NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS

02-LOT-001.255-2-00 Revision 6

TITLE CONDENSER AIR REMOVAL AND OFF-GAS

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Summary of Pages

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THIS LESSON PLAN IS A GENERAL REWRITE

5/3/327 48pp

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I. TRAINING DESCRIPTION

A. Title of Lesson: Condenser Air Removal and Off-Gas

B. Lesson Description: This lesson contains information pertaining to the Condenser Air Removal and Off-Gas System. The scope of this training is defined by the learning objectives and in general covers the knowledge required of a Licensed Control Room Operator.

C. Estimate of the Duration of the Lesson: 4 hours

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

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

F. Prerequisites:

1. Instructor:
   a. Certified in accordance with NTP-16.
2. Trainee:
   a. Initial License Candidate - In accordance with the eligibility requirements of NTP-10.
   b. Licensed Operator Requal - In accordance with the requirements of NTP-11.

G References:

1. Technical Specifications
   a. 3.4.5 Specific Activity
   b. 3.11.2.1 Dose Rate
   c. 3.11.2.2 Dose - Noble Gases
   d. 3.11.2.4 Gaseous Radwaste Treatment System
   e. 3.11.2.6 Explosive Gas Mixture
   f. 3.11.2.7 Main Condenser Off-Gas
2. Procedures
   a. N2-OP-9 Condenser Air Removal System
   b. N2-OP-42 Off-Gas System
   c. N2-EOP-6, Attachment 16
   d. N2-EOP-MSL "MSIV Leakage Control"
   e. N2-EOP-RR "Radioactivity Release Control"

3. NMP-2 FSAR
   a. Design Bases Sections 10.4.2 and 11.3
4. Industry Events
   a. NRC IE Information Notice 83-52
   b. Service Information Letter 150, Rev. 2
   c. Service Information Letter 150, Rev. 2, Supplement 1

II. REQUIREMENTS

A. AP-9, Administration of Training
B. NTP-10, Training of Licensed Operator Candidates
C. NTP-11, Licensed Operator Requalification Training
D. NTP-12, Unlicensed Operator Training

III. TRAINING MATERIALS

A. Instructor Materials:
   1. Classroom
   2. Lesson plan
   3. TR
   4. Transparency package
   5. Overhead projector
   6. Applicable references
   7. Trainee handouts
B. Trainee Materials
   1. Handouts (can include text, drawings, objectives, procedures, etc.)
   2. Pens, pencils, paper
   3. Course Evaluation

IV. EXAMS AND MASTER ANSWER KEYS

A. Exams will be generated and administered as necessary.
B. Exams and master answer keys will be on permanent file in the records room.

V. LEARNING OBJECTIVES

A. Terminal Objectives:

Upon completion of this lesson, the trainee will demonstrate the knowledge to:

TO#	Terminal Objective	Task Number
TO-1.0	Perform the actions for a loss of condenser vacuum	2000080501
TO-2.0	Start and operate the mechanical vacuum pumps.	2550090101
TO-3.0	Place the steam jet air ejector in service from the Control Room.	2550110101
TO-4.0	Seal the turbine with the gland seal system.	2550130101
TO-5.0	Shutdown the condenser air removal system.	2559010101
TO-6.0	Operate the SJAE with the aux boiler steam.	2559030101
TO-7.0	Perform lineups on the Off-Gas System.	2710010101
TO-8.0	Shutdown the Off-gas System.	2710070101
TO-9.0	Operate the Off-gas System with a vacuum pump high suction pressure.	2719050401
TO-10.0	Operate the Off-gas System with a freeze out dryer high differential pressure.	2719060401
TO-11.0	Operate the Off-gas System during fuel clad failure or high activity in the reactor coolant.	2719070101
TO-12.0	Perform the actions required for an Off-gas hydrogen explosion.	271908501
TO-13.0	Perform the actions required for a fire in the Off-gas charcoal adsorbers.	2719090501
TO-14.0	(SRO ONLY) Respond to an increasing main steam line radiation level.	3449440503
TO-15.0	(SRO ONLY) Recover from automatic termination of off-gas release due to effluent monitor system alarm.	3440600303

