NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

02-LOT-001-212-2-00 Revision 6

REACTOR PROTECTION SYSTEM

TITLE:

DATE SIGNATUR PREPARER TRAINING AREA 122 SUPERVISOR 1 TRAINING SUPPORT SUPERVISOR PLANT SUPERVISOR/ 4/91 USER GROUP SUPERVISOR rea JB HIELKAL Summary of Pages 129/8/ > (Effective Date: 5 Number of Pages: 36 Date Pages May 1991 1 - 36 ţ THIS 155 53 فثننا 23 NING DEPARTMENT RECORDS ADMINISTRATION ONL 16 : ERIFICATION - 10 - S DATA ENTRY RECORDS ê en se J.J 9305030099 91103 PDR ADDCK 05000 PDR

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I. TRAINING DESCRIPTION

A. Title of Lesson: Reactor Protection System

- B. Lesson Description: This lesson contains information that will provide the knowledge necessary for safe and efficient operation of the Reactor Protection (RPS) System.
- C. Estimate of the Duration of the Lesson: 4 hours
- D. Method of Evaluation, Grade Format, and Standard of Evaluation: A written exam will be given with a minimum grade of 80% required for satisfactory performance.
- E. Method and Setting of Instruction: Lecture conducted in the classroom.
- F. Prerequisites:

1. Instructor:

- a. Certified in accordance with NTP-16.
- 2. Trainee:
 - a. In accordance with eligibility requirements of NTP-10.
- G. References:
 - 1. Technical Specifications
 - a. 2.2.1 Reactor Protection System Instrumentation Setpoints
 - b. 3.3.1 Reactor Protection System Instrumentation Setpoints
 - c. 3.3.4.2 Recirculation Pump Trip Actuation Instrumentation
 - d. 3.8.4.4 RPS Electric Power Monitoring (RPS Logic)
 - e. 3.8.4.5 RPS Electric Power Monitoring (SCRAM solenoids)

2. Procedures

N2-OP-97 Reactor Protection System

- 3. NMP-2 FSAR
 - a. General Plant Description, Volume 1, Chapter 1, Section
 1.2.9.1, Page 1.2-27.
 - b. Instrumentation and Controls, Volume 15 Chapter 7, Section 7.2.1, Page 7.2.1.
 - c. Instrumentation and Controls, Volume 16 Chapter 7, Section 7.6.1.5, Page 7.6-7.

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 d. RPS Power Supplies, Volume 16, Chapter 8, Section 8.3.1.1.3, Page 8.3-27c.II. <u>REQUIREMENTS</u>

II. <u>REQUIREMENTS</u>

- A. AP-9.0, Administration of Training
- B. NTP-10, Training of Licensed Operator Candidates

III. TRAINING MATERIALS

- A. Instructor Materials:
 - 1. Training Record (TR)
 - 2. Instructor's working copy of Lesson Plan
 - 3. Whiteboard and Markers
 - 4. Overhead Projector
 - 5. Transparencies as needed
 - 6. Flipchart
 - 7. Copy of Trainee Handouts
 - 8. Trainee Course Evaluation Forms
- B. Trainee Materials:
 - 1. Handouts
 - 2. Paper or notebook
 - 3. Pen or pencil

IV. EXAM AND MASTER ANSWER KEYS

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LEARNING OBJECTIVES

Upon satisfactory completion of this lesson the trainee will have gained the knowledge related to the Reactor Protection System to:

A. Terminal Objectives:

- TO-1.0 Energize the RPS (Power Supplies 2VBB-UPS 3A/3B) service. (2120010101)
- TO-2.0 Place an RPS channel in the Tripped Condition. (2120020101)
- TO-3.0 Conduct a Manual SCRAM Functional Test. (N2-OSP-RPS-M004) (2120060201)
- TO-4.0 Operate the Reactor Mode Switch during a Plant Startup or Shutdown. (2120070101)
- TO-5.0 Shift the RPS Bus to the Alternate Supply. (2120090101)
- TO-6.0 Perform the Monthly Functional Test of the RPS Turbine Control Valve Closure (N2-OSP-RSP-M001). (2120920201)
- TO-7.0 Perform Functional Test of Turbine Stop Valve Closure (N2-OSP-RPS-M002). (2129030101)
- TO-8.0 Perform the RPS Weekly Turbine Valve Cycling Test. (N2-OSP-RPS-W001). (2129050201)

Upon satisfactory completion of t is lesson the Senior Reactor Operator trainee will have gained the knowledge related to the Reactor Protection System to:

- TO-9.0 Authorize Placement of RPS Channel in the Test or Tripped Position. (3410430303)
- TO-10.0 Authorize Bypass of an RPS Channel from a Trip Condition (Prevent actuation). (3410440303)
- TO-11.0 Direct the actions required for a Loss of an RPS Channel. (3449230503)
- TO-12.0 Respond to a Loss of RPS Bus. (3449950403)
- TO-13.0 Authorize de-energizing the Reactor Protection System. (3450360103)
- B. Enabling Objectives:
 - EO-1.0 Explain the function and the purpose of the Reactor Protection System and the Recirculation Pump Trip System.
 - EO-2.0 Explain the difference between the terms "SCRAM" and "half SCRAM".

