Ø7-188-91

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS

02-LOT-001-256-2-01 Revision 6

TITLE: CONDENSATE SYSTEM

	SIGNATURE	DATE
PREPARER	M S Chindler	7/26/91
TRAINING AREA SUPERVISOR	[signature]	7/26/91
TRAINING SUPPORT SUPERVISOR	[signature] for J. LaClair	7-29-91
PLANT SUPERVISOR/ USER GROUP SUPERVISOR	[signature] JTSHALLICKER	7/31/91

Summary of Pages

(Effective Date: 7/31/91)

Number of Pages: 21

Date	Pages
July 1991	1 - 21

TRAINING DEPARTMENT RECORDS ADMINISTRATION ONLY

VERIFICATION: _____

DATA ENTRY: _____ _____

RECORDS: _____ _____

22 pp.

5/3/330

I. TRAINING DESCRIPTION

A. Title of Lesson: CONDENSATE SYSTEM |6

B. Lesson Description: This lesson contains information pertaining to the Condensate System. The scope of this training is defined by the learning objectives and in general covers the knowledge requirements of a Licensed Control Room Operator.

C. Estimate of the Duration of the Lesson: 2 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 eligibility requirements of NTP-10.

b. Licensed Operator requalification - in accordance with the requirements of NTP-11.

G. References:

1. Technical Specifications

a. None

2. Procedures

a. N2-OP-3, Condensate System

b. N2-OP-101A through D, Plant Operations

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. 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 Designated Clerk file cabinets.

V. LEARNING OBJECTIVES

A. Terminal Objectives: Upon completion of the training the trainee will have gained the knowledge to

TO-1.0 Perform the actions required for a hotwell level high/low. (2560040101)

TO-2.0 Startup the condensate pump and cleanup operation from the Control Room. (2560070101)

TO-3.0 Operate the condensate pumps in a different combinations. (2560080101)

TO-4.0 Shutdown the Condensate System. (2560130101)

TO-5.0 Startup a condensate booster pump. (2569040101)

TO-6.0 Perform the actions for loss of condensate or a system failure. (2000280501)

TO-7.0 Place the third condensate and booster pump in standby. (2569100101)

TO-8.0 Start the third condensate and booster pump. (2569130101)

TO-9.0 Restore the Condensate System after a turbine trip a power. (2569140401)

B. Enabling Objectives:

EO-1.0 Explain the purpose of the Condensate System.

EO-2.0 Describe the purpose and function of each of the following major components and auxiliary systems of the CONDENSATE SYSTEM:

a. Condenser hotwell
b. Condensate pumps
c. Recirc line to main condenser
d. Condensate booster pumps
e. Feedwater heater strings
f. Condensate Demineralizer and Heater Strings Bypass Valves
g. Condenser neck spray

EO-3.0 Regarding the Condensate System, |6

a. Locate the correct drawing and |

b. Use the drawings to perform the following: |

1. Identify electrical and mechanical components |
2. Trace the flow-path of fluids and electricity. |
3. Identify interlocks and setpoints. |
4. Describe the system operation. |
5. Locate information about specific components. |
6. Identify system interrelations. |

EO-4.0 Describe the interrelationship of each of the following systems that interrelate with the CONDENSATE SYSTEM: |

a. Extraction Steam System |
b. Steam Seal System |
c. Condensate Transfer and Storage System |
d. Condensate Demineralizer System |
e. Feedwater System |
f. Feedwater Heater System |
g. Control Rod Drive System |

EO-5.0 For the precautions and limitations listed in N2-OP-3 explain the basis for each precaution and limitation. |

EO-6.0 Regarding the Condensate System, determine and use the correct procedure to identify the actions and/or locate information related to: |

a. Start up |
b. Shutdown |
c. Normal |
d. Off normal |
e. Annunciator response procedures |

EO-7.0 Given a specific set of plant conditions, determine how the Condensate System responds. |