TO-16.0 (SRO ONLY) Direct the actions for a fuel clad failure or a high activity in reactor coolant or off-gas. 3449750403

TO-17.0 (SRO ONLY) Direct the actions for a hydrogen explosion in the Off-gas System. 3449780403

TO-18.0 (SRO ONLY) Direct the actions for a fire in the Off-gas charcoal adsorbers. 3449790403

TO-19.0 (SRO ONLY) Respond to a high main stack radiation. 3449830403

TO-20.0 (SRO ONLY) Respond to an Off-gas isolation. 3449990403

B. Enabling Objectives:

EO-1.0 Explain the purpose and function of the Condenser Air Removal and Off-Gas System.

EO-2.0 Describe the purpose and function of each of the following listed major components of the Condenser Air Removal and Off-gas System.

a. Air Removal Pumps
b. Air Ejectors
c. Recombiners
d. Dryers
e. Charcoa' Adsorbers

EO-3.0 Regarding the Condenser Air Removal and Off-Gas System, (1) locate the correct drawings and (2) Use drawings to perform the following:

a. Identify electrical and mechanical components
b. Trace the flowpath of fluids
c. Identify interlocks and setpoints
d. Describe system operation
e. Locate information about specific components
f. Identify system interrelations

EO-4.0 (1) State the setpoint and (2) Describe its purpose for the following interlocks:

a. Condenser air removal pump trip.
b. Condenser air removal pump isolation.

c. Recombiner train inlet and outlet valves.
d. Off-gas vacuum pump trip.
e. Off-gas system discharge isolation valve.
f. Off-gas system refrigerator unit trip.

EO-5.0 Determine and use the correct procedure to identify the actions and/or locate information related to the following with regards to the Condenser Air Removal and Off-gas System.
a. Startup
b. Shutdown
c. Normal Operations
d. Off-Normal Operations
e. Annunciator Responses

EO-6.0 Describe how the Condenser Air Removal and Off-Gas System is utilized during the performance of the EOP's.

EO-7.0 Describe the interrelationship that the following list of systems have with the Condenser Air Removal and Off-Gas System.
a. Condensate (CNM)
b. TBCLCW (CCS)
c. Service Water (SWP)
d. Main Stack
e. Aux Steam (ASS)
f. Instrument Air (IAS)
g. Service Air (SAS)
h. Electrical System

EO-8.0 (SRO ONLY) Given the NMP2 Technical Specifications and a set of plant conditions, determine the appropriate bases, limiting conditions for operation, and limiting safety system settings, and/or action statement as applicable.

EO-9.0 For the precautions and limitations listed in N2-OP-9 and N2-OP-42 explain the basis for each precaution and limitation.

EO-10.0 Given a specific set of plant conditions, describe the immediate operator actions required.

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
I. INTRODUCTION		
A. Introduction		
1. Have students fill out TR.		
2. Explain purpose of course evaluation and how to use it.		
3. Explain method of evaluation.	Describe daily quizzes/weekly exams.	
4. Review Student Learning Objectives.		
B. System Purpose		EO-1.0
1. The condenser air removal system establishes and maintains a vacuum in the main condenser by drawing the non-condensable gases from the condenser.		
2. The Off-Gas System processes and controls the release of gaseous radioactive effluents from the condenser to the environment through the stack.		
C. General Description		
1. Condenser Air Removal (ARC) Startup Subsystems	Use figures 1-4 and discuss system operation and major flowpaths.	EO-2.0
a. The startup subsystem consists of two motor driven vacuum pumps which take suction on the air cooler sections of the main condenser.		

b. The pumps discharge the gas and water mixture to a separator which discharges the gas to the main stack and supplies the water to the pump seal cooler.

