07-186-91

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

02-LOT-001-215-2-02 Revision 6

TITLE: ROD BLOCK MONITOR

	SIGNATURE	DATE
PREPARER		5/23/91
TRAINING AREA SUPERVISOR		6/3/91
TRAINING SUPPORT SUPERVISOR	for J. LeClair	6-3-91
PLANT SUPERVISOR/ USER GROUP SUPERVISOR	FOR JB HAECKER	6/19/91

Summary of Pages

(Effective Date: 6/19/91)

Number of Pages: 14

Date	Pages
May 1991	1 - 14

TRAINING DEPARTMENT-RECORDS ADMINISTRATION ONLY:

VERIFICATION: _____

DATA ENTRY: _____

RECORDS: _____

16. 5/3/02

I. TRAINING DESCRIPTION

A. Title of Lesson: Rod Block Monitor

B. Lesson Description: 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. Estimate of the Duration of the Lesson: 2.0 hours

D. Method of Evaluation, Grade Format, and Standard of Evaluation:
Written examination: passing grade of 80% or greater.

E. Method and Setting of Instruction:
This training should be conducted in the classroom.

F. Prerequisites:

1. Instructor:

a. The instructor shall be familiar with the lesson materials and have achieved the necessary instructor certification in accordance with NTP-16.

2. Trainee:

a. Initial License Candidate - In accordance with the eligibility requirements of NTP-10.

G. References:

1. Technical Specifications

a. 3/4.1.4.3 Rod Block Monitor

c. 3/4.3.6 Control Rod Block Instrumentation

2. Procedures

a. N2-OP-92 Neutron Monitoring System

3. NMP-2 FSAR

a. Design Basis, Vol 16, Section 7.7-40

4. Technical Manuals

a. GEK 83310 Nuclear Monitoring Systems

II. REQUIREMENTS

A. AP-9, Administration of Training

B. NTP-10, Training of Licensed Operator Candidates

III. TRAINING MATERIALS

A. Instructor Materials:

1. Training Record
2. Instructor's working copy of the lesson plan
3. Whiteboard and Markers
4. Overhead Projector
5. Transparencies as needed
6. Flip Chart (if necessary)
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

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

V. LEARNING OBJECTIVES

Upon completion of this training the trainee will have gained the knowledge to:

A. Terminal Objectives:

TO-1.0 Perform the required actions when the Rod Block Monitor fails to null (2129170101).

TO-2.0 Locate the Nuclear Instrumentation System power supplies (2150050101).

TO-3.0 Operate the Nuclear Instrumentation System during a reactor startup (2150190101).

B. Enabling Objectives:

EO-1.0 Explain the purpose of the Rod Block Monitor System.

EO-2.0 Describe the purpose and function of each of the following list of the major components and auxiliary systems of the Rod Block Monitor System:

a. Selection Matrix
b. Averaging Circuit
c. Gain Change Amplifier
d. How Amplitude Trip Circuits
e. Count Circuit
f. Flow Units
g. Flow Control Trip Reference
h. Trip Units

EO-3.0 For the following interlocks

1) State the setpoint
2) Describe its purpose:
   a) RBM Downscale
   b) RBM Inop
   c) RBM Gain Adjust
   d) RBM upscale

EO-4.0 Given a specific set of plant conditions, determine how the Rod Block Monitor System responds.

EO-5.0 Describe the interrelationship of the following systems that interrelate with the Rod Block Monitor System.

a. Plant Electrical Distribution
b. Neutron Monitoring System (APRMS)
c. Reactor Manual Control

EO-6.0 Given NMP2 Technical Specifications and a set of plant conditions, determine the appropriate bases, limiting condition for operations, limiting safety systems setting, and/or actions statement as appropriate. |6

EO-7.0 For the precautions and limitations listed in N2-OP-92 explain the basis for each precaution and limitation.

EO-8.0 Regarding the Rod Block Monitor System, determine and use the correct procedure to identify the actions and/or located information related to.

a. Startup
b. Shutdown
c. Normal
d. Off Normal
e. Annunciator Response Procedures