EO-8.0 Describe how the Condensate System is utilized during the performance of the EOP's. |

|

EO-9.0 For the following interlocks |6

a. State the setpoint. |

b. Describe its purpose. |

1) Condensate pump min. flow valve. |

2) Condensate booster pump min. flow valve. |

3) Condensate pump auto start and stop signals. |

4) Condensate booster auto start and stop signals. |

5) Condensate booster pump aux. oil pump auto start and stop signals. |

EO-10.0 State the design basis of the Condensate System. |

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES	
I. INTRODUCTION:	1. Pass out and complete T.R.	EO-1.0	6
A. Purpose	2. Review method of evaluation with class.	EO-10.0	
1. The condensate system:	3. Explain purpose and use of evaluation form and distribute.		
a. Transports condensate in sufficient quantities from the main condenser hotwell to the reactor feed pump suction header.	4. Review objectives.		
b. Provides cooling water for the Steam Packing Exhausters and Steam Jet Air Ejector Inter-Condensers.			
2. The main condenser provides:			
a. A heat sink for turbine exhaust steam, turbine bypass steam, and other turbine cycle flows and drains.			
b. Condensate deaeration			
c. A collection point for noncondensable gas removal			
d. Condensate storage.			
B. General Description	Simplified system drawings from text or use P & ID's.	EO-2.0 EO-3.0	6
1. Use Figures 1 and 2 to discuss flowpaths and major system components.			
2. Point out inlets, outlets, inter-connections, and instrumentation.			

a. Note that makeup supplied to condenser from CNS system. b. Excess condensate drawn off condensate pump discharge and sent to CNS system.	Pumped or gravity/vac. droy 4" or 6" lines resp.	EO-2.0a	6

II. DETAILED DESCRIPTION

A. Main Condenser

1. The main condenser is a triple shell, single pass condenser constructed of carbon steel located directly beneath the low pressure exhaust hoods.	Note that the L.P. hoods are lettered reversed from the letters on their respective condenser shell. "C" turbine is "A" shell & "A" turbine is "C" shell.	EO-2.0a	6
2. The condenser is designed to receive 25% rated steam flow from the bypass valves, as well as miscellaneous vents and drains from throughout the steam plant.	Steam flow is cooled by Condenser Neck Spray retrofitted cooling system.		6
3. It is mounted to the turbine exhaust hood through a flexible connection.			
4. The hotwell provides a surge volume for the system and adequate NPSH for the condensate pumps. Baffle plates in the condenser hotwells provide the 5 minute hold up time for radioactive isotope decay.	N16 gamma is approximately 7 MeV.		6
5. The three water boxes are made of steel plate with bonnet-type construction. Equipped with manway for inspection.	Reason for 4" steel shielding around condenser area. 4" of steel = 1 tenth thickness of shielding for gamma's.		

6. Circulating water is passed through the condensing tubes in each condenser shell to remove the latent heat of condensation from the turbine exhaust.

EO-2.0a |6
EO-3.0 |

7. Condensate falls to a false bottom then drains to a hotwell through a screen in the false bottom. The three hotwells drain to a common collection box under condenser 1A.
8. A reheating and deaerating effect is achieved in the lower portion of the condenser shells.
   a. As the condensate falls through the exhaust steam entering the lower tube bundle area, it gains heat thus reheating and deaerating the condensate.
9. Condenser maintained at a vacuum to derive greater work from the exiting steam of the turbine. The Condenser Air Removal System is used to remove noncondensable gases.
10. Each exhaust hood has an exhaust hood spray connection to spray condensate water into the hoods on a high exhaust hood temperature caused by low load turbine operation.

11.	Condenser neck spray is supplied from condensate pump discharge to cool Turbine Bypass steam during bypass operation. Prevents condenser component steam impingement erosion, and excessive turbine exhaust temps, with the turbine idle.	EO-2.0g	6
B.	Condensate Pumps (2CNM-P1A, B, C)		
1.	Three AC motor driven motor driven centrifugal condensate pumps.		
2.	The pumps take a suction on the condenser collection box and discharge to the condensate piping. Rated at 11,800 GPM.	EO-2.0b EO-3.0	6
3.	Power Supplies		
a.	P1A 2NNS-SWG011		
b.	P1B 2NNS-SWG013		
c.	P1C 2NNS-SWG011 and 2NNS-SWG013 with separate breakers and controls for each supply	Separate, dual power supply provides reliability and flexability of the pumps.	6
C.	Condensate Booster Pumps (2CNM-P2A, B, C)	EO-2.0d	6
1.	Three AC motor driven centrifugal booster pumps rated 11,750 gpm.		
2.	Booster pumps pump the condensate through the low pressure feedwater heating strings and provide sufficient NPSH for the reactor feed pumps.	PID 3-C	6