2. Condenser Air Removal Holding Subsystem
   a. The holding subsystem is placed on the line after the condenser air removal vacuum pumps have drawn sufficient condenser vacuum.
   b. The holding subsystem consists of two full capacity steam jet air ejectors (SJAE's) — EO-2.0
      1) Each SJAE consists of:
         a) Precooler,
         b) First stage double jet,
         c) Intercondenser,
         d) And second stage double jet.
      2) SJAE uses auxiliary steam to draw non-condensables from the main condenser and discharge them to the Off-Gas System.

3. Off-Gas System (OFG) — EO-2.0
   a. The OFG consists of preheaters and recombiners which remove hydrogen gas.
   b. The resulting water vapor is removed by an off-gas condenser.

c. Flow of the remaining gases is directed through a long pipe run to allow sufficient time for short lived radioactive isotopes to decay.

d. The moisture content of the gas stream is further reduced by freezeout dryers.

e. The gases are then sent through a series of charcoal adsorbers and are drawn through high efficiency particulate air filters by vacuum pumps which discharge out the main stack.

EO-2.0

EO-2.0

II. DETAILED DESCRIPTION

A. Condenser Air Take-Off Header

1. The condenser air take-off header supplies the air removal startup subsystem through air operated valve 2ARC-AOV105 and the air removal holding subsystem through air operated valve 2ARC-AOV104.

Show Figure 1.
Use Figure to show flowpath and orientation of components.

EO-3.0

2. Each of the three main condenser shells (2CNM-CND1A-C) contains two tube bundles.

   a. Each tube bundle has an air cooling section.

   b. Non-condensable gases flow into vapor ducts in the air cooler section.

c. Two air take-off lines per condenser connect the air cooling section to the header via air operated valves (2ARC-HV25A-C, HV26A-C)

B. Condenser Vacuum Breakers (2ARC-MOV5A-C)

1. A 10-inch motor operated valve is provided on the north end of each main condenser to rapidly admit air through the shell to the condenser and decrease condenser vacuum.

2. Decreasing the vacuum increases the turbine blade windage losses and greatly reduces coast down time.

Used to rapidly slow down the turbine during a loss of CCS. (Turb. Bldg. Closed Loop Cooling).

C. Condenser Air Removal Vacuum Pumps (2ARC-P1A/B)

1. There are two parallel, motor driven, two stage, centrifugal vacuum pumps that remove air and non-condensable gases from the main condenser during startup.

Not used at greater than 5% rated power, because the pumps discharge directly to stack and it is not "detonation" proof.

D. Separator (2ARC-SP1A/B)

1. The separator separates the pump discharge gas from water.

a. Water is collected at the bottom of the separator.

1) Water overflow is directed to Turbine Building equip. drain system.

2) Seal water makeup is supplied from water treatment system.

2. Recirculation pump 2ARC-P2A/B takes a suction from the bottom of the separator and discharges it to the pump seal cooler 2ARC-E1A/B where it is cooled by service water. The water then flows back to the air removal pump.

3. Gases from the separator go through a swing check valve, a silencer, and a manual butterfly valve to a startup discharge header common to both vacuum pumps.

a. The discharge header is equipped with a drain tank 2ARC-TK1 to collect any moisture that may be carried over from the separators. The drain tank is pumped to the Turbine Bldg. floor drains.

b. The discharge header directs non-condensable gases to the main stack.

Discharge gases are mostly Hydrogen which can be made to explode very easily.