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- EO-3.0 Explain the power supply network for the following RPS components:
 - a. Trip Systems
 - b. SCRAM Pilot Solenoids
 - c. Backup SCRAM Valve Solenoids
- EO-4.0 Describe the purpose and function of the RPS major components listed below:
 - a. Electrical Protection Assemblies (EPAs)
 - b. RPS Trip System
 - c. RPS Trip Channel
 - d. Channel Sensor Relays
 - e. SCRAM Pilot Valves
 - f. Backup SCRAM Valves
 - g. SCRAM Discharge Volume (SDV) Isolation Pilot Valves
 - h. SDV High Water Level Bypass Switches
 - i. RPS Logic Reset Switches
 - j. Pilot SCRAM Valve Solenoid Indicating Lights
 - k. Power Source Selector Switch
 - 1. Reactor Mode Switch
 - m. SDV Isolation Valve Test Switches
 - n. Hydraulic Control Unit Rod SCRAM Test (SRI) Switches
- EO-5.0 List all automatic scram signals and the setpoint at which each is activated.
- EO-6.0 Describe the two methods available to manually trip the RPS.
- EO-7.0 Describe the method and any applicable setpoints utilized in bypassing the following RPS trip signals:
 - a. SDV High Level
 - b. MSIV Closure
 - c. TSV Closure
 - d. TCV Fast Closure
 - e. Neutron Monitoring System Inputs

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- EO-8.0 Utilize an RPS Trip System circuit drawing to describe the trip system response to a valid trip signal including:
 - a. Channel Sensor Relay response
 - b. Channel Reset logic response
 - c. SCRAM valve response (inlet, outlet, SDV isolation and backup SCRAM valve)
 - d. EOC-RPT actuation and bypass
- EO-9.0 Regarding the Reactor Protection System, determine and use the correct procedure(s) to identify actions or locate information related to the following:
 - a. Startup
 - b. Shutdown
 - c. Normal Operations
 - d. Off normal operations
 - e. Annunciator responses
- EO-10.0 <u>SRO ONLY</u> Given the NMP-2 Technical Specifications and a set of plant conditions, determine the appropriate bases, limiting conditions for operations, limiting safety system setting or action statement as applicable.

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I. INTRODUCTION

Distribute TR for completion

Distribute Course Evaluation forms and describe how it should be utilized.

Shourd be utilized.

Review Student Learning Objectives

Describe Text Layout for Chapter

Explain the lesson will be evaluated by written exam

at the end of the week.

Trainees must achieve an 80% to pass the course.

A. System Purpose

The Reactor Protection System (RPS) automatically initiates a rapid reactor shutdown called a SCRAM for one of the following reasons:

- 1. Preserve the integrity of the fuel cladding.
- 2. Preserve the integrity of the reactor coolant system.
- 3. Minimize the energy which must be absorbed during a loss of coolant accident.

4. Prevent inadvertant criticality. The RPS is a dual-trip electrical alarm and actuating system designed to prevent the reactor from operating under unsafe, or potentially unsafe conditions. The RPS is designed to provide a signal to cause a SCRAM and shutdown the reactor when specific variables exceed predetermined limits.

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DELIVERY NOTES

End of Cycle Recirculation Pump Trip (EOC-RPT)

The recirculation pumps are downshifted to slow speed to reduce the severity on the fuel of thermal transients caused by turbine trip or generator load rejection. By transferring the recirculation pumps to low speed early in the event, the rapid core flow reduction maintains void content for a longer period reducing reactivity in conjunction with a control rod insertion.

Although utilized throughout the core cycle the EOC-RPT system is specifically required at the end of cycle when thermal margins are smaller.

The EOC-RPT system is a part of the RPS.

- B. General Description
 - The RPS consists of two independent and identical trip systems (A and B).
 - Each trip system is divided into two independent trip channels (A1, A2, B1, B2).

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Show TP of basic. System logic path.



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- Each RPS channel receives an input from at 3. least one independent sensor for each critical reactor parameter. When a sufficient number of sensors for a parameter reaches its trip setpoint, a trip signal will be generated by the RPS logic.
- Electrical power to the scram pilot valves 4. on each CRD-HCU is interrupted, and all control rods rapidly insert into the reactor core.
- Two methods of manually causing a trip will 5. also be discussed.
- DETAILED DESCRIPTION Π.
 - Power Supplies Α.
 - Each trip system's sensor logic, trip logic, 1. status lights, and AC/DC power supplies receive power from one of the two 10KVA, 120 VAC, 1-phase Uninterruptable Power Supply (UPS) systems.
 - RPS trip system A is fed from UPS a. 2VBB-UPS3A:
 - UPS is normally powered by 600 1) VAC, 2 LAT-PNL 100,
 - UPS receives backup power from 125 2) VDC, 2 BYS-SWG001A.

02-1.0T-001-212-2-00 -8 May 1991 Minimum of four sensors for each parameter. Some parameters have more.

Show TP of RPS. Logic power supply. EO-3.0a

Briefly review UPS operation.

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- a) The associated battery charger 1A1 is fed from 2NJS-US5.
- 3) The alternate source to the UPS is from 600 VAC, 2NJS-PNL500.
- b. Trip system B is fed from UPS-2VBB-UPS3B:
 - UPS is normally powered by 2NJS-PNL402.
 - 2) UPS receives backup power from 2BYS-SWG001B.
 - a) The associated Battery Charger 1B1 is fed from 2NJS-US6.
 - The alternate source to the UPS is 2NJS-PNL600.
- Two Electrical Protection Assemblies (EPA), in series, connects each UPS to its associated distribution panel.
 - a. EPA provides electrical separation between safety related RPS circuits and non-safety related normal power supplies.

