NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS

LESSON PLAN

RADIATION MONITORING SYSTEM

02-REQ-Ø91-272-2-Ø1

Prepared by: Unit #2 Training Department

APPROVALS	SIGNATURES	DATE AND INITIALS REVISION 4
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Summary of Pages

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THIS LESSON PLAN IS A GENERAL REWRITE

NIAGARA MOHAWK POWER CORPORATION

Attachment "A"

OBJECTIVE APPROVAL

Author: UNIT II OP's TRAINING

Training Dept: Unit II OPS.

Lesson Title: Radiation Monitoring System

Lesson Plan #: NZ-OLP-62

Training Setting(s): Classroom

Purpose: 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: LICENSED OPERATOR CANDIDATE
NON-LICENSED OPERATOR TRAINING
LICENSED OPERATOR REQUALIFICATION

Approvals/Review	Signatures	Date
Training Supervisor		1/16/89
Plant Supervisor		1/23/89
Training Analysts Supervisor		1-12-89

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

I. TRAINING DESCRIPTION

A. Title: N2-OLP-62, Radiation Monitoring System

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

C. Estimated Duration: Approximately 1.5 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. 3/4.3.7.1, Radiation Monitoring
   b. 3/4.3.7.10, Radioactive Liquid Effluent
   c. 3/4.3.7.11, Radioactive Gaseous Effluent Monitoring Instrumentation
2. Procedures
   a. N2-OP-79, "Radiation Monitoring System"
3. NMP-2 FSAR
   a. Vol. 25, Chapter 12, Page 123-1

II. REQUIREMENTS AND PREREQUISITES

A. Requirements for Class:

1. AP-9, Rev. 2, "Administration of Training"
2. NTP-10, Rev. 4, "Training of Licensed Operator Candidates"
3. NTP-11, Rev. 5, "Licensed Operator Retraining and Continuing Training"
4. NTP-12, Rev. 3, "Unlicensed Operator Training"

B. Prerequisites:

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

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

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

2. Students

a. Meet eligibility requirements per 10CFR55, or

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

III. TRAINING MATERIALS

A. Teaching Materials:

1. Transparency Package
2. Overhead Projector
3. Whiteboard and Felt Tip Markers
4. N2-OLP-62
5. N2-OLT-62
6. See Section I.E.1
7. See Section I.E.2

B. Student Materials

1. N2-OLT-62
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. STUDENT LEARNING OBJECTIVES FOR RADIOACTIVE WASTE SYSTEM

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

62-1 State the purpose of the Radiation Monitoring System (RMS).

62-2 Describe the subsystems of Radiation Monitoring System.

62-3 Explain where the following types of radiation detectors employed in the process and area radiation monitors are used:

a. Scintillation detectors
b. Ionization chamber
c. Geiger-Mueller chambers

62-4 Name the systems which automatically isolate on high radioactivity in their process or effluent stream.

62-5 List the types of radiation detectors used for process and area radiation monitoring.

62-6 Given N2-OP-79, "Radiation Monitoring System", identify the appropriate actions and/or locate information related to:

a. Start-Up
b. Normal Operations
c. Shutdown
d. Off Normal Operations
e. Procedures for Correcting Alarm Conditions

62-7 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 RMS System.

