e. RRS Flow Control Valve

8-3 Describe how Net Positive Suction Head is provided to the RRS pumps in low and high speed operation.

8-4 Describe the RRS pump seals with respect to the purpose of the following components:

a. Seal cavities
b. Seal staging flow
c. Seal water source
d. Throttle/breakdown bushing
e. Types of seal failures
f. Indications of seal failures

8-5 Given a drawing of the RRS pump power supply network, label each breaker and state the switchgear designation associated with each.

8-6 Explain why the RRS pumps are always started on the high speed power source versus being started on the Low Frequency Motor Generator.

8-7 Explain the reason for utilizing jet pump risers, and jet pumps in Boiling Water Reactors.

8-8 Given N2-OP-29, Reactor Recirculation System, use the procedure to identify appropriate actions and/or locate information related to:

a. Startup
b. Normal Operation
c. Shutdown
d. Off-Normal Operations
e. Procedures for correcting alarm conditions

8-9 List the seven permissives which must be met in any (high or low speed) start sequence and explain the basis of each.

8-10 State the three thermal limits including setpoints associated with starting a RRS pump.

8-11 List the three basic steps of the sequence for a low speed start of the RRS pumps.

8-12 List the five signals including setpoints that cause an automatic high to low speed transfer.

8-13 List the seven signals that cause an automatic trip of the RRS pump from high speed to zero speed.

8-14 List the ten signals that cause an automatic trip of the RRS pump from low speed to zero speed.

8-15 (SRO ONLY) Given Technical Specifications, identify the appropriate actions and/or locate information relating to limiting conditions for operation, bases, and surveillance requirements for the Reactor Recirculation System.

RW | 8-16 Given N2-OP-101D and a sudden decrease in core flow, describe all actions required for a reactor recirc pump trip.

VI. LESSON CONTENT

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
I. INTRODUCTION			
A. Student Learning Objectives	i,ii		
B. System Purpose	1		1
1. Provides forced circulation of water through the reactor core.			
2. In conjunction with the Reactor Recirculation Flow Control (RRFC) System, provides a means of controlling reactor power over a limited range without adjusting control rods.			
C. General Description	1,2	1,2	
1. The RRS consists of two parallel loops each containing:			
a. 10 jet pumps (internal to vessel)			
b. one recirculation pump			
c. one flow control valve			
d. one suction and one discharge stop valve			
e. instrumentation			
f. connections to vessel			
2. Recirculated water consists of saturated water returning from steam separators and dryers which is then subcooled by incoming feedwater.			
3. Portion of this coolant is drawn into recirculation pump suction piping which penetrates vessel downcomer annulus.			
a. Coolant passes through pump suction valves, the pumps,			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
the flow control valves, pump discharge valves, and into jet pump supply header.			
b. Flow passes through multiple (5 per loop) nozzles on vessel shell which then connects the flow (driving flow) to jet pump nozzles (10 per loop)			
c. Driving flow passes through jet pumps entraining water (driven flow) from downcomer region of the vessel.			
d. The combined flow (driven and driving) is discharged through jet pump diffusers to core inlet pleuum.			
4. Sum of all jet pump flow (20 total) is called core flow			
a. 90% enters fuel bundles			