EO-3.0a

EO-4.0a

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SSON CONTENT		DELIVERY NOTES	NOTES
	 b. These disconnect the RPS circuits whenever voltage deviates from 120V by more than <u>+</u> 10% and whenever frequency drops below 60 HZ by 5%. c. EPA's require local manual reset if tripped. 	Exact numbers are in Tech. Specs.	
3.	The power supply to the scram pilot valve	Show TP of RPS	EO-3.0b
	solenoids is from two high-inertia motor	MG Set supply	
	generator (MG) sets: a. MG set 2RPM-MG1A feeds all of the A solenoid valves.		
	b. MG set 2RPM-MG1B feeds all of the B solenoid valves.		
	c. Each MG set consists of a 3-phase induction motor, driving a 120 VAC, 60		
	HZ, 1-phase synchronous generator.d. A flywheel mounted on the MG shaft		
	helps control MG Set voltage and frequency (by utilizing inertia) during input power deviations.		
	e. The driving motor for 1A is powered by 600 VAC from 2NHS-MCC008 (stub bus 5),	· · · ·	-
-	and motor 1B from 2NHS-MCCOO9 (stub bus 6).	-	
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DELIVERY NOTES

- f. Alternate power for the "A" solenoids comes from 2LAT-PNL100 via 2RPM-PNL1A.
- g. Alternate power for the "B" solenoids comes from 2LAS-PNL400 via 2RPM-PNL1B.
- h. Alternate power is used when the MG set is taken out of service for maintenance.
- Only one alternate supply may be selected at any one time due to switch design.
- j. EPA's work the same as previously discussed.
- 4. Power for the Backup Scram Valve solenoids comes from 2BYS*SWG002A and 2B switchgear (Division 1 and 2 Battery buses):
- B. System Operating Fundamentals
 - 1. "One-out-of-two-taken-twice" logic:
 - Two trip systems control power to a group (A or B) of solenoids on scram pilot valves. Each trip stream contains two trip channels.
 - b. At least one of two channels in <u>each</u> trip system must trip to cause a SCRAM. This will cause a rapid rod insertion.

EPA's also have same purpose (i.e. provide separation).

Note these are RPM EPAs where others where EO-3.0c VBS.

RPS is a coincident, fail safe logic.

EO-4.0b

EO-4.0c

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LESSON CONTENT

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- c. "<u>Half-SCRAM</u>"--if only one trip system trips, the one group of solenoids on the scram pilot valves will de-energize, but no SCRAM will occur and no rod movement occurs.
- During normal reactor operation all sensor trip contacts are closed, the bypass contacts are open, and the channel sensor relays are energized.
- Channel sensor relays operate contacts which interrupt power to solenoid valves in the CRDH. system.
- 4. Each HCU has:
 - a. One three-way, 120 VAC, dual-coil, solenoid-operated pilot scram valve.
 - b. One air operated exhaust valve.

c. Two air operated scram valves. Energizing of the A or B solenoid on the pilot SCRAM valves allows instrument air to hold the exhaust and scram valves closed. De-energizing <u>both</u> solenoids causes the SCRAM pilot valve to change position and the air bleeds off the SCRAM valves. The SCRAM valves will open by spring force and the rods insert into the core. Half SCRAM is simply a trip of one trip system.

EO-2.0

Sensor trip contacts are the contacts operated in the trip channels by the various sensors of RPS monitored parameters.

Channel sensor relays are normally energized EO-4.0d and de-energized on a trip.

Note: All drawing are shown de-energized.

EO-4.0e

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- 5. Channel sensor relays in Trip System "A" operate contacts to allow the "A" solenoid to be energized. Channel sensor relays in Trip System "B" operate contacts to allow the "B" solenoid to be energized.
- Two backup SCRAM valves (normally de-energized, DC solenoid-operated valves) provide a backup means of bleeding air from the SCRAM valves.
 - a. When <u>both</u> trip systems trip, the backup SCRAM solenoids energize shifting the valves to block the instrument air _supply to the CRD SCRAM valve pilot air header.
 - b. The pilot air header bleeds down and the SCRAM valves open, causing insertion of all control rods.
- 7. SCRAM Discharge Volume (SDV):
 - a. Receives water from the over-piston area of the CRDM's when the scram outlet valves open.
 - b. The Instrument volume (vertical section of the SDV) has two 120 VAC, dual solenoid-operated pilot valves (normally energized open).

Backup SCRAM valve function only works if pilot SCRAM valve fails to reposition for blocking and venting air. SDV is part of CRDH System. EO-4.0f

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DELIVERY NOTES NOTES

- c. The SDV Isolation Pilot Valves allow air to keep the volume vent and drain valves open during normal conditions and vent the air to allow isolation of the volume during a SCRAM.
- d. De-energizing a channel sensor relay in one channel of <u>both</u> trip systems will cause the pilot valves to de-energize venting air from the SDV air operated vent and drain valves (2 each) which will cause them to close by spring pressure. This isolates the SDV from its vent path and drain path.
- D. RPS Parameters, Inputs, Setpoints, Logic, and Bases
 - 1. Turbine Stop Valve Closure
 - a. When 3 out of 4 turbine stop valves close above 30% reactor power (sensed by first stage turbine pressure) a SCRAM is initiated.
 - b. Inputs to the RPS come from valve stem position switches on the four turbine stop valves.