VI. LESSON CONTENT	Text Ref. Page	Text Ref. Fig.	S.L.O.
I. INTRODUCTION			
Student Learning Objectives	i		
A. System Purpose	1		1
The Radiation Monitoring System (RMS) collects and processes data from radiation monitoring sensors throughout the plant. It incorporates the functions of an Area Radiation Monitoring System (ARM) and a Process Radiation Monitoring System (PRM).			
The Area Radiation Monitoring System monitors, records and provides alarms for radiation levels in selected plant areas. The Process Radiation Monitoring System monitors, records and provides alarms for radioactivity or concentration levels in potentially radioactive effluents or process streams. The systems also initiate appropriate protective action to limit the uncontrolled release of radioactive materials to the environment.			
B. General Description			
1. The Radiation Monitoring System encompasses two functional groups:			
a. Process Radiation Monitoring System (PRM)			
b. Area Radiation Monitoring System (ARM)			
2. PRM and ARM are brought together under the Digital Radiation Monitoring System (DRMS). DRMS has 4 operational systems:			2
a. Radiation Detection			
b. Data Acquisition			
c. Data Processing			
d. Alarm and Data Display			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
3. Area Radiation Monitoring	2		
a. Reports and records abnormal gamma radiation levels in areas where radioactive materials may be stored, transported or inadvertently introduced.			
b. Has warning alarms for high radiation and channel failure, but does not initiate any protection or control functions.			
c. Most of the area radiation monitors are Geiger-Mueller tubes. The rest are ionization Chambers.			3b, 5 3c
d. Output from radiation monitors goes to their associated microcomputer data processor,. then to the central computer which feeds display terminals in the control room and other important stations.			
4. Process Radiation Monitoring			2
a. Monitors radiation levels in potentially contaminated liquid process streams, gaseous process streams and the airborne radioactivity levels in potentially contaminated ventilation ducts using 33 monitors.			
b. When a radioactivity setpoint is exceeded:			
1) The condition is annunciated in the control room.			
2) Trip signals automatically close isolation valves to prevent release of radioactivity to the environment.			
c. The processing of signals from the PRM detectors is the same as the ARM's.			
d. Some monitors sample a small portion of the process stream while others measure the radiation emanating from the pipe.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
5. Radiation Detection Subsystem	2	1	2
a. Consists of ARM's and RPM's			
6. Data Acquisition Subsystem	3		
a. Consists of Data Acquisition Units			
1) Serve as the interface between the monitors and processors.			
2) Provides local indication and alarm functions.			
7. Data Processing Subsystem			
a. Receives data from the radiation monitors via the Data Acquisition Subsystem			
b. Generates displays, logs and reports.			
c. Provides for storage of the data in memory.			
8. Alarm and Data Display Subsystem			
a. Consists of:			
1) Safety related (Category I) Auxiliary Control Units			
2) Related controls			
3) Alarms			
4) Recorders in the control room on the Process and Area Radiation Monitoring Panel PNL880.			

II. DETAILED DESCRIPTION

A. Radiation Monitors

1. Function
   a. Detect and respond to the presence of radioactivity in a system or area.
   b. Measure the level or concentration of radioactivity.
   c. Electronically transmit information on radioactivity to the data acquisition and processing subsystems.

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
2. Types (7)	4		
a. Off-Line gas monitors			
1) Used in the Control Room air intake ducts, the standby gas treatment system discharge, the off-gas system pretreatment lines and the reactor building ventilation ducts from above and below the refueling floor.			
2) Detector is a beat scintillation counter			5
3) Continuously withdraws a sample through an isokinetic nozzle within the ventila-			
4) The sample gas is drawn through charcoal and particulate filter cartridges, through the sample chamber where it is counted and returned to the process stream by a sample pump.			
5) The filters are removable for laboratory analysis.			
6) Detector circuit continuity is periodically verified using a remotely operated check source.			
7) Gas sample chamber and sample tubing can be purged remotely with air.			
b. Off-line gas and particulate monitors			
1) Used to monitor activity in the drywell atmosphere.			
2) A sample pump draws air from the drywell through a moving filter paper, removable charcoal filter cartridges, a gas sample chamber and returns it to the drywell.			
3) Particulate activity accumulating on the filter paper is counted by a beta scintillation detector.			31, 5