b. 10% is designed bypass flow to cool incore components.			
II. DETAILED DESCRIPTION	2	2	
A. Recirculation Loop Suction			
1. Suction taken from the reactor downcomer annulus.			
2. Flow sensing elbow used to measure recirculation loop flow.			2d
3. WCS inlet comes from a line off each recirculation loop suction.			
4. "A" recirculation loop suction has an additional penetration that is not present on the "B" loop.	2		
a. This penetration provides for the suction to shutdown cooling mode of RHS.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
5. RRS pump differential pressure transmitter taps are located on the suction and discharge of the RRS pump.			
6. Suction Isolation Valve (MOV-10A/B)			
a. Motor operated, double disk, gate valves.			
b. Remote operated from the control room on panel P602.			
c. Used to isolate recirc pump suction.			2a
B. Reactor Recirculation Pumps	2	3,4	
1. RRS pumps are single-stage, centrifugal pumps used to provide the "driven" portion of core flow.			
2. Motors are energized from 60 Hz, 13.8 Kv electrical buses for 100% rated speed.			2b
3. For reactor startup or low power operations the motors are energized from 15Hz, LFMG sets for 25% rated speed.			
4. Rated flow 47,200 gpm at a discharge pressure head of 805 ft.			
5. Net Positive Suction Head	3		3
a. Low speed NPSH is from the height of water in the reactor vessel.			
b. High speed NPSH is mostly provided by the subcooling effect of incoming feedwater flow with remainder provided by height of water.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
C. Reactor Recirculation Pump Shaft Seals	3	4,5,6	4
1. Dual mechanical shaft seal.			
2. Can be replaced without removing the motor from the pump.			
3. Each seal is designed for full pump pressure.			
4. Breakdown bushing reduces leakage to approx. 50 gpm in the event of gross failure of both shaft seals.	3		4d
5. Seal purge flow of 3 to 5 gpm from the CRDH system keeps the seal clean and cool.			4c
a. 1 gpm as staging flow through seal no. 1.			4b
b. Remainder flows around shaft and throttle bushing into impeller cavity.			
6. Cooling of the pump seal cavity is provided by the Reactor Building Closed Loop Cooling Water through a cooling jacket around the seal assembly.	3	4	
7. Each seal provides about 500 psid across its surface; staging flow allows the second seal to provide some of the sealing load (equal pressure drop across each seal).			4a
8. Detecting a seal failure (inner, outer or both, use Fig. 6 and explain)		6	4e 4f
D. Reactor Recirculation Pump Motor	4		2b
1. Three-phase, induction motor-capable of 100 and 25 percent rated speed.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
2. Kingsbury thrust bearings and radial bearings are lubricated from oil reservoirs in the motor. Levels are monitored by level switches. Oil coolers cooled by CCP.			
3. Air-water heat exchanger cools the motor windings. CCP provides the coolant flow through the heat exchanger cooling coils.			
4. Slow coastdown time aids in core cooling during a loss of electrical power transient.			
E. Recirculation Pump Speed Control	4	7	5
1. Breaker arrangement determines pump speed.			
2. 5 breakers			
a. CB-1 supplies power to the LFMG set drive motor			
b. CB-2 connects the LFMG set generator output to the RRS pump motor.			
c. CB-3, CB-4, and CB-5 supply the 60 Hz power to the pump motor.			
3. All breakers are interlocked to prevent paralleling both power sources to the pump simultaneously.	4	7	
4. Pump is always started at high speed because the LFMG cannot supply the breakaway torque required.	5		6