E. Steam Jet Air Ejectors

1. The holding air supply branches into two lines that supply the SJAE sets.

2. Each SJAE consists of:

a. Motor operated inlet valve MOV15A/B,

b. Precooler E2A/B

c. 1st stage air ejector jets J1A/B1 and 2
d. Intercondenser E3A/B
e. 2nd stage air ejector jets(J2A/B1 and 2)

3. Each SJAE is located in a shielded cubicle which is inaccessible when the set is in operation.
4. Valves can be operated from either the Control Room or locally using a hand wheel connected to the valve by a reach rod to allow for ALARA concerns.
5. The precooler condenses water vapor entrained in the air.
   a. The water is returned to condenser by a loop seal.
   b. Precooler is cooled by service water.
6. 1st stage air ejector
   a. Each is 100% capacity
   b. Utilizes aux. steam as a driving mechanism
   c. Aux. steam enters air ejector at high velocity and gas molecules in the suction chamber are entrained in the steam flow. This creates a low pressure area and draws in more gases from the Main Condenser and maintains condenser vacuum during operation.

Explain why pressure drops as velocity increases and how a venturi works.

7. Intercondenser receives the discharge from the 1st stage.
   a. The intercondenser uses condensate water to cool the gas/steam mixture.
   b. The intercondenser drains to main condenser by way of a loop seal.
8. 2nd stage air ejector
   a. Increases system efficiency by further reducing condenser pressure.
   b. The 2nd stage air ejectors take suction from the respective intercondenser shell.
   c. They are supplied with sufficient aux. steam flow to ensure the hydrogen concentration in the discharge is less than the lower explosive H_2 concentration of 4 percent by volume.
   d. The discharge of 2nd stage air ejectors combine in a single header to supply the Off-Gas System.

F. Off-Gas Recombiner Trains

1. Two 100% capacity off-gas recombiner trains are provided. These combine Hydrogen from the condenser with Oxygen to prevent H_2 buildup in the Off-Gas System. Each train consists of: a. Preheater, (20FG-E1A/B) b. Catalytic recombiner, (20FG-RBNR 1A/B) c. Condenser (20FG-CND 1A/B), d. Air operated inlet (20FG-AOV1A/B) and outlet (20FG-AOV11A/B) isolation valves.	Use Figure 2 to show flowpaths and explain operation.	EO-3.0
2. Service air is supplied for additional makeup air to maintain sufficient system flow to prevent localized hydrogen buildup and therefore prevent the possibility of a Hydrogen Detonation.	Solution to pollution is Dilution.	
3. The preheater uses aux. steam as heating source to raise the steam/gas mixture from approximately 250°F to 290°F in combination with recombiner catalyst begins the recombination of oxygen and hydrogen. b. The recombination reaction produces additional heating (exothermic). c. Aux. steam is also used for warmup of the recombiner trains.	This reaction becomes self sustaining.	

4. Off-Gas Condenser (CND1A/B) condenses any moisture in the mixture.
   a. The condenser is cooled by TBCLCW.
   b. Condensate is returned to the main condenser.
   c. Non-condensable gases in off-gas condenser are vented through a flow element (FE3A/B) and a discharge train isolation valve (AOV11A/B) to a header that supplies the off-gas dryer section.

G. Off-Gas Dryer Section

1. Off-gas dryer section supply line provides a 75 second holdup time for system flow to allow short lived isotopes to decay.

Use Figure 3 to show flowpaths and explain operation.

EO-3.0

2. There are 3 parallel 100% capacity off-gas dryers (DRY1A-C) used to reduce moisture content in the off-gas stream.
   a. Dryers are freeze out type having a set of 2 refrigerators each.
      1) The medium temperature-refrigerators supply freon to the 1st set of dryer cooling coils.

a) The 1st set of coils consists of 2 condenser coils which cool the gases to approximately 40°F.

b) A hotwell collects condensed moisture and the water in the hotwell is drained to the drain collection skid located in the pipe tunnel under the off-gas equipment rooms.

This remote drain tank assembly was installed in MOD# PN2Y88MX077 because the original sensing lines located on the dryer hotwell were too small and would freeze causing a malfunction of the level control system.