3.	The bearings are lubricated by an attached oil pump during normal operation, and a motor drive auxiliary oil pump during startup and emergencies.	Normally left running when boosters are shutdown with flow in Condensate System.		6
4.	The pump shaft is sealed by mechanical seals and throat bushings with seal water supplied from the pump discharge through strainers.	PID 3-B G-9		6
5.	Power Supplies:			
	a. P2A 2NPS-SWG001			6
	b. P2B 2NPS-SWG003			
	c. P2C 2NPS-SWG001 and 2NPS-SWG003 with separate controls and breakers for each supply.	Separate dual power supply provides reliability and flexability of the pumps.		
D.	Second and Third Point Heater Drain Coolers.		EO-3.0 EO-2.0e	6
1.	The drain coolers heat the condensate using second and third point heater drains as a heat source.			
2.	They are single pass straight tube counter flow heat exchangers, shell side drains to the Main Condenser.			
F.	First Point Feedwater Heaters			
1.	Heaters are horizontal, single zone shell, two pass, U-tube low pressure heat exchangers.	Internal view of all coolers and heatups can be seen on PID-8 series.		6

2. Condensate enters the tubes and makes two passes.
3. Extraction steam from main turbine thirteenth stage, with moisture from the twelfth stage enter through 4 steam nozzles on top of the heater.
4. Shell side water is returned to the main condenser via a loop seal.
5. Noncondensable gases are vented to the main condenser through orifices.

EO-2.0e |6
EO-3.0 |

G. Second Point Feedwater Heaters
1. The second point heaters use turbine 11th stage extraction steam to heat the condensate.
2. Similar to first point heaters (two pass - one zone U-tube)
3. Shell side water drains to the second point feedwater heater drain receiver. Noncondensable gases are vented to the main condenser.

H. Third Point Feedwater Heater
1. Third point heaters are two zone shell, two pass, U-tube heat ex-changers.
2. It receives extraction steam from the ninth stage of the turbine and the HP turbine gland seals and drains.

3. They contain an integral drain cooler section in the lower shell.
   a. Consists of a shroud and segmented steel baffles.
   b. Water from cooler drains to the third point drain cooler.
4. Noncondensable gases are routed to the main condenser. — EO-2.0f, EO-3.0 | 6

I. Fourth Point Feedwater Heaters
1. Horizontal, two pass, one zone heat exchangers.
2. Receive eight stage extraction steam, fifth point heater and moisture separator drains.
3. Shell side water is pumped forward to a connection to the feedwater line between the fourth and fifth point heaters. Contributes 33% of total feedwater flow at rated conditions. — Heater Drain Pump System is PID-8 Series. Heater Drain Pump is multi. staged with seal and bearing water cooled by CCS. | 6

J. Fifth Point Feedwater Heater
1. Horizontal, two pass, two zone heat exchangers.
2. Receive extraction steam from cold reheat lines and drains from sixth point heater.
3. Shell water is subcooled in integral cooler and cascade to fourth point heater shell.

4. Noncondensable gases are vented to the main condenser.

K. Condensate Demineralizer Bypass (AOV 109) and Heater String Bypass (AOV 101) — EO-2.0f |6

1. Fast opening (> 5 sec) AOV's
2. Provides 115% condensate flow to the feedwater pumps following a turbine trip from 100%.