2 valves may cause 1/2 SCRAM depending on which2, 3 valves will always cause a SCRAM.

Limit switches sense valve not full open at 95% open.

EO-5.0

EO-4.0g

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LESSON CONTENT			DELIVERY NOTES	NOFES -
	ć.	Turbine stop valve closure SCRAM initiates a SCRAM earlier than either the high neutron flux or vessel high pressure resulting from the valve closure.	-	•
	d.			
2.	Tur	rbine Control Valve Fast Closure		
	a.	When the turbine control valves trip closed, above 30% reactor power, a SCRAM is initiated.	•	EO-5.0
	b.	Inputs to the RPS come from pressure switches NOO5A-D, located in the		

d. Actuation of one pressure switch in Pressure switch per channel. <u>each</u> RPS trip system will cause a SCRAM.

electro-hydraulic control system (EHC) emergency trip system (ETS) lines.
c. Each pressure switch (4) provides an

> input to one RPS channel and actuates at an EHC trip oil pressure of 530 psig

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LESSON CONTENT

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- e. ETS fluid pressure was chosen as the input signal because the turbine control valve positions vary at different power levels, thus control valve position is not an appropriate parameter.
- f. TCV fast closure initiates a SCRAM earlier than either high neutron flux or vessel high pressure resulting from the closure.
- g. Classified as an anticipatory SCRAM.
- 3. Turbine Stop Valve and Control Valve Closure Bypass
 - Permits reactor operation with turbine valves closed at low power level (<30% power).
 - b. Inputs to RPS come from pressure transmitters mounted on each of the first stage pressure taps.
 - c. Actuation of at least one trip unit in each RPS trip system will cause bypass of the turbine stop valve and control valve closure SCRAM.

EO-7.0c EO-7.0d

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DELIVERY NOTES

- 4. SCRAM Discharge Volume High Water Level
 - A SCRAM is initiated by high level in SDV instrument volume to insure sufficient volume exist for the water exhausted from CRDM during SCRAM.
 - b. Inputs to the RPS come from 4 non-indicating float switches and 4 level transmitters sensing instrument volume level. Float switch setpoint is <u><48.5</u> inches while transmitter setpoint is <u><43.4</u> inches.
 - c. Each RPS channel gets input from one. switch and one transmitter.
 - Actuation of at least one switch or transmitter in each RPS trip system will cause a SCRAM.
- 5. SCRAM Discharge Volume High Level Bypass
 - a. The SDV high level SCRAM must always be bypassed prior to RPS reset. The level will exceed the setpoint following a SCRAM and the volume isolates from the drain path until RPS is reset.
 - Four switches are provided, on panel
 603 to bypass the trip, (one for each
 RPS channel).

Either switch or transmitter will trip the channel.

EO-7.0a

EO-4.0h

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EO-5.0

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DELIVERY NOTES

- LESSON CONTENT
 - c. In order for the SDV High Level Bypass switches to bypass the scram signal, the reactor mode switch <u>must</u> be in either SHUTDOWN or REFUEL.
 - d. The bypass signal provides a rod block signal to the RMCS.
 - e. With the signal bypassed RPS reset can be accomplished (provided all other trip signals are reset or bypassed).
 With RPS reset the SDV vent and drain valves reopen and the volume drains.
 - 6. Main Steamline Isolation Valve Closure
 - A SCRAM is initiated if 3 of 4 Main
 Steam lines become isolated with the
 Reactor Mode Switch in the RUN position.
 - b. Inputs to RPS come from the MSIV position limit switches mounted on the MSIV's (HYV6A-D and HYV7A-D) when valve is 8% closed.
 - c. The logic is arranged such that any combination of MSIV closures' resulting in three main steamlines being isolated (inboard <u>or</u> outboard valve closed) causes a reactor SCRAM.

RPS input limit switches indicate valve closure at 92% open.

Some 2 line isolations may result in a

half SCRAM.

EO-5.0

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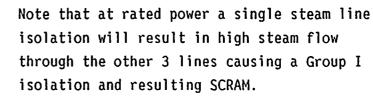
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EO-7.0b

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Checking MSIV position is required prior to placing mode switch to RUN.

- One main steamline can be isolated d. completely without tripping either trip system. Two main steamlines isolated may result in a half SCRAM if it is the correct combination.
- MSIV closure initiates a SCRAM faster e. than the high neutron flux or high vessel pressure resulting from the
 - closure.
- f. Classified as an anticipatory SCRAM.
- 7. MSIV Closure Bypass
 - This permits low power reactor a. operation with the main steamlines isolated. levels.
 - Bypass sensor relays are energized when b. the reactor mode switch is placed in any position other than RUN.
- 8. High Drywell Pressure
 - A drywell pressure of 1.68 psig, will a. cause a trip.
 - Input to RPS come from four pressure b. transmitters sensing drywell free air space pressure.

