NINE MILE POINT NUCLEAR STATION

UNIT #2 OPERATIONS

LESSON PLAN

02-REQ-001-256-2-01.4

07-19-91

CONDENSATE SYSTEM

Prepared By: Unit #2 Training Department

APPROVALS	SIGNATURES	DATE AND INITIALS REVISION 4
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Summary of Pages

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NIAGARA MOHAWK POWER CORPORATION

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Attachment "A"

OBJECTIVE APPROVAL

Author: UNIT II OP's TRAINING

Training Dept: Unit II OPS.

Lesson Title: CONDENSATE SYSTEM

Lesson Plan #: NZ-OLP-49

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	K. A. Thorne	1/3/89
Plant Supervisor	R. P. Smith	1/20/89
Training Analysts Supervisor	D. L. Gardner	1-12-89

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

I. TRAINING DESCRIPTION

A. Title: N2-OLP-49, Condensate System

B. Purpose: 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. Total Time: 1 hour

D. Teaching 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. None
2. Procedures
   a. N2-OP-3, Condensate System
3. NMP-2 FSAR
   a. None

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-49
5. N2-OLT-49
6. See Section I.E.1
7. See Section I.E.2

B. Student Materials:

1. N2-OLT-49
2. See Section I.E.1
3. See Section I.E.2

IV. QUIZZES, TESTS, EXAMS AND ANSWER KEYS

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

V. LEARNING OBJECTIVES FOR THE CONDENSATE SYSTEM

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

49-1 State the purpose of the Condensate System.

49-2 State the purpose of the following major components.

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 string bypass valves

49-3 Describe the operation of major Condensate System Components, including controls and interlocks.

49-4 Describe the system flowpath during all modes of operation and flow capacities of major components.

49-5 Given N2-OP-3, Condensate System, identify the appropriate actions and/or locate information related to:

a. Startup
b. Normal Operations
c. Shutdown
d. Off-Normal Operations
e. Procedures for correcting alarm conditions

VI. LESSON CONTENT

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
I. INTRODUCTION:			
Student Learning Objectives	i		
A. Purpose	1		1
1. The condensate system:			
a) transports condensate in sufficient quantities from the main condenser hotwell to the reactor feed pump suction header.			
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.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
B. General Description	1		
1. Use Figures 1 and 2 to discuss flowpaths and major system components.		1,2	
2. Point out inlets, outlets, interconnections, and instrumentation.	2		
a. Note that makeup supplied to condenser from CNS system			
b. Excess condensate drawn off condensate pump discharge and sent to CNS system.			

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.
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.
3. It is mounted to the turbine exhaust hood through a flexible connection.

Activity		Text Ref. Page	Text Ref. Fig.	S.L.O.
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.	3		2a
5.	The three water boxes are made of steel plate with bonnet-type construction. Equipped with manway for inspection.			
6.	Circulating water is passed through the condensing tubes in each condenser shell to remove the latent heat of condensation from the turbine exhaust.			
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.			

Activity		Text Ref. Page	Text Ref. Fig.	S.L.O.
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.	3		
B.	Condensate Pumps (2CNM-P1A, B, C)			
1.	Three AC motor driven motor driven centrifugal condensate pumps.	4	1	2b
2.	The pumps take a suction on the condenser collection box and discharge to the condensate piping. Rated at 11,800 GPM.			4
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			
C.	Condensate Booster Pumps (2CNM-P2A, B, C)			2d
1.	Three AC motor driven centrifugal booster pumps rated 11,750 gpm.			4