The need for 115% flow is based on the vessel shrink after the scram from load rejection at full power. The FWLC System tries to compensate for the level decrease by opening upon the FCV's. The FCV's are limited on how for they will open to prevent feed pump run out. (48%) OP-3 |6

III INSTRUMENTATION, CONTROLS AND INTERLOCKS — EO-3.0 |6

A. Instrumentation

1. Separate indication for motor current of each condensate and condensate booster pump are on panel 851.
2. Flow indications on panel 851 include
   a. Condensate pump discharge header total flow.
   b. Individual condensate booster pump.
3. Pressure indications on panel 851 include
   a. Each condenser shell
   b. Condensate discharger header

c. Condensate booster pump suction
d. Condensate booster pump discharge

4. Valve position (0-100%) on panel 851
   a. One condensate pump recirculation valve.
   b. Three condensate booster pump recirculation valves.

B. Controls

1. Pump control switch
   a. Four position switch used to control condensate and condensate booster pumps. Pumps P1C and P2C have two control switches, one switch for each power supply.

   Caution: Leaving the standby power supply switch in normal after stop (green flag) will cause misoperation of the aux. oil pump sec. precaution in AR-OP-3.

   EO-3.0 | 6
   EO-9.0 |

2. Heater string inlet valves and outlet (MOV-32 ABC) (MOV-33A,B,C), the lower pressure heater string bypass (AOV-101) and exhaust hood spray supply valve (MOV-120) have control switches on panel 851.

   EO-3.0 | 6
   EO-9.0 |

3. Condensate demineralizer bypass (AOV-109) and heater string bypass (AOV-101) fast open with a turbine trip and first stage shell pressure > 566 psig.

   Triggers flow limiter logic light Pnl 603. | 6

C. Interlocks

1. Condensate Pump Minimum Flow Valve (FV114).

a. Valve directs flow to the main condenser to ensure condensate pumps have enough flow for proper cooling. Valve automatic control setpoint is controlled by the number of running pumps approximately (4800 gpm 1 pump) (9600 2 pumps).

Can be controlled in manual with control slide switch, usually runs in auto.

EO-3.0 |6
EO-2.0c |
EO-9.0 |
|
|
|

b. Flow element is used to position FV114. The valve control signal is automatically compensated for the number of condensate pumps running.

2. Condensate Booster Pump Minimum Flow Valves (FV38A, B, C).

a. Valves directs flow from discharge of respective pump to the main condenser to ensure sufficient flow through the booster pump for cooling.

b. Each valve is adjusted using a signal from a flow element on the suction of the respective pump.

4400 gpm minimum.

EO-3.0 |6
EO-9.0 |

3. Condensate pumps will pump auto start when:

a. A running pump trips.

b. A condensate booster pump is running with low suction pressure.

c. Less than 2 FWH pumps running and cond. flow 11,000 gpm.

4. Condensate Booster Pump

a. Same as CNM except RFP running with low suction pressure.

5. Condensate Booster Pumps will trip on a Low/Low suction pressure or motor overload.

6. Condensate booster pump auxiliary lube oil pump will start automatically when any of the following occur:

a. The respective booster pump control switch is taken to the STOP position. The auxiliary oil pump will run for 5 min. after the pump stops.

b. The respective booster pump is not running and the condensate booster pump main lube oil pump has a high suction pressure (>35 psig).

Supplies coast down flow until pump is completely stopped and cools bearings residual heat. [NOTE: We normally run all aux. oil pumps man. with main pump in standby.] Indicates reverse flow through the idle booster discharge check valve. This causes the oil pressure to build up in the oil pump suction due to the rotation of the main pump. You want the aux. oil pump to start so the bearings of the booster pump are protected until the booster pump suction can be closed to stop the pump rotation Ann. 851555 response in OP-3. |6

	c. The respective booster pump is running and the main lube oil pump has a low discharge pressure (<4 psig).	Note: That is the alternate pump power supply for the booster pump "C" is out of pull to lock the aux. oil pump will continue to run even if the booster pump is already running with >4 psi oil pressure. See OP-3 D.10 precaution.		|6
	d. The respective booster pump control switch is taken to the start position.			
7.	The auxiliary lube oil pumps will shutdown to standby if: the respective booster pump has been stopped for five minutes or the booster pump is running with normal lube oil pressure (>4 psig).	Also note extraction steam valves to the affected string will also close. Makes sense.		
8.	Heater String Inlet and Outlet Valves close automatically on a high-high water level in the respective first point or second point heaters.			
9.	Condenser shells 1A and 1B have pressure transmitters which provide a signal to close the MSIV's on low vacuum (8.5" Hg vacuum).			
10.	Various tops are provided to the condenser shell and hotwell for chemistry sampling capability.	Go to Turbine Building Sampling Station in (and demin room TB el 250'	EO-5.0 EO-6.0	|6