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- c. The logic is arranged such that a high pressure signal from at least one transmitter in <u>each</u> RPS trip system will cause a SCRAM.
- d. High pressure in the drywell may indicate a break in the nuclear system process barrier.
- e. This function is never bypassed.
- 9. High Reactor Pressure
 - a. A reactor vessel pressure of 1037 psig will cause a SCRAM.
 - b. Inputs to RPS comes from four pressure
 - transmitters sensing vessel steam dome pressure. Each provides an input into one RPS channel trip unit.
 - c. This function is never bypassed.
- 10. Low Reactor Water Level
 - A reactor vessel water level below the low water level setpoint (159.3") causes a SCRAM.
 - Inputs to RPS come from four differential pressure transmitters (one per channel).
 - c. This function is never bypassed

Level	is	also	referred	to	as	level	3	in	EO-5.0
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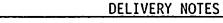
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11. Main Steamline High Radiation

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LESSON CONTENT

- Radiation levels in the vicinity of the main steamlines exceeding 3 times full power background level will cause a SCRAM.
- Inputs to RPS come from four gamma-sensitive ion chamber monitors, one monitor for each RPS channel.
- c. The monitors are geometrically arranged downstream of the outboard MSIV's so that each detector can sense radiation levels in each of the four steamlines.
- d. _ The RPS logic is arranged such that a high radiation signal from at least one monitor in <u>each</u> RPS trip system will cause a SCRAM.
- An inoperative signal from a monitor (i.e. module unplugged or low voltage) also causes a trip signal from that monitor.
- f. This function limits the release of fission products from the containment following a gross fuel failure.

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DELIVERY NOTES

- 12. Neutron Monitoring System (NMS)
 - a. During startup and low power ops, eight IRM's provide inputs to RPS. During power range operation, six APRM's provide inputs to the RPS.
 - b. NMS SCRAMS are necessary to protect the fuel against excessively high power generation rates.
 - c. Two IRMs and two APRMs provide inputs to each RPS channel.
 - d. At least one monitor in each trip system must sense high flux or an INOP condition to cause a SCRAM.
 - e. When the reactor mode switch is placed in RUN, the IRM logic is bypassed.
 - f. Each NMS input is bypassed individually by joysticks on P603.
 - g. A non-coincident NMS protection logic may also be used (shorting links removed). The logic adds the SRM input to the RPS trip logic and makes all NMS trips non-coincident. (i.e. any one instrument sensing high flux will cause a SCRAM).

APRM E and F are used by two RPS channels.

IRM and APRM trip setpoints are discussed in the associated system chapters.

EO-7.0e

This function is only used prior to proving Shutdown Margin following a refueling.

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LESSON CONTENT

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- h. Shorting links are located in P609 and P611 in the Control Room.
- 13. Manual SCRAM
 - a. Four manual SCRAM pushbuttons are located in the control room, on panel 603 (one pushbutton for each RPS channel) to provides the operator with a means to manually SCRAM the reactor.
 - Each pushbutton is armed by turning its collar clockwise.
 - c. At least one pushbutton in each RPS trip system must be armed and depressed
 . to initiate a SCRAM.
 - d. Placing the Reactor Mode Switch in the SHUTDOWN position will open a contact in all four RPS channels which causes a SCRAM.
 - The action also closes a contact in all four channels which energizes a time delay and seals in the signal for 10 sec.
- 14. SCRAM Reset
 - a. Four RPS logic reset switches, (one for each channel), are located on panel 603.

Pushbutton located on either side of 4 rod display. Arming and pushing the two buttons on either side will cause a SCRAM.

2-position, spring return- to- normal, keylock EO-4.01 switches.

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EO-6.0

BJECTIVES/ NOTES

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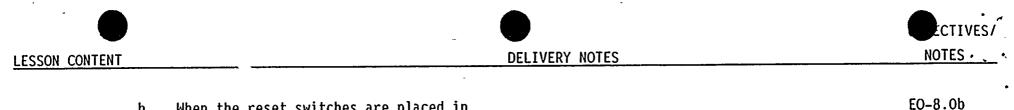
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- b. When the reset switches are placed in the reset position the following occurs (in order):
 - 1) Reset contacts close.
 - Reset sensor relays K19A-D will energize.
 - Reset sensor relay contacts K19A-D close.
 - Channel sensor relays K14A-D energize (if all trip signals cleared or bypassed).
 - 5) Channel sensor relay contacts
 - K14A-D close to seal in the reset.
- c. The reset is prevented for 10 seconds following a SCRAM to allow all rods to fully insert in the core.
- **!II. INSTRUMENTATION AND CONTROL**
 - A. Indications
 - 2 groups of 4 white indicating lights on panel 603, one group on either side of the full core display.
 - The normally lit lights are each associated with one of the four rod groups in Trip System A or B.

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A half SCRAM can be reset without the time delay.

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 The lights extinguish as a result of denergizing the associated group of solenoids.