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
5. Logic controls sequencing of breakers			
a. High speed - Pump accelerates to 100% speed and remains there.			
b. Slow speed - Pump accelerates to 95% speed then downshifts to slow speed.			
F. LFMG Set	5		
1. LFMG sets are driven by 400 hp induction motors powered by 4.16 Kv buses.			
a. Externally excited			
b. Generator output voltage is maintained by voltage regulators that vary the field current to the exciter.			
2. Bearings lubricated by individual internal oil reservoir.			
G. Recirc Flow Control Valve (HYV 17A/B)			
1. 24 inch, electrohydraulic operated.			2e
2. Provides linear flow response throughout its entire stroke.			
3. Positioned by an independent Hydraulic Control Unit (HCU).			
4. FCV fails "as is" on loss of power or control signal.	6		
H. Discharge Isolation Valve (MOV-18A/B)			
1. Motor operated, double disc, gate valves,			
2. Remotely operated from control room panel 602,			
3. Open against RCS pump shutoff head.			
4. Used to isolate the pump discharge from the Rx vessel.			2c

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
I. Reactor Water Sample Connection			
1. Samples taken from the "A" recirculation loop - used when WCS out of service.			
2. Sample station located outside the drywell.			
J. Reactor Recirculation Loop Discharge	6		
1. Each pump discharges to a semi-circular distribution manifold.			
a. Feeds 5 vertical risers			
b. Each riser feeds two jet pumps			
2. Located in annular region to minimize flux exposure to the nozzles and welds.			7
3. Contains RHS Shutdown Cooling return line (each loop).			
4. "A" loop contains sample line.			
5. Jet pumps utilized to minimize the pump and piping size requirements.			7
K. Reactor Vessel Bottom Head Drain	7		
1. Connects to the Reactor Water Cleanup System.			
2. Temperature sensors provide indication and inputs to RRS pump interlocks.			
III. INSTRUMENTATION, CONTROL AND INTERLOCKS	7		
A. Instrumentation			
1. Flow			
a. Detected by flow elbow on each pump suction line.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
b. Flow elbow signal sent to four flow drawers to be used by Nuclear Instruments, Rod Block Monitor, and Process Computer.			
c. Indication on Panel 602 from Flow Drawer "A".			
2. Pressure			
a. Pump seals and D/P are indicated on Panel 602.			
B. Controls	7		
1. Panel 602 Control Switches are:			
a. Pump suction/discharge valves			
b. CB 1-5			
c. Loop Flow Control Valves			
C. RRS Pump Start Sequence Interlocks	8		9
1. The following permissives must be met before any start sequence will initiate.			
a. Incomplete start sequence relay not actuated.			
b. CB-5 breaker fully inserted in switchgear			
c. FCV in Manual mode.			
d. FCV at minimum position			
e. Pump suction valve greater than 90% open			
f. Pump discharge valve greater than 90% open			
g. Vessel thermal shock interlocks satisfied			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
2. Incomplete start sequence relays activate:			
a. On a low speed start if pump is not operating between 20-26% speed with CB-2 closed after 40 sec.			
c. On a high speed start if the pump is not at 100% speed after 40 sec.			9
d. Loss of 125 VDC logic power during any start sequence will immediately initiate the incomplete sequence.			
e. Incomplete sequence relay trips CB-1 and CB-5.	8		
f. Incomplete start sequence seal-in is reset by taking respective high speed control switch to pull-to-lock.			
3. FCV is in manual during pump start to prevent valve cycling.			
4. FCV is in minimum to prevent excessive starting current during pump starts.			
5. a. Suction valve open - allows adequate suction pressure to pump.	9		
b. Discharge valve open - provides a flowpath for pump minimum flow requirements.			
6. Temp Interlocks			
a. Temperature difference between the reactor vessel bottom head drain and steam dome shall not exceed 145°F.			10

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.

b. Temperature difference between the steam dome and the applicable RRS loop suction shall not exceed 50°F.

c. Temperature difference between the loop suction lines shall not exceed 50°F.

D. High Speed Start Sequence Interlocks

1. For CB-5 to close the following additional permissives must be met:

a. Feedwater flow >30% (Power interlock)

b. Feedwater flow >30% (cavitation interlock)

c. Reactor vessel level above level 3 - reduces velocity head effects on WR level instruments.

d. Low speed start sequence not activated - ensures CB-5 and CB-2 do not close simultaneously

e. RR pump trip signal (EOC-RPT) not present - signal prevents closing CB-3 and CB-4.

f. Pump suction/dome steam differential temp. >10.7°F - ensures adequate NPSH for he jet pumps and RRS pumps.

g. Pumps speed less than 20% - prevents excessive shaft torques in case the pump has tripped from high speed.