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
4) Airborne activity is monitored in the sample chamber by a separate detector.	5		3a, 5
5) There are connections for taking grab samples of the process stream and for taking samples downstream of the filters for tritium analysis.			
6) Use of check sources and purging is similar to the off-line gas monitors.			
c. <u>On-line liquid or gas monitors</u>			
1) Use ion chamber radiation detectors.			3b
2) Monitor radwaste feed to the extruder/ evaporators and main steam line radiation.			
3) Mounted directly on the outside of the pipe being monitored. No contact with the process fluid.			
4) Shielded to minimize the effect of background radiation.			
5) Provided with check sources for circuit continuity checks.			
6) Main steam line detectors provide radiation level trip signals to the Reactor Protection and Containment Isolation systems. They do not interface with the Digital Radiation Monitoring System.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
d. Off-line liquid monitors	5		
1) Scintillation detectors count the activity in a liquid sample chamber			3a,5
2) A continuous liquid sample is drawn through a sample chamber from the following sources: service water side of the Residual Heat Removal heat exchangers, service water system discharge, fuel pool cooling pumps discharge, turbine building closed loop cooling water, reactor building closed loop cooling water, liquid radwaste effluent and cooling tower blowdown.			
3) A pump inside the monitor unit returns the sample fluid to its system of origin.			
4) Heat exchangers cool the samples from high temperature systems.			
5) Each detector has its own integral check source.			
e. On-line isotopic monitors			
1) Three detectors within the on-line isotopic monitor check for iodine, noble gases, and particulate activity.			
2) They are used for the effluent of the main stack and the reactor building ventilation system exhaust.			
3) The monitor automatically purges itself with air and performs daily maintenance routines such as background checks, source checks and diagnostic checks.			
4) Monitors controlled by a separate microcomputer on T.B. 306' elevation (counting room) and they print out in the control room. TSC and EOF.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
f. Portable continuous air monitor (CAM)	5		
1) Mounted on a wheeled carriage to transport whenever needed.			
2) Scintillation detectors monitor for noble gas and particulates.			3a
3) A removable charcoal filter allows sampling of riodine.			
4) Monitors process ventilation systems and local area ambient airborne activity.			
5) Fixed isokinetic probes on the CAM are used to monitor ventilation systems.			
6) Computer interface capability is provided through remote terminal connections.			
g. Area Radiation Monitors	6		
1) Five different models to cover five different ranges of radiation level.			
2) The ARM detectors measure gamma radiation levels in the detector's general area.			
3) Geiger-Mueller chambers are utilized for the 3 low ranges and ionization chambers for the 2 high ranges.			
4) Each of 58 detectors in the plant has its own integral check source.			
B. Data Acquisition Subsystem (DAS)			2
1. Each radiation monitor in the plant has an associated microcomputer physically located near the detector.			
2. Each microcomputer incorporates two sub-units of the Data Acquisition Subsystem, one of which is the Data Acquisition Unit (DAU).			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
3. Data Acquisition Unit (DAU)	6		
a. The DAU calculates the radioactivity or radiation present and displays the results.			
C. Data Processing Subsystem			
1. Central Processing Units			
a. Located in Computer Room.			
b. Consists of two redundant units.			
2. Composed of:			
a. Five display units (CRT's), five receive-only printers and two printers with send and receive capability.	7		
3. Receive only printers			
a. Provides a hard copy printout of radiation monitoring data hourly or on demand.			
D. Alarm and Data Display Subsystem (Control Room panel PNL880)			2
1. Applies only to the safety related, Category 1 radiation monitors.			
2. Consists of:			
a. Divisional auxiliary control units			
b. Pen recorders in the control room			
c. Process and Area Radiation Monitoring Panel			
3. Auxiliary Control Units			
a. Receives data from the associated Data Acquisition Unit for display and alarm.			
b. Provides remote controls for all DAU operations.			
c. Can provide input to one of the pen recorders in the control room panel PNL880.			
E. Main Steam Line Radiation Monitoring System			
1. Noncomputer Based Process Radiation Monitoring			
a. Monitors gamma radiation external to the main steam lines.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
b. Provides channel trip signals to the RPS and the containment isolation system in the event of gross release of fission products from the core. Trip signals provided for: 1) RPS 2) PCIS 3) Vessel Isolation	7		2
c. System consists of four redundant instrument channels.			
d. Detectors are located near Main steam lines just downstream of the outboard MSIVs.			
e. Detectors arranged such that significant rad level increase is seen by all detectors.			
III. INSTRUMENTATION, CONTROL AND INTERLOCKS	8		
A. Instrumentation			
1. Control room instrumentation for the Area and Process Radiation Monitoring systems located on panel 880 and the Operator's Console.			
B. Controls			
1. Located on Operator's Console in the Control Room.			
C. Interlocks			
1. Reactor Building Ventilation Above and Below Refueling Floor			
a. On a high radiation alarm signal, the exhaust flow path is isolated and the reactor building air is recirculated. A small fraction of the air is diverted and exhausted through the Standby Gas Treatment System (SGTS) which auto initiates on same signal.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
2. Main Control Room Air Intake	8		
a. If the activity of the unfiltered control room intake air reaches the high radiation setpoint of the radiation monitors, the air is diverted through a HEPA and charcoal filter train.			
3. Liquid Radwaste Effluent			
a. Isolates radwaste effluent on high radiation level.			
4. Standby Gas Treatment Discharge	9		
a. The off-line gas monitor installed on the discharge of the Standby Gas Treatment System isolates the normal containment purge on high radiation level.			
5. Off-gas Pretreatment			4
a. The offgas process flow upstream of the charcoal bed absorbers is monitored by offline gaseous monitors. These monitors isolate the offgas effluent following receipt of a high radiation signal.			
6. Main Steam Line Radiation Monitoring			
a. Each channel has four trip circuits: two upscale (high-high and high), one downscale (low) and one inoperative.			
b. A high-high (>3x normal) or inoperative trip of the radiation monitor results in trip of that channel's auxiliary trip unit which provides an input to Reactor Protection and Containment Isolation logic circuits.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
c. A one-out-of-two twice main steam line radiation channel trip results in initiation of main steam isolation valve closure, reactor scram, mechanical vacuum pump shutdown and discharge valve closure. A high level or downscale trip actuates an annunciator in the main control room to warn the operator of off-normal conditions and a potential Rx scram.	9		