- This shows which RPS trip system (A or B) has tripped.
- B. Controls

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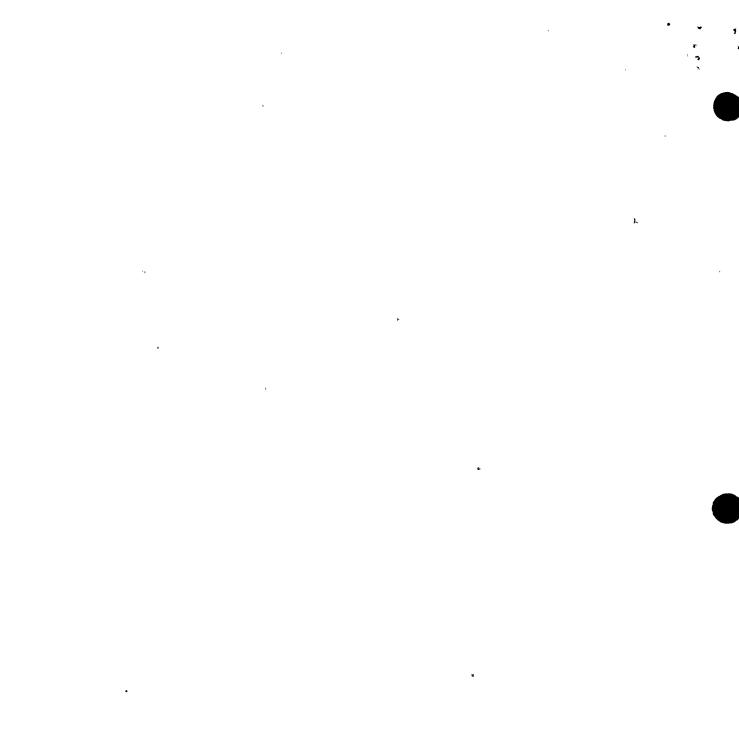
- 1. RPS Power Source Selector Switch
 - a. Located on Control Rod Test Panel 610 in the control room.
 - b. Three positions:
 - <u>NORMAL</u>-RPS M-G sets A and B supplying power to solenoids
 - 2) <u>ALT A</u>-supply from 2 LAT-PNL100 for "A" solenoids, "B" solenoids from MG 1B
 - 3) <u>ALT B</u>-supply from 2 LAS-PNL 400 for "B" solenoids, "A" solenoids from MG 1A
 - c. A loss of power will occur whenever this switch is operated, however, the trip system channel sensor relays will not de-energize (i.e. only a power loss to solenoids).

The loss of power will trip the RPM*EPA's. The EPAs must be locally reset.



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- MSIV and Turbine Stop Valve Closure Test Switches
 - a. These switches are located in the control room on panel 609 and 611.
 - Allow for testing of the MSIV or turbine stop valve sensor logic circuits.
- 3. Reactor Mode Switch
 - a. 4-position keylock switch located on control room panel 603.
 - b. The mode switch position establishes plant operating conditions and affects the RPS logic circuitry.
 - c. When the mode switch is placed in SHUTDOWN both RPS trip systems are deenergized causing a SCRAM. A 10 second time delay ensures that all control rods are fully inserted into the core prior to automatically bypassing the SCRAM signal. This position also bypasses the trip functions for MSIV closure and allows bypassing the SDV High Water Level trip.

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LESSON CONTENT



- In REFUEL, the APRM setdown trip functions are in effect while the trip functions for MSIV closure are bypassed, and the SDV High Water Level trip can be bypassed.
- e. In STARTUP, criticality and heatup are allowed with APRM setdown trip functions in operation and the trip functions for MSIV closure bypassed.
- f. In RUN, higher power levels are allowed, but proper valve lineups, pressures, and flows must be adhered to strictly. IRM trip functions are bypassed.
- Reactor Scram Manual Trip Switches (Previously discussed)
- 5. Reactor Scram Reset Logic Switches (Previously discussed)
- Discharge Volume High Water Letter Bypass Switches

(Previously discussed)

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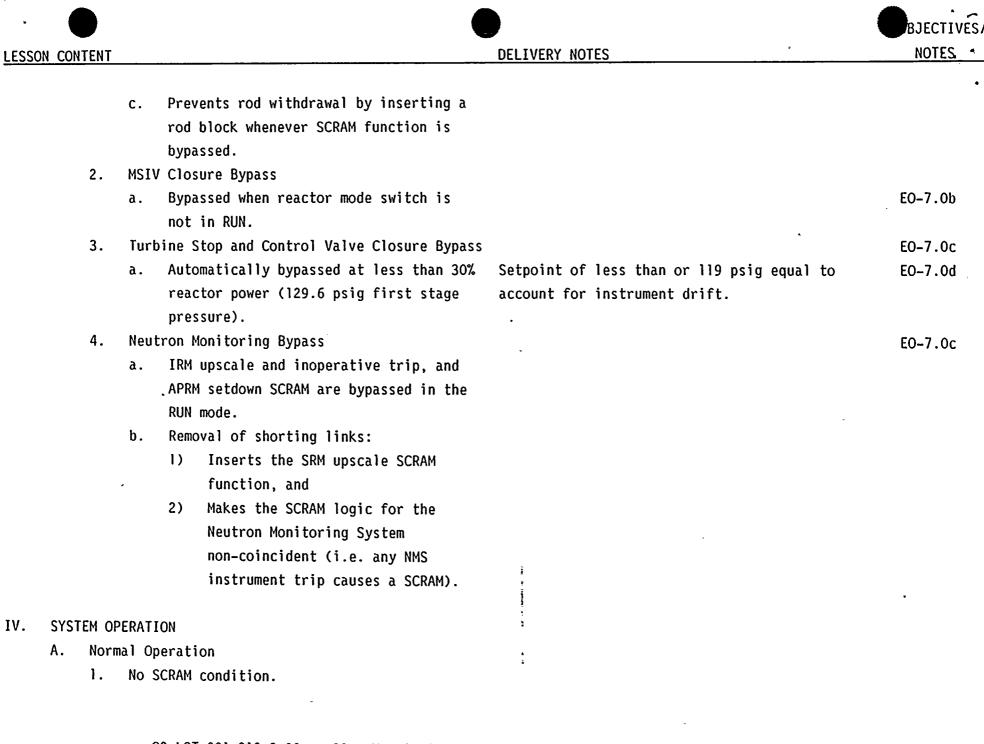
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N CONTEN	T DELIVERY NOTES	NOTES -
7.	a. Depressing both switches (S2A,B) will de-energize both solenoids on the SDV isolation valve pilot valves, closing the SDV vent and drain valves (pushing one only de-energizes A or B solenoid	EO-4.Om
8.	 so no valves will reposition). Rod Scram Test Switches a. Two, 2-position toggle switches located on each CRDH-HCU. b. These switches are used for: Testing of the individual coil of the scram pilot solenoid valve. 2) Surveillance testing of the individual coil individual control rod scram lines. 	EO-4.On
	c. Placing both switches to TEST deenergizes both solenoids, causing that particular rod to scram.	
C. Ir l.	 SDV Bypass a. Allows resetting of RPS logic following a scram. b. Enables draining of the SDV, (i.e. once scram reset vent and drain valve reopen). 	EO-7.0a