TCO-02
LIC-90-058

c) The drain tank has two associated 100% capacity drain pumps and a motor operated ball valve which operate as follows:
The drain pump to be used is selected on panel 20FG-IPNL122. The pump is controlled by a level switch which starts the pump on a high level and opens the motor operated ball valve (MOV-137). When the tank reaches the low level setpoint, the pump stops and MOV-137 shuts.

If the selected drain pump cannot pump down the tank, a high level alarm will reflash in the control room and the second drain pump will start.

d) The discharge of the drain pump is sent to the main condenser.

2) The low temperature refrigerators supply freon to the 2nd set of coils.

a) The 2nd set of dryer cooling coils consists of a single freezing coil that cools the gas to approximately -20°F.

b) Moisture freezes on coil.

c) Dryer is periodically removed from service for defrosting.

d) Moisture from defrosting of the dryer is collected in the hotwell.

3. Each dryer is provided with air operated inlet (AOV4A-C) and outlet (AOV5A-C) isolation valves.

4. A common discharge header supplies the Off-Gas System charcoal adsorbers.
5. Two dryers are on line during system operation with the third dryer in standby. Of the two dryers on line, one is in operation while the other defrosts.

H. Off-Gas Charcoal Adsorbers

1. There are 8 charcoal adsorbers each containing 6 tons of charcoal.
   a. The adsorbers are normally operated in parallel (2 sets of 4).
   b. Charcoal has a large surface area made of small openings and has a large affinity for xenon and krypton.
2. Charcoal bed operational theory
   a. Air acts as a carrier gas for xenon, krypton and other fission product gases.
   b. Xenon for example, is adsorbed by charcoal. (A weak electrostatic bond is established called the Vanderwall's Force)

Use Figure 4 to show flowpaths and explain operation.

EO-3.0

c. The atoms' random motion will break the electrostatic bond and cause the xenon atom to be carried further into the charcoal bed until it is adsorbed by another charcoal granule.

d. The gas temp. of -20°F and adsorber temp. of 70°F reduces the KE of gases to allow an individual gas atom to stay at a given site longer which provides a 26.6 hr holdup time for krypton and a 20 day holdup time for xenon which allows decay to take place.

e. Krypton and xenon decay to rubidium and cesium respectively. Rb and Cs are particulate and become permanently lodged in charcoal beds.

J. Off-Gas Vacuum Pumps (P1A/B)

1. The vacuum pumps maintain the system at a negative (below atmospheric) pressure to prevent outleakage of gas which could result in hydrogen pockets or radioactive gas buildup in the Off-Gas System.

2. This is the motive force to draw the gas stream through the Off-Gas system.

3. The Pumps take a suction from the HEPA filters which are used to remove charcoal dust (called fines) and other particulates to prevent their discharge out the stack.
4. The pumps are equipped with air operated inlet (AOV45A/B) and outlet (AOV52A/B) isolation valves.
5. Service air connections to each pump suction line insures that sufficient pump suction pressure is maintained.
6. The pumps discharge to the main stack through a line joining the condenser air removal vacuum pump discharge.

III. INSTRUMENTATION, CONTROLS AND INTERLOCKS

A. Instrumentation

1. Moisture
   a. Measured at off-gas dryer outlets. — Figure 3
2. Hydrogen
   a. Measured at outlet of off-gas condensers and common dryer piping. — Figure 2
   b. In order to prevent freezing of the sample lines a sample gas conditioning system was installed upstream of the hydrogen analyzers (MOD # PN2Y87MX233). — The unit is designed to handle analyzer sample flow up to 4 SCFM with a saturated process sample at 120° F. The system is capable of condensing and drying the process sample to a temperature of 36° F (2° C). — TCO-02-IC-90-057

This system consists of a compressor, condenser and heat exchanger with moisture traps all mounted on a common skid. An air eductor is installed in the common discharge line of the H2 analyzers.

c. Alarms in control room on high concentration.