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
h. Pump motor lockout relay reset - prevents pump start if tripped.			
i. LFMG lockout relay reset - prevents LFMG start if tripped			
j. CB-2 open - ensures pump power supply lineup correct.			
k. CB-3 closed - ensures pump power supply lineup correct.			
l. CB-4 closed - ensures pump power supply lineup correct.	10		
E. Low Speed Start Sequence Interlocks	11		11
1. CB-5 closes to accelerate the pump when the following permissives are satisfied:			
a. Feedwater flow <30% (power interlock)			
b. Feedwater flow <30% (Cavitation interlock)			
c. Pump speed less than 20%			
d. Pump motor lockout relay reset			
e. LFMG generator lockout relay reset			
f. CB-2 open			
g. CB-3 and CB-4 closed			
2. Simultaneously CB-1 closes to start the LFMG if the following permissives are satisfied:			
a. Low speed start sequence activated			
b. CB-1 control switch not in the PULL TO LOCK position			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
c. Pump motor lockout relay reset			
d. CB-2 open			
e. LFMG generator lockout relay reset			
3. At 95% speed CB-5 trips, allowing the pump to coast down.			
4. When pump speed between 20-26%, CB-2 closes to hold pump at 25% speed if the following permissives are satisfied:	11		
1. Pump speed 20 - 26%			
2. CB-1 Closed			
3. Motor line voltage less than 75 VAC in 12 seconds			
4. LFMG at Rated Volts			
5. CB-2 in normal			
6. CB-5 open			
F. Manual High-to-Low Speed Transfer			
1. Both CB-5 control switches to Transfer M-G position			
2. CB-5 trips, CB-1 closes			
3. As the pump coasts down, LFMG comes up to rated speed and voltage.			
4. CB-2 closes when pump speed between 20-26% (460-350 rpm).	12		
5. Any high to low speed transfer shifts FCV to manual mode.			
6. Incomplete transfer actuated if not 20-26% speed with CB-2 closed in 40 sec. - trips CB-1.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
G. Auto High-to-Low Speed Transfer	12		12
1. ΔT between steam dome and recirc. loop suction <10.7°F for 15 sec.			
2. FW flow <30% rated for 15 sec.			
3. Vessel water level < level 3.			
4. EOC-RPT trip present			
5. RRCS high dome pressure signal present (1050 psig)			
H. Low-to-High Speed Transfer			
1. CB-5 control switch is positioned to START.			
2. CB-1 and CB-2 will trip if the following permissives are satisfied:			
a. Reactor power level interlock satisfied (>30% FW flow)			
b. FW flow >30% (cavitation interlock)			
c. Vessel level above level 3			
d. Low speed auto start sequence not activated			
e. EOC-RPT relays not actuated			
f. Dome steam/pump suction interlock not actuated (>10.7°F)			
3. CB-5 closes when the following permissives are satisfied:	13		
a. Pump speed less than 20%			
b. Pump motor lockout relay reset			
c. LFMG generator lockout relay reset			
d. CB-2 open			
e. CB-3 and CB-4 closed			
I. Trips From High Speed			13
1. Reactor Vessel Level 2 (RRCS) Trip			
2. Suction valve less than 90% open.			
3. Discharge valve less than 90% open.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
4. Pump motor lockout relay actuated.			
5. CB-3 open/Control Switch in PTL.			
6. CB-4 open/Control Switch in PTL.			
7. CB-5 open/control switch in PTL.			
J. Trips from Low Speed			14
1. Suction valve less than 90% open.			
2. Discharge valve less than 90% open			
3. RRCS Level 2 Trip.			
4. LFMG generator lockout relay actuated.			
5. Pump motor lockout relay actuated.			
6. CB-1 control switch positioned to TRIP or PULL TO LOCK.			
7. Loss of 240 VAC to LFMG voltage regulator.			
8. RRCS Trip, high RPV pressure with APRMs not downscale after a TD of 25 seconds			
9. CB-2 control switch to trip or Pull to Lock			
10. Incomplete sequence relay actuated			
K. Flow Control Valve	14		
1. Valve motion inhibit on high drywell pressure.			
IV. SYSTEM OPERATION	14		
A. Normal			
1. Startup			
a. FCV to minimum, pumps started on high voltage supply.			
b. When pump approaches 95% speed, high speed breaker tripped. When pumps coast to 25% then low speed breaker closes.			11
c. Pump at 25% speed (15 Hz) (450 rpm)			
2. Low to High			
a. Power at approximately 35%, increasing			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
b. Shut flow control valves to minimum	14		
c. Shift pumps up individually.			
3. High to Low			
a. Power at approximately 35%, decreasing			
b. Downshift pumps simultaneously			
c. Open flow control valves fully.			
4. Shutdown			
a. When directed, trip LFMG sets			
b. Shut discharge blocking valve (5 mins) to stop pump.			
V. SYSTEM INTERRELATIONS	14		
A. Reactor Building Closed Loop Cooling Cools recirculation pump motor windings, bearings and mechanical seals.			
B. Reactor Recirc Flow Control Controls loop flow control valves.	15		
C. Control Rod Drive Hydraulics Provides purge water to RRS pump seals.			
D. Residual Heat Removal RRS "A" loop is shutdown cooling supply. Return is to both loops.			
E. Reactor Water Cleanup RRS A & B loops provide supply for RWCU system			
F. Feedwater Level Control Provide low feedwater flow and low total feedwater flow interlocks.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
G. Reactor Protection System Supplies EOC-RPT Trip signal for reactor recirculation pump	15		
H. Neutron Monitoring Flow elbows supply flow signal to Neutron Monitoring			
I. Redundant Reactivity Control System Provides ATWS trip signal to RRS pumps	16		
J. Electrical Systems Provide Electrical Power			