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
IV SYSTEM OPERATIONS		
A. Normal Operations		
1. Condensate pumps take suction on the collection box and discharge condensate through the condensate demineralizer system, the operating air ejector intercondenser, and operating steam packing exhauster to the suction of the condensate booster pumps.	Review significant precautions and limitations as each normal operation is discussed if applicable.	|6 | |
2. Condensate booster pumps supply condensate and NPSH for the feedwater pumps. The condensate is heated as it flows through the low pressure heater strings.		
3. The standby condensate and condensate booster pumps are ready to start automatically in the event of a running pump failure.	Auto starts were covered in detail in Section C. Interlocks. Review if needed.	|6 |
4. The system also supplies feed to the clean steam reboilers and condenser neck spray as required.		EO-6.0 |6 EO-7.0 |
B. Startup and Shutdown		
1. Startup of system		
a. Initial system lineups performed in preparation for startup.		

b. A single condensate pump is started with the discharge valve shut. The discharge valve is opened and the system is verified to be filled and vented by opening the system vent valves.	Serious water hammer change and tube erosion can result from in proper venting if piping and heat exchangers.	6
c. The pump recirculation valves are in automatic and recirculate pump flow to the main condenser as required.		
d. The recirculation valves provide sufficient pump flow for cooling until reactor demand is sufficiently high.		
e. The system is lined up as required to support plant operation. Additional pumps are started as required.	See OP-101A for sequencing of feed and condensate pumps during startup.	6
2. Shutdown of system		
a. Pumps are secured as they are no longer required.	See OP-101 D & C for sequencing of feed and condensate pumps.	6
b. Condensate demineralizers are removed from service as required.		

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES	
V. SYSTEM INTERRELATIONS			
A. Extraction Steam System - extraction steam is supplied as the heat source for the feedwater heaters.	Controls located in Pnl 842 in main Control Room ext. non return controls on Pnl 204 on TB el 306' controls on	EO-4.0a	6
B. Steam Seal System - condensate is supplied to the clean steam reboiler for use as sealing steam and to the SPE to condense turbine gland waste steam.	Pnl 851 CR., control on Pnl 851 CR OP-4.	EO-4.0b	
C. Condensate Transfer and Storage System- supplies makeup water to the condensate system and receives excess condensate.		EO-4.0c	6
D. Condensate Demineralizer System-normally receives and returns all of the condensate system flow.	This system is covered in detail in cond. demin lesson plan & OP-5.	EO-4.0d	6
E. Feedwater System-condensate system supplies adequate flow at the required NPSH to the feed pumps.	See OP-4 and PID 3 & 4 series.	EO-4.0e	6
F. Feedwater Heaters System-approximately 1/3 of the total condensate flow for full power operation is supplied by the (FWH) 4th point heater drain pumps.	Less than 2/3 heater drain pumps in operation requires the 3rd condensate pump to be running. (We normally run 3 all the time anyway).	EO-4.0f	6
G. Control Rod Drive Hydraulics-normal supply to CRD pump suction is from the condensate system normal makeup & draw off line.	See OP 3 & 4 series.	EO-4.0g	
			6

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES

VI. DETAILED SYSTEM REFERENCE REVIEW

Review each of the following referenced documents with the class. EO-5.0 |6
EO-6.0 |
EO-7.0 |
EO-8.0 |

A. Technical Specifications

None

B. Procedures

1. N2-OP-3 Condensate System

VII. RELATED PLANT EVENTS

A. Refer to events as required. |6

VIII. SYSTEM HISTORY

A. Refer to events as required. |6

IX. WRAP-UP

A. Review the Student Learning Objectives.