3. Flow — Figure 2

a. Measured in recombiner trains. Indication on Panel 851 used to control makeup air valve to adjust service air flow.

4. Radiation — Figure 3

a. Measured in common charcoal adsorber supply line and provides Off-Gas System isolation on high radiation.

b. Stack radiation level is also measured.

5. Level

a. Recombiner Condenser — Figure 2

b. Off-gas dryers — Figure 3

c. Level used to control drain pumps which allow water to be pumped to the main condenser.

6. Pressure
   a. Off-gas preheater - adjust auxiliary steam flow for optimum performance. — Figure 2
   b. Off-gas vacuum pump suction pressure used to adjust service air flow to maintain system pressure. — Figure 4

B. Local Controls
   1. Freeze Out Dryer Control
      a. Thermostatic expansion valves (TCV6A-C and TCV7A-C) are used to maintain a constant degree of superheat at the coil discharge of the condensing portion.
      b. The expansion valve uses a temp. sensing bulb located at the discharge of the freon coil to modulate its position.
      c. A pressure regulator (PV63A-C) valve maintains a constant coil inlet pressure and thus a constant coil operating temp.
      d. Freezer portion has a similar control but no pressure regulating valve and thus the operating temperature is controlled by the capacity of the refrigerator.

C. Control Room Controls (Panel 851)
   1. Condenser Air Removal Pumps (P1A/B)
   2. Air Ejector Air Removal Pump Valves (AOV-104/105)
   3. Strainer Blowdown Valves (HV16A/B, HV17A/B)
   4. Condenser Air Take Off Valves (HV25A-C, HV26A-C)
   5. Condenser Vacuum Breakers (MOV5A-C)
   6. Air Ejector Precooler Inlet Valves (MOV15A/B)

D. Interlocks — EO-4.0
   1. Condenser Air Removal Pumps (2ARC-P1A/B) trip when:
      a. Pump running with respective seal water flow less than 10 gpm for longer than 10 seconds.
      b. Main steam line radiation level high-high, greater than 3xNFPB or radiation monitor inoperative.
      c. Sustained undervoltage.
   2. Seal Recirculation Water Pump (2ARC-P2A/B)
      a. The seal recirculation pump auto starts when the respective air removal pump is started and stops when it is secured.
      b. The pump trips on pump motor overload.
   3. Air Removal Pump Isolation Valve (2ARC-AOV105) Auto closes when:
      a. Neither air removal pump is running or
      b. Main steam line radiation 3xNFPB or

c. Main steam line radiation monitor inoperative.

4. Air Ejector Isolation Valve (2ARC-AOV104) Auto closes when the air removal pump is running.

5. Air Removal Pump Discharge Header Condenser Drain Tank (2ARC-TK1) Drain Valve (2ARC-SOV111)
   a. The valve opens when tank level is high (8 in.)
   b. The valve closes when tank level is low (6 in.)

6. Off-Gas Recombiner Inlet (2OFG-AOV1A/B) and Outlet (2OFG-AOV2A/B) Valves will auto close when any of the following occur in the respective train:
   a. Condenser outlet flow low-low (<6 SCFM)
   b. Recombiner outlet temperature high (>790°F)
   c. Recombiner inlet temperature low-low (<240°F)
   d. Condenser outlet H_2 concentration high (>4%)
   e. Condenser outlet temperature high (>200°F)

f. High Radiation Pretreatment System A and B (9.6 $^{uci}/_{cc}$)

After automatic closure has occurred, the operator must reset the valves by pushing the reset pushbuttons.