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- 2. SCRAM logic system reset.
- 3. SCRAM Pilot Valve solenoids energized.
- 4. Backup SCRAM Valve solenoids de-energized.
- SDV vent and drain valves open (Discharge Valve Isolation Valves solenoids energized).
- Power from 2VBB-UPS3A, B for sensors and logic and 2RPM-PNL1A, 1B for pilot SCRAM valve solenoids.
- B. Startup Operation
 - 1. SCRAM logic is reset
 - SDV high water level bypass switches in NORMAL.
 - 3. Reactor mode switch in STARTUP/HOT STANDBY
 - 4. IRM SCRAM functions in effect
 - 5. Setdown APRM SCRAM function in effect
 - 6. MSIV Closure SCRAM bypassed
 - 7. TSV and TCV closure trip bypassed
- C. Non-coincident Logic
 - Used when required by Technical Specifications
 - 2. SRM SCRAM signal is inserted ($\leq 2x10^5$ cps)
 - 3. Any single NMS trip signal causes SCRAM.
- D. SCRAM occurs when any of the monitored parameters reaches its trip setpoint. This deenergizes the sensor relay for that parameter.

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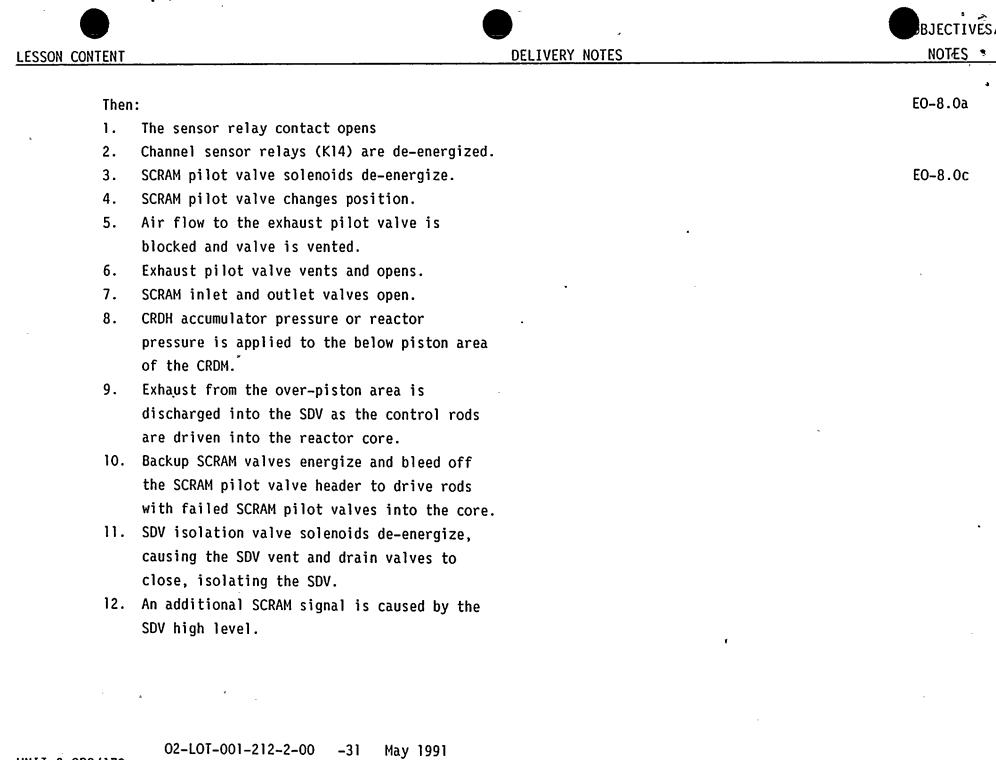
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- 13. EOC-RPT Logic
 - a. RPS logic detects TCV fast closure and TSV closure using four channels of sensor logic.
 - RPS logic combines the four channels of sensor logic into two divisions of RPT logic.
 - c. Trip of either division of the RPT logic will trip both recirculation pumps from fast speed to slow speed.
 - Trip requires two channel sensor trip signals for the condition.
 - 2) The logic is automatically bypassed below 30% power sensed by turbine first stage pressure.
 - 3) The RPT logics are powered from UPS 3A/3B.
 - Manual out of service pushbuttons for EOC-RPT on P602 physically disable the circuit.