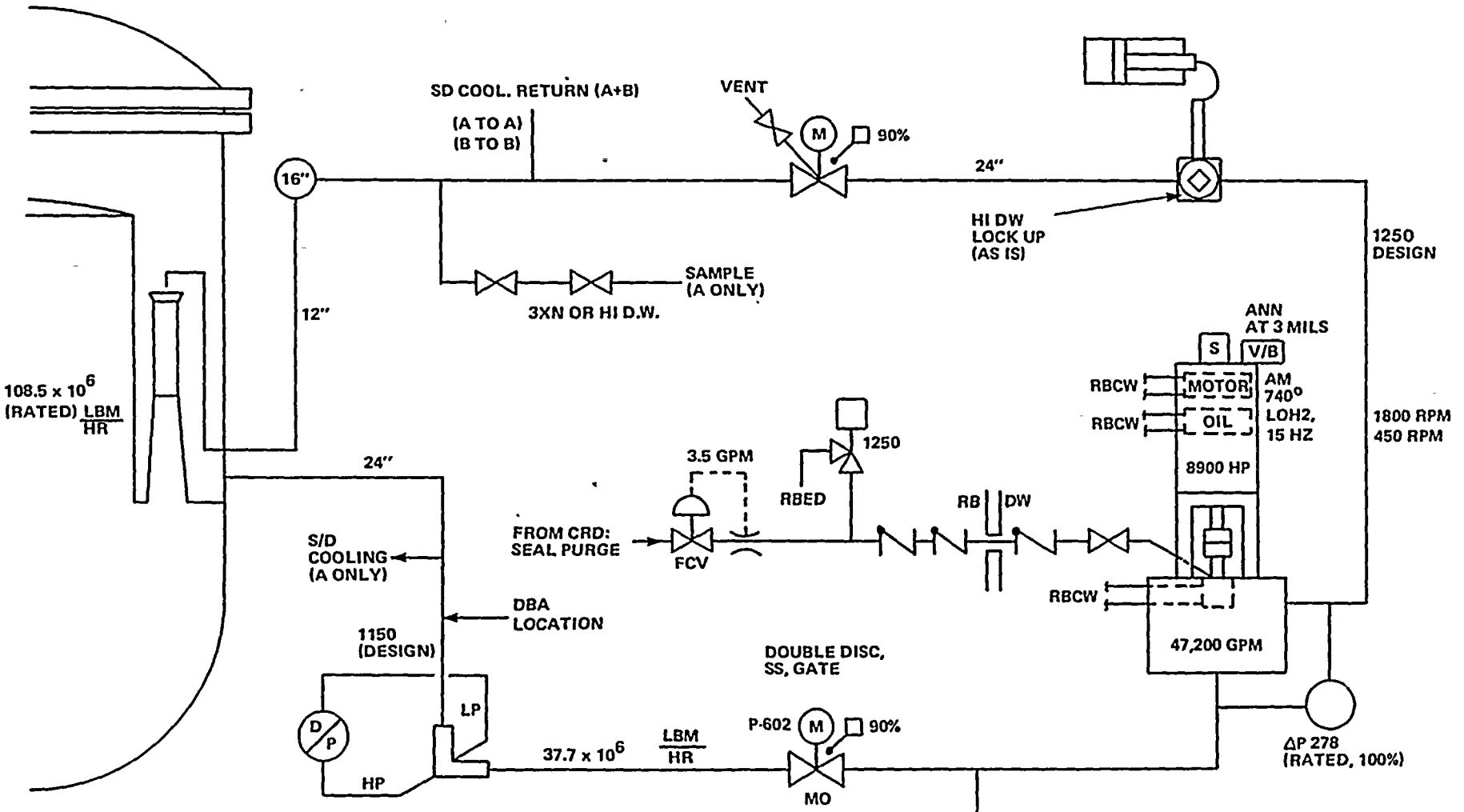
VI. DETAILED SYSTEM REFERENCE REVIEW

Review each of the following referenced documents with the class 15

A. Technical Specifications

Specification For:	Applicable Section Including Bases			
	SL	LSSS	LCO	SR
1. Recirculation loops			3.4.1.1	4.4.1.1
2. Jet Pumps			3.4.1.2	4.4.1.2
3. Recirculation Loop Flow			3.4.1.3	4.4.1.3
4. Idle Recirculation Loop Startup			3.4.1.4	4.4.1.4
5. ATWS Recirculation Pump Trip System Instrumentation			3.3.4.1	4.3.4.1
6. End of Cycle Recirculation Pump Trip System Instrumentation			3.3.4.2	4.3.4.2.1