7. Service Air Supply Valve (SOV112)
   a. Low air flow through either train causes valve to open.
   b. High air flow causes makeup valve to close.
   c. A closing signal overrides an opening signal.
8. Off-Gas Condenser Level Control Valve (LV20A/B)
   The valve closes on low level and opens on high level.
9. Off-Gas Vacuum Pump (20FG-P1A/B) trips when:
   a. Inlet or outlet valve not open,
   b. Pump suction pressure high, (10.9 psia) (in this case the inlet and outlet valves also shut and the standby pump inlet and outlet valves will open. When the valves are open the standby pump will start.)

c. Discharge radiation level (adsorber supply line) high-high, or
d. Motor overload

10. Off-Gas System Discharge Isolation Valve (AOV103)
    a. Valve auto closes on high-high discharge radiation level.
    b. High-high radiation signal must be reset by operator.
11. Off-Gas System Refrigerator Unit trips when:
    a. Refrigerator discharge pressure high,
    b. Refrigerator pressure low,
    c. Compressor oil failure or
    d. Refrigerator motor overload.

The freezeout units are normally selected so that 2 of them alternate on line and defrost time. The units transfer on a high differential pressure (30" WC) across the on line freezeout dryer.

LESSON CONTENT	DELIVERY NOTES	ECTIVES/ NOTES

IV. SYSTEM OPERATION

A. System Startup

1. The condenser air removal pumps are used to initially draw a vacuum. This operation will take approximately 2 hours with two pumps and 4 hours with one pump. After the main steam pressure is sufficient to support operation of the air ejectors they are placed in service to maintain condenser vacuum during normal operations.

   Refer to Section E of N2-OP-9 or N2-O-42 for specific start up steps.

   N2-OP-9
   N2-OP-42
   EO-5.0

2. The Off-gas System startup requires planning in advance to ensure the system will be ready for operation when it is required. The Recombiner train heaters must be energized for approximately three days prior to plant startup to ensure proper recombiner warm-up and the Hydrogen analyzers must be started 24 hours before they are considered operable.

B. Normal Operation

During Normal operation one set of steam jet air ejectors are in service maintaining condenser vacuum with the other set in standby. The discharge of the air ejectors is directed to one

Refer to Section F of N2-OP-9 or N2-OP-42 for specific Normal Operating procedures.

N2-OP-9
N2-OP-42
EO-5

of the recombiner trains with the other in standby. The offgasses are then passed to one of the three freeze out dryers (FOD). Normally one of the FOD's is in standby with one of the remaining two in service while the last is being defrosted. The process train is then directed to the two trains of four each charcoal adsorbers in parallel.

C. System Shutdown

During shutdown the vacuum pumps are started when the air ejectors are no longer needed and when power is below 5% rated. When directed to do so by N2-OP-101C and when vacuum in the condenser is no longer required, the air removal and off-gas systems are secured and condenser vacuum is broken by opening the vacuum breakers (2ARC-MOV5s).

Refer to Section G of N2-OP-9 or N2-OP-42 N2-OP-42 for specific Shutdown steps.

N2-OP-9
N2-OP-42
EO-5

D. Off Normal Operation

1. Refer to section H.0 of N2-OP-9 and N2-OP-42 for Off Normal Procedures.

E. Emergency Operation

1. Off-gas and Condenser air removal system indications are used to determine actions in Emergency Operating Procedures Radioactivity Release Control (RR) and MSIV Leakage Control (MSL). In EOP-RR one of the entry conditions is Stack GEMS exceeds the alarm setpoint (p882). In EOP-MSL one of the indications used for the entry conditions is Off-gas pretreatment radiation (OG-RE13A/B) above the "ALERT" level. One of the conditions in a wait statement of EOP-MSL is Off-gas pretreatment radiation level exceeds the Off-gas Release Rate (Figure MSL-3) or cannot be determined.

Refer to N2-EOP-RR and N2-EOP-MSL for specific steps and entry conditions.