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
I. INTRODUCTION	Preliminary Activity	6
	1. Introduce self to trainees (if unfamiliar).	
	2. Circulate and explain Training Record.	
	3. Explain Method of Evaluation.	
	4. Pass out Course Evaluation Forms.	
Student Learning Objectives	Pass out copies of Learning Objectives.	
A. Purpose		EO-1.0
1. The Rod Block Monitor (RBM) is a monitoring system which ensures that local neutron flux levels do not exceed preset limits during control rod withdrawal.		
2. The RBM prevents the power in the fuel bundles surrounding the control rod being withdrawn from approaching thermal limits thereby preventing gross overpower in the local region which would not exceed core power limits.		
3. The RBM will apply rod withdrawal blocks to prevent a local over-power condition, when power is above 30%.		
B. General Description		
1. Rod Block Monitor is a subsystem of the Neutron Monitoring System.	Show TP	6

a. Composed of RBM channel A/B which monitor local flux levels during rod withdrawal, and generates trip signals (if APRM's >30%).

b. Generates flow-biased trip signals (blocks), related to RRS driving flow

II. DETAILED DESCRIPTION — EO-2.0a | 6

A. Selection Matrix |

1. Each RBM channel contains a selection matrix which utilizes a signal from the Rod Select Module (RSM) to select up to eight Local Power Range Monitor (LPRM) detectors adjacent to the selected rod.

a. RBM Channel A selects A and C LPRM detectors.

b. RBM Channel B selects B and D LPRM detectors.

This is done to evenly distribute flux to the channels (one input of relatively high flux, one of low) | 6 | |

2. The LPRM signals are sent to the averaging circuit and the count circuit.

B. Averaging Circuit — EO-2.0.b | 6

1. The averaging circuit receives the LPRM signals from the selection matrix and outputs a local core average power signal.

2. The average power signal is sent to a gain change amplifier.

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
C. Gain Change Amplifier		EO-2.0c |6
1. The Gain Change Amplifier compares the local power signal from the averaging circuit with the Average Power Range Monitor (APRM) channel output.		
a. RBM A uses APRM C and E.	APRM C is the primary. APRM E will input if C is bypassed with the joystick.	|6 | |
b. RBM B uses APRM D and F.	Same arrangement with D primary.	|6
2. If the local core power is less than average core power, the gain change amplifier increase the local core power signal until it equals the average core power signal.		
a. This moves power as seen by the trip units closer to a trip point before rod withdrawal starts.		
b. This limits the amount that the selected rod may move to increase power.	The gain is left at unity if greater than or equal to average power.	|6 |
3. If the local core power is equal to or greater than average core power, no amplification takes place.		
4. This comparison and gain change is called a nulling sequence and takes place immediately after a rod selected on the RSM.		

5. The output of the amplifier is applied to the RBM trip units and to recorders on panel 603.

D. Low Amplitude Trip Circuits — EO-2.0d |6

1. Each of the eight low amplitude trip circuits monitors an LPRM signal from the selection matrix that will be used by the averaging circuit and removes the signal it is monitoring, from the averaging circuit, if the signal fails low.
2. An output from each low amplitude trip circuit is applied to the count circuit.

E. Count Circuit — EO-2.0e |6

1. The count circuitry ensures that a significant number (at least half) of the LPRM signals are being averaged by counting the number of low amplitude trip units untripped.
2. The count circuit determines the number of LPRM signals required to be averaged by receiving a signal from the selection matrix and corrects itself for a rod from a center, 3 LPRM string, or 2 LPRM string group.

   This ensures the trip is variable depending on the normal number of inputs. |6
3. Its output is sent to an RBM trip unit if an insufficient number of LPRM's are available.

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
F. Flow Units		
1. Reactor Recirculation Flow Units provide two inputs to each RBM channel. a. RBM A from flow units A and C. b. RBM B from flow units B and D.		EO-2.0f
2. The flow signal with the lowest value is used.	This will establish the most conservative setpoints.	|6
G. Flow Control Trip Reference	Converts the flow signal to a variable reference voltage for use by the trip units.	EO-2.0g |6
1. The flow control trip reference circuit receives the flow input signal and outputs four flow reference signals for the RBM trip units.		
H. RBM Trip Units		
1. The RBM trip units compare the local core power with core flow and provide rod block signals to the reactor manual control system if setpoints are reached.		EO-2.0h |6
2. By receiving the four flow references they provide the means by which a rod block can occur at a low, intermediate, or high level.		
a. The last flow reference is used for a backup trip unit, set above the high (normal) level to provide a rod block if the normal trip unit fails.	This is a backup only and cannont be selected by the operator.	|6

3. A trip unit that compares power against a fixed reference will provide a rod block if the RBM channel fails low.
4. The APRM signals used in the gain change amplifier comparator are also used by a trip unit for automatic bypassing of the RBM below 30% power.
5. A rod block will occur if another trip unit determines the RBM is inoperative.