IV. SYSTEM OPERATION

A. Normal Operation

1. The RMS passively monitors the radiation levels at its process and area monitors and prints out hourly averages of all the monitored stations.
2. It also provides a display containing informaltion on the safety-related category I monitoring channels at the operator's console and provides a full screen display of radiation channels grouped by areas of the plant when requested.
3. A group display function is also available which groups monitors by the function they perform. Operators can also create their own group by commanding the CRT to display the readings of the specific channels he wants to monitor. 10

B. Emergency Operation

When a radiation monitor's reading exceeds its "alert" or its high radiation alarm setpoint, an annunciator is received in the control room.

V. SYSTEM INTERRELATIONS

A. Control Room Ventilation - monitored by four off-line gas monitors on control room air intake ducts.

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
B. Reactor Building Ventilation - monitored by four off-line gas and particulate monitors; two each for above and below refueling floor.	10		
C. Service Water - monitored by four off-line liquid monitors; one at each Residual Heat Removal heat exchanger outlet, two on the system discharge line.			
D. Primary Containment - atmosphere monitored by two off-line gas and particulate monitors; also monitored by four post-accident area radiation monitors.			
E. Reactor Building Closed Loop Cooling Water - monitored by two off-line liquid monitors.			
F. Turbine Building Closed Loop Cooling Water - monitored by one off-line liquid monitor.			
G. Circulating Water - monitored on cooling tower blowdown line by one off-line liquid monitor.			
H. Standby Gas Treatment - monitored on discharge line by one off-line gas monitor.	11		
I. Turbine Building Ventilation - a connection tap is provided in the system exhaust ductwork for a portable Continuous Air Monitor.			
J. Radioactive Liquid Waste - monitored by off-line liquid monitor in the effluent line.			
K. Offgas - monitored before charcoal bed adsorbers (pretreatment) by two off-line gaseous monitors.			
L. Spent Fuel Pool Cooling - monitored by off-line liquid monitor at filter inlet.			
M. Solid Radioactive Waste - monitored by on-line liquid radiation monitors; one each for waste sludge feed and waste concentrates feed to extruder/evaporator.			
N. Main Steam - monitored by area monitors downstream of outboard main steam isolation valves for scram and containment isolation protection.			

VI. DETAILED SYSTEMS REFERENCE REVIEW

Review each of the following referenced documents with the class.

A. Technical Specifications

1. 3/4.3.7.1, Radiation Monitoring
2. 3/4.3.7.10, Radioactive Liquid Effluent
3. 3/4.3.7.11, Radioactive Gaseous Effluent Monitoring Instrumentation

B. Procedures

1. N2-OP-79, "Radiation Monitoring System"

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.