N2-EOP-R
N2-EOP-MSL
EO-6

2. The Steam Jet Air Ejectors (SJAEs) are used if required in EOP-MSL in accordance with EOP-6.

Refer to EOP-6 Attachment 16 for procedure

N2-EOP-6

V. SYSTEM INTERRELATIONS

A. Condensate System (CNM)

1. The condenser air removal system removes air from the main condenser.

EO-7.0

2. Condensate system flow is used to cool the steam jet air ejector intercondenser.
3. Water from the Off-Gas and Air Removal Systems is sent to the main condenser.

B. Turbine Building Closed Loop Cooling Water System (CCS)

The off-gas recombiner train condensers and the off-gas refrigeration unit condensers are cooled by Turbine Building Closed Loop Cooling Water.

C. Service Water System (SWP)

The service water system cools the air removal vacuum pump seal coolers (2ARC-E1A/B) and the steam jet air ejector precoolers (2ARC-E2A/B).

D. Main Stack

The air removal pumps and the Off-Gas System discharge to the main stack.

E. Auxiliary Steam System (ASS)

The auxiliary steam system supplies the steam for the steam jet air ejectors, the preheating of the off-gas recombiners, and heating in the off-gas preheaters.

F. Instrument Air System (IAS)

The Instrument Air System supplies air for system instrumentation and operation of pneumatic valves.

G. Service Air System (SAS)

The Service Air System supplies makeup air to the off-gas recombiner train inlet and off-gas vacuum pump inlet.

H. Plant Electrical

The plant electrical system provides electrical power for component operation and control.

VI. DETAILED SYSTEM REFERENCE REVIEW

Review each of the following referenced documents with the class.

A. Technical Specifications — EO-8.0

1. 3.4.5 . Specific Activity
2. 3.11.2.1 Dose Rate
3. 3.11.2.2 Dose-Noble Gases
4. 3.11.2.4 Gaseous Radwaste Treatment System
5. 3.11.2.6 Explosive Gas Monitor
6. 3.11.2.7 Main Condenser - Off-Gas

B. Procedures — EO-9.0, EO-10.0

1. N2-OP-9 Condenser Air Removal
2. N2-OP-42 Off-Gas
3. N2-EOP-6, Attachment 16

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES

VII. RELATED PLANT EVENTS

A. MODIFIED CASE STUDY

1. Using the modified case study format, discuss each of the events described NRC IE Information Notice 83-52 "RADIOACTIVE WASTE GAS SYSTEM EVENTS".

Have each student read a paragraph of the event description. After each paragraph is read, have the class pick key points of that paragraph to be listed on the board to aid in analysis of the event.

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After reading the event description use a guided class discussion to determine:

1. Probable root cause
2. Recommended corrective actions (as if you were the licensee)
3. Relevance to NMP2 (ie. is the event described a concern at NMP2?)
4. Actions that can be taken to prevent this event from happening at NMP2.

INSTRUCTOR NOTE: Use of OEA response to this INFORMATION NOTICE may be useful for the discussion of items 3 and 4 above.

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B. REVIEW OF INFORMATION LETTERS

1. Review Service Information Letters (SIL) 150 Rev. 2, dated 11/30/76 "PREVENTION OF HYDROGEN IGNITIONS RELATED TO THE OFF-GAS SYSTEM" and SIL 150, Rev. 2, Supplement 1 "IGNITION PREVENTION FOR RECOMBINER/CHARCOAL ADSORBER OFF-GAS SYSTEMS"

Read the introduction and discussion sections of the SIL's with to class (or have the trainees read these section aloud).

After reviewing the SIL's, use a guided class discussion to determine:

1. Probable root cause
2. Recommended corrective actions
   After the trainees have determined the corrective actions they would recommend, review the Recommended Action section of the SIL with the class to compare results.
3. Relevance to NMP2 (ie. is the problem described, a concern NMP2?)
4. Actions that can be taken to prevent this problem at NMP2.

VIII. SYSTEM HISTORY

A. Modifications

1. PN2Y88MX077 Relocate OFG freeze out dryer level control.
2. PN2Y88MX233 Add sample pumps to hydrogen analzers.