III. INSTRUMENTATION, CONTROLS, AND INTERLOCKS

A. Instrumentation

1. Power

a. The LPRM strings provide input to the RMB for local core power indication and averaging.

b. The APRM channels provide input to the RMB for core power signal and automatic bypassing of the RBM.

2. Flow

a. The Reactor Recirculation flow units provide core flow for comparison with power in the RBM trip units.

B. Controls

1. Operator controls and indications are provided on panel 603 to set the intermediate and high trip levels and a joystick for manual bypass of one (1) channel (A or B).

C. Interlocks (Refer to Table 1)

Using Table 1, cover all trips and related setpoints.

EO-3.0 |6

IV. SYSTEM OPERATION

A. Normal Operation

RBM

EO-4.0 |6

1. RBM auto initiated at 30% (increasing) — As sensed by reference APRM (align w/#1) — 6
2. Effects of increasing power -Alarm Set Lo lite lit
   a. As power increases (locally) the "Push to Set Up" light illuminates (rod block setpt minus 2%). This informs the operator that the Low Level rod block is near.
   b. Operator presses "Push to Set Up", which transfers the RBM to the next higher trip level (prevents getting an unwanted rod block).
   c. "Alarm Set Low" and "Push to Set Up" lights extinguish, "Alarm Set Intm" light illuminates.
   d. If further power increases (local) cause the Normal Transfer Level trip to reset, the "Push to Set Up" light illuminates again.
   e. Operator presses "Push to Set Up" which extinguishes "Push to Set Up" an "Alarm Set Intm" lights, and illuminates "Alarm Set Hi" light.
   f. Further rod withdrawal is limited to the rod block setpoint (Normal).
   g. The Rod Block Backup (Upscale) will limit withdrawal if others fail.

3. RBM will be automatically bypassed when power decreases below 30%.

B. Infrequent Operation — EO-3.0b |6

RBM Infrequent Operation

Bypasses (RBM)

1. One RBM may be manually bypassed without a rod block.
2. Automatic bypasses of RBM:
   a) Peripheral rod selected
   b) No rod selected
   c) APRM level <30%

   Bypass termination initiates null sequence.

V. SYSTEM INTERRELATIONS

A. Plant Electrical Distribution

The RBM is powered by 120 VAC from 2 VBS*PNLA104 and 2 VBS*PNLB104 — These are fed from UPS 3A and 3B respectively — EO-5.0a |6

B. Neutron Monitoring System

The RBM receives signals from APRM and LPRM system. — EO-5.0b |6

C. Reactor Manual Control System

The RBM receives rod I.D. signals from the Rod Select Module and sends rod permissive output signals to Reactor Manual Rod Control System. — EO-5.0c |6

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES

VI. DETAILED SYSTEM REFERENCE REVIEW

Review each of the following referenced documents with the class.

A. Technical Specifications — EO-6.0 | 6

1. 3/4.1.4.3 Rod Block Monitor
2. 3/4.3.6 Control Rod Block Instrumentation

B. Procedures

1. N2-OP-92 Neutron Monitoring System — EO-7.0/ EO-8.0 | 6

VII. RELATED PLANT EVENTS

A. Refer to Addendum "A" and review related events with class (if applicable).

VIII. SYSTEM HISTORY

A. Refer to Addendum "B" and review related modifications with class (if applicable).

IX. WRAP-UP

A. Review the Student Learning Objectives

Table 1

RBM ROD BLOCKS

Withdrawal Block	Setpoints	Bypassed	
RPM Downscale Alarm	1) ≥ 5% 2) Failure to null	Reactor Mode Switch not in RUN, RBM bypassed.	EO-3.0.a EO-3.0.b
RBM Inop Alarm	1) <1/2 LPRM inputs 2) Select Matrix self-check unsuccessful 3) Failure to null 4) Drawer interlocks open. 5) RBM Mode switch not in Operate.	RBM bypassed (Inop Inhibit pushbutton depressed for 5)	
RBM Gain Ajust in Progress	First 1/2 second of null sequnce.	RBM bypassed	EO-3.0.c
RBM Upscale Alarm			
1) Low	≤.66 (W - W)+24%	RBM bypassed	EO-3.0.d
2) Intermediate	≤.66 (W - W)+32%	RBM bypassed	
3) Normal	≤.66 (W - W)+44% with a maximum of 110%	RBM bypassed	
4) Backup	≤.66 (W - W)+54% W = Reactor Recirc Flow W = Adjustment for number of operating loops as specified in tech. specs.	RBM bypassed	

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