Activity		Text Ref. Page	Text Ref. Fig.	S.L.O.
2.	Booster pumps pump the condensate through the low pressure feedwater heating strings and provide sufficient NPSH for the reactor feed pumps.	4		2d
3.	The bearings are lubricated by an attached oil pump during normal operation, and a motor drive auxiliary oil pump during startup and emergencies.			
4.	The pump shaft is sealed by mechanical seals and throat bushings with seal water supplied from the pump suction.			
5.	Power Supplies: a. P2A 2NPS-SWG001 b. P2B 2NPS-SWG003 c. P2C 2NPS-SWG001 and 2NPS-SWG003 with separate controls and breakers for each supply.			
D.	Second and Third Point Heater Drain Coolers.		2	
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.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
F. First Point Feedwater Heaters	5	4	2e
1. Heaters are horizontal, single zone shell, two pass, U-tube low pressure heat exchangers.			
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.			
G. Second Point Feedwater Heaters		4	2e
1. The second point heaters use turbine 11th stage extraction steam to heat the condensate.			
2. Similiar 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.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
H. Third Point Feedwater Heater	5	3	2e
1. Third point heaters are two zone shell, two pass, U-tube heat exchangers.			
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.			
I. Fourth Point Feedwater Heaters	6	4	2e
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 between the fourth and fifth point heaters. Contributes 33% of total feedwater flow at rated conditions.			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
J. Fifth Point Feedwater Heater	6	3	2e
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)			2f
1. Fast opening ($\geq$ 5 sec) AOV's			
2. Provides 115% condensate flow to the feedwater pumps following a turbine trip from 100%.			
III INSTRUMENTATION, CONTROLS AND INTERLOCKS			
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	7		
a. Each condenser shell			
b. Condensate discharger header			
c. Condensate booster pump suction			
d. Condensate booster pump discharge			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
4. Valve position (0-100%) on panel 851	7		
a. One condensate pump recirculation valve.			
b. Three condensate booster pump recirculation valves.			
B. Controls			3
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.			
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.			
3. Condensate demineralizer bypass (AOV-109) and heater string bypass (AOV-101) fast open with a turbine trip and first stage shell pressure $\geq$ 566 psig.			
C. Interlocks			3
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 control setpoint is controled by the operator (4800 gpm) (9600 2 pumps).			

Activity		Text Ref. Page	Text Ref. Fig.	S.L.O.
	b. Flow element is used to position FV114. The valve control signal is automatically compensated for the number of condensate pumps running.	7		3
	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.			
	3. Condensate pumps will pump auto start when:	8		
	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:			

Activity		Text Ref. Page	Text Ref. Fig.	S.L.O.
	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.	8		3
	b. The respective booster pump is not running and the condensate booster pump main lube oil pump has a high suction pressure (>35 psig).			
	c. The respective booster pump is running and the main lube oil pump has a low discharge pressure (<4 psig).			
	d. The respective booster pump control switch is taken to the start position.			
7.	The auxiliary lube oil pumps will trip if: the respective booster pump has been stopped for five minutes or the booster pump is running with normal lube oil pressure (>4 psig).			
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).			

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
IV SYSTEM OPERATIONS	8		
A. Normal Operations			4
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.			
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.	9		
B. Startup and Shutdown			4
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.			

Activity		Text Ref. Page	Text Ref. Fig.	S.L.O.
	c. The pump recirculation valves are in automatic and recirculate pump flow to the main condenser as required.	9		4
	d. The recirculation valves provide sufficient pump flow for cooling until reactor demand is sufficiently high.			2c
	e. The system is lined up as required to support plant operation. Additional pumps are started as required.			
	2. Shutdown of system			
	a. Pumps are secured as they are no longer required.			
	b. Condensate demineralizers are removed from service as required.			

V. SYSTEM INTERRELATIONS

A. Extraction Steam System - extraction steam is supplied as the heat source for the feedwater heaters.

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. 10

C. Condensate Transfer and Storage System- supplies makeup water to the condensate system and receives excess condensate.

Activity	Text Ref. Page	Text Ref. Fig.	S.L.O.
D. Condensate Demineralizer System-normally receives and returns all of the condensate system flow.	10		
E. Feedwater System-condensate system supplies adequate flow at the required NPSL to the feed pumps.			
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.			
G. Control Rod Drive Hydraulics-normal supply to CRD pump suction is from the condensate system normal overflow line.			
VI. DETAILED SYSTEM REFERENCE REVIEW			
Review each of the following referenced documents with the class.			
A. Technical Specifications			
None			
B. Procedures			5
1. N2-OP-3 Condensate 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.			