Use TP of RPT logic.

A logic trips the 3A and 3B Breakers. B logic trips the 4A and 4B Breakers.

Turbine 1st stage pressure sensor also used to bypass RPS trips, same setpoint.

Amber pushbuttons on vertical section of panel. Buttons generally just give warning annunciator in most systems. EO-8.0d

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- E. Transfer to Auxiliary Power
 - If power is lost from an M-G set, power is lost to that set (A or B) of solenoids, resulting in a half- scram (Channel sensor relays do not de-energize).
 - The power source select switch at panel 610 is positioned to supply power from the alternate source.
 - Only one set of solenoids can be selected to an alternate source at one time.
 - Normal operation may be continued with one RPS-MG set out of service.

V. SYSTEM INTERRELATIONS

- A. Instrument Air System (IAS)
 - Supplies 70-75 psig air for scram inlet and outlet, exhaust pilot and SDV vent and drain valves.
- B. Control Rod Drive Hydraulic (CRDH) Provides motive force for initiation of control rod insertion during a reactor scram.
- C. Neutron Monitoring System (NMS) Provides trip input signals to RPS logic.

NOTE: If the power loss in one channel is coincident with a half SCRAM in the opposite channel, all rods will SCRAM. However, the SCRAM discharge volume vent and drain valves and the backup SCRAM valves do not reposition until the SCRAM discharge volume fills to the trip point.

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- D. Reactor Manual Control System (RMCS) Provides rod block when the SDV high level SCRAM signal is bypassed.
- E. Reactor Recirculation System (RRS) When >30% power, RPS supplies signals for EOC-RPT.
- F. Radiation Monitoring System(RMS) Supplies inputs to RPS for MSL high radiation scram.
- G. Reactor Vessel Instrumentation (RVI)
 Supplies inputs to RPS for vessel level and pressure functions.
- H. Redundant Reactivity Control System (RRCS) Controls 8 DC powered valves called ARI valves that provide alternate means to depressurize the scram air header.
- VI. DETAILED SYSTEM REFERENCE REVIEW

Review each of the following referenced documents with the class.

A. Procedure N2-OP-97

Use latest revision.

EO-9.0

- 1. Review applicable precautions.
- 2. Review startup, shutdown, normal, and off normal sections for applicable information.

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LESSON CONTENT	DELIVERY NOTES	NOTES C
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B. Technical Specifications	•	h

1.	2.2.1	Reactor Protection System	
		Instrumentation Setpoints	
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- 2. 3.3.1 Reactor Protection System Instrumentation Setpoints
- 3. 3.3.4.2 Recirculation Pump Trip Actuation Instrumentation
- 4. 3.8.4.4 RPS Electric Power Monitoring (RPS Logic)
- 5. 3.8.4.5 RPS Electric Power Monitoring (SCRAM Solenoids)

VII. RELATED PLANT EVENTS

- A. Refer to the following LER's:
 - 1. 86-10 Quarter Core SCRAM
 - 2. 86-14 Loss of Power to Group 2 SCRAM Solenoid Coils
 - 3. 86-19 Recurrence of SDV High Reactor SCRAM due to Ineffective Corrective Action
 - 4. 87-10 Spurious Reactor SCRAM Signal due to Technician Error
 - 5. 87-54 MSIV Isolation Signal due to Turbine Stop Valve Surveillance Testing
 - 6. 87-82 MSIV Isolation and subsequent SCRAM due to Mode Switch Design Deficiency

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B. Industry Concerns 1. G.E. Problem Report GE PRC 89-24 Malfunction of CR2940 Switch a. Go over high lighted portions of the report with class - point out how to avoid this problem with "positive" key action b. Key lock switches (Sposition) used in the following locations

The following is a list of applications of the GE CR 2940 switch (P/N 145C3040P022) at NMP2:

Control switches for safety relief valves;

2MSS*PSV121 2MSS*PSV124 2MSS*PSV127 2MSS*PSV130 2NSS*PSV133 2MSS*PSV136

2MSS*PSV122 2MSS*PSV125 2MSS*PSV128 2MSS*PSV131 2MSS*PSV134 2MSS*PSV137

Turbine Stop Valve Closure Test Switches Turbine Control Valve Fast Closure Test Switches Main Steam Line Isolation Valve Closure Test Switches



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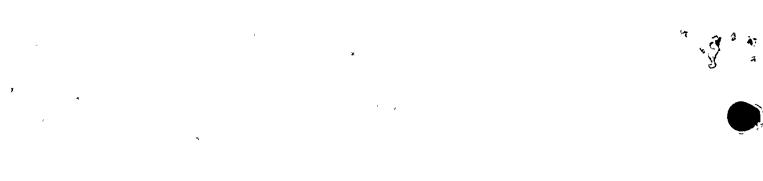




 7. 89-11 Miscalibration of Main Steamline Radiation Monitors causes Violation of Technical Specifications

VIII. SYSTEM HISTORY

- A. Refer to the following RPS System modifications:
 - 1. PN2Y88MX085 Provide Lights to verify RPS TSV Closure Relays Energized.
- IX. WRAP UP
 - A. Review the System Learning Objectives



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