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
B. Procedures			
1. N2-OP-29 Reactor Recirculation System			8
2. N2-OP-101A Plant Startup			
3. N2-OP-101C Plant Shutdown			
4. N2-OP-101D Power Changes			
VII. Related Plant Events			
Refer to addendum "A" and review related events with class (if applicable)			
VIII. System History			
Refer to addendum "B" and review related modifications with class (if applicable).			
IX. WRAP-UP			
A. Review Student Learning Objectives			



5 TRANSMITTERS, EACH LOOP:

4 TO FLOW DWRS., ONE FROM LOOP "A" AND ONE FROM LOOP "B" TO EACH DRAWER (4).

PUMP DOWNSHIFTS

1. FW FLOW 30%
2. STM DOME/SUCTION T>10.7°F
3. LEVEL 3 (159.3")
4. TSV/TCV CLOSURE @ 30% PWR (EOC-RPT)
5. ATWS (1050 PSIG)

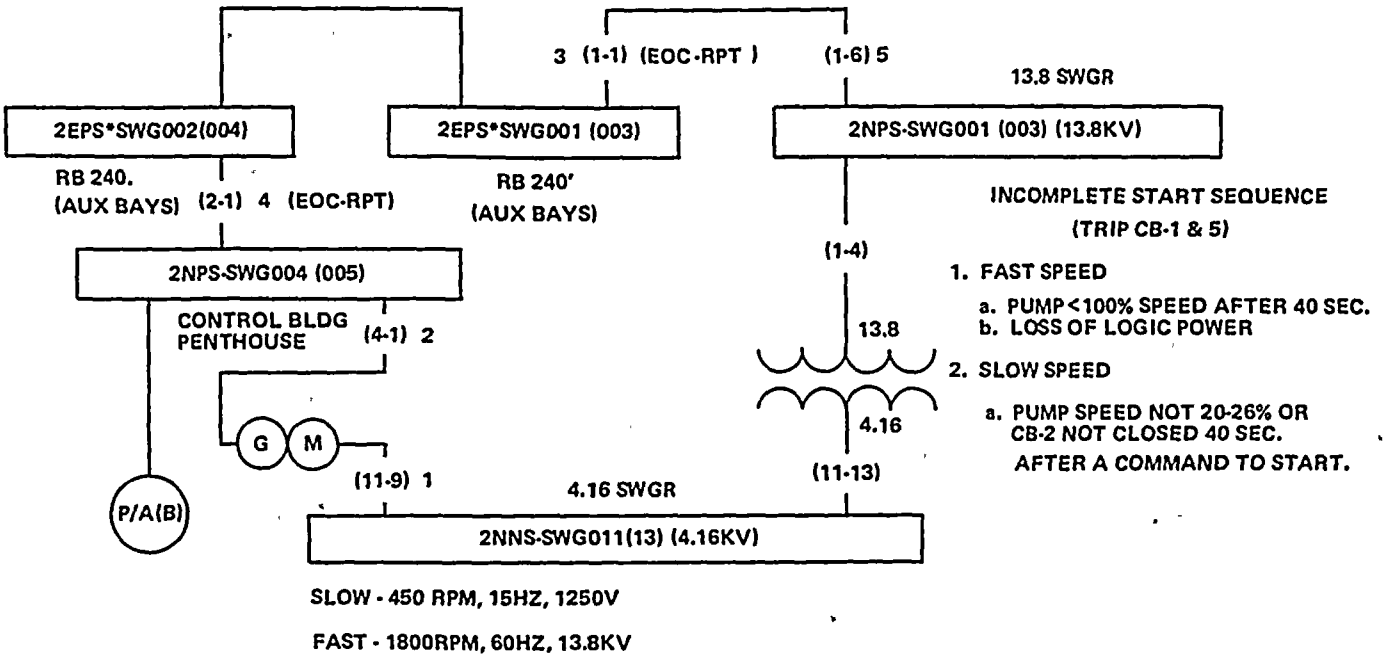
OPEN IN 2 MIN @ 50 PSID

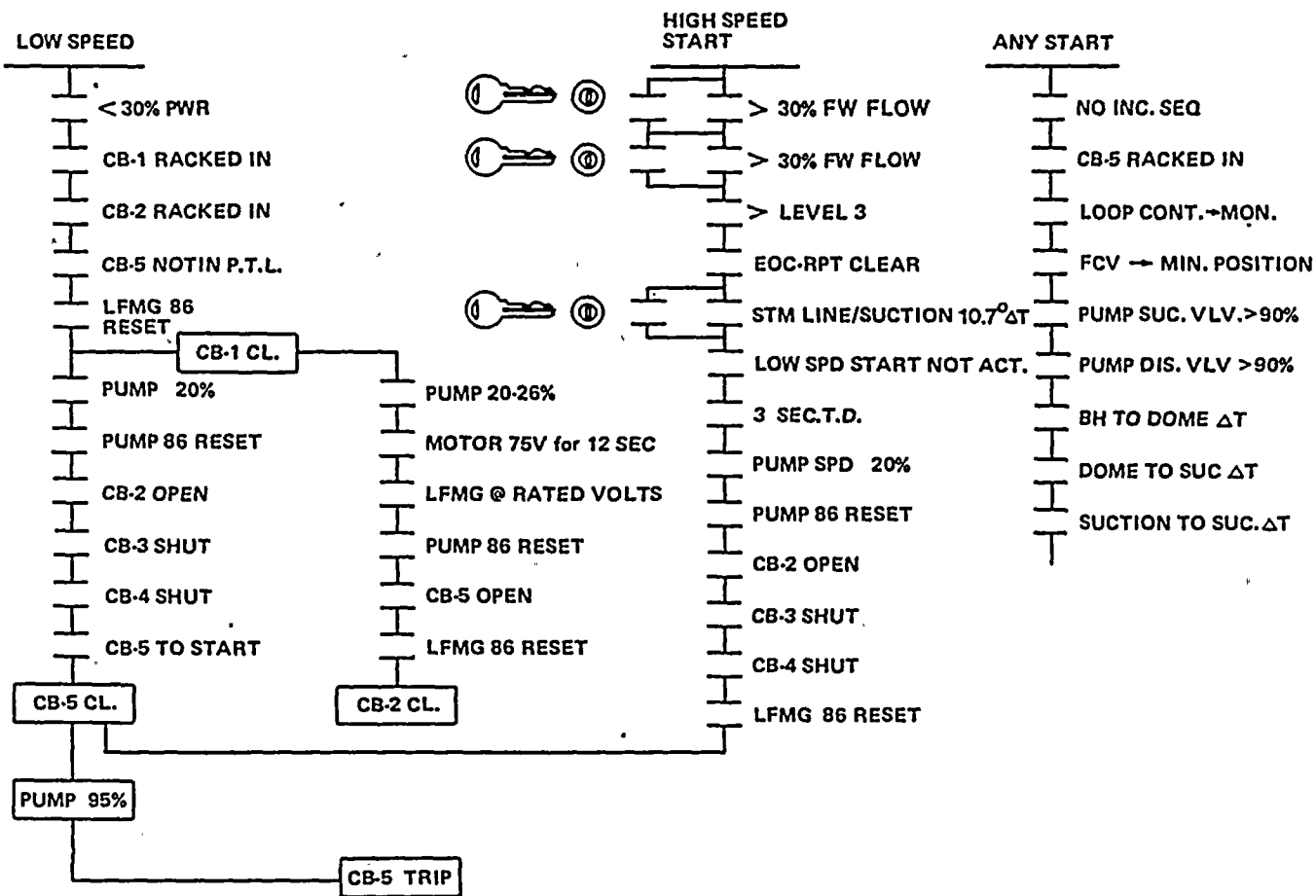
RWCU

RX LEVEL EFFECTS

1. LVL 4 W/LOSS 1 FP FCV RUNBACK TO 45% FLOW
2. LEVEL 3 - PUMP DOWNSHIFT
3. LEVEL 2 - PUMP TRIP (ATWS)

RR OVERVIEW
HANDOUT





RECIRC. PUMP SPEED CONTROL
HANDOUT