NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS

02-REQ-001-259-2-01 Revision 5

Ø7-191-91

TITLE: FEEDWATER SYSTEM

	SIGNATURE	DATE
PREPARER		9/7/90
TRAINING SUPPORT SUPERVISOR		9-18-90
TRAINING AREA SUPERVISOR		
PLANT SUPERVISOR/ USER GROUP SUPERVISOR		

MASTER CONTROLLED DOCUMENT

Summary of Pages

(Effective Date)

Number of Pages: 16

Date	Pages
September 1990	1 - 16

THIS LESSON PLAN IS A GENERAL REWRITE

TRAINING DEPARTMENT RECORDS ADMINISTRATION ONLY:

VERIFICATION: _____ _____

DATA ENTRY: _____ _____

RECORDS: _____ _____

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ATTACHMENT 3
LESSON PLAN TEMPORARY/PUBLICATION/ADDENDUM CHANGE FORM

The attached change was made to:

Lesson plan title: Feedwater System

Lesson plan number: 02-REQ-0001-259-2-01

Name of instructor initiating change: David Pettit

Reason for the change: Add SOER 84-4 to reference sections as requested by TRR 600801-15

Type of change:

1. Temporary change ____
2. Publication change ____
3. Addendum change ✓

Disposition:

✓ 1. Incorporate this change during the next scheduled revision.

____ 2. Begin revising the lesson plan immediately. Supervisor initiate the process.

____ 3. To be used one time only.

Approvals:

Instructor: David W. Pettit /Date 8/12/91

Training Area Supervisor (or designee): Eric Reedy for J. Reid /Date 8/12/91

ATTACHMENT 6

LESSON PLAN TEMPORARY/PUBLICATION/ADDENDUM CHANGE FORM

The attached change was made to:

Lesson plan title: Feedwater

Lesson plan number: 02-BEQ-001-259-2-01

Name of instructor initiating change: P. Walsh

Reason for the change: Add Objective EO-2.3 for loss of Feedwater heating

Type of change:

1. Temporary change X
2. Publication change ____
3. Addendum change ____

Disposition:

X 1. Incorporate this change during the next scheduled revision.

____ 2. Begin revising the lesson plan immediately. Supervisor initiate the process.

____ 3. To be used one time only.

Approvals:

Instructor: [signature] /Date 5/8/91

Training Area Supervisor (or designee): [signature] /Date 5/31/91

I. TRAINING DESCRIPTION

A. Title of Lesson: Feedwater System

B. Lesson Description: Provide a review of the Feedwater System for licensed operators.

C. Estimate of the Duration of the Lesson: Approximately 2 hours

D. Method of Evaluation, Grade Format, and Standard of Evaluation: Open reference, written exam >80%.

E. Method and Setting of Instruction: Classroom

F. Prerequisites:

1. Instructor:

a. Instructors shall be qualified for the material being delivered in accordance with NTP-16, Attachment A.

b. Qualified in instructional skills as certified by NTP-16.

2. Trainee:

a. Meet the eligibility requirements per 10CFR55, or

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

G. References:

1. N1-OP-3, Condensate and Feedwater System
2. N2-OP-8, Feedwater Heaters and Extraction Steam System
3. GEK 83315A
4. Technical Specification 3/4 3.9 Plant System Actuation Instrumentation
5. NMP2 PID 6A to 6D
6. ESK 5FWS01, 05 and 8 - 2FWS-P1A
7. ESK 7FWR01 - 2FWR-FV2 Control
8. ESK 6FWS07 Feedwater Inlet Shutoff Valve to Reactor
9. NMP2 LER 88-01
10. NMP2 LER 89-14
11. 50ER: 84-4

*TRR6ØØ8Ø1-15 *

II. REQUIREMENTS

A. AP-9.0, Administration of Training

B. NTP-11, Licensed Operator Retraining and Continuing Training

III. TRAINING MATERIALS

A. Instructor:

1. Lesson Plan
2. N2-OP-3
3. N2-OP-8
4. Related T/S
5. ESK's listed in Section I.G
6. NMP2 LER 88-01
7. NMP2 LER 89-14

B. Trainee:

1. N2-OP-3
2. N2-OP-8
3. Tech. Spec. 3/4 3.9
4. Prints as determined by instructor.

IV. EXAM AND MASTER ANSWER KEYS

Contained with the cycle records.

V. OBJECTIVES

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

A. Terminal Objectives:

TO-1.0 Perform the actions required for a complete loss of feedwater (2009080501).

TO-2.0 Perform the actions required for a single feedwater pump trip.

B. Enabling Objectives:

EO-1.1 Describe the purpose of the feedwater system.

EO-1.2 Given a diagram of the feedwater system, describe all major flowpaths and when they are used.

EO-1.3 Explain the function of the following feedwater system components.

a. Reactor Feedwater Pumps
b. Feed Pump Lube Oil System
c. Feed Pump Seal Water and Leak Off
d. Feed Pump Recirc. Valves
e. Six Point Feedwater Heaters

EO-2.1 Explain the RFP trip signals and there function.

EO-2.2 Given N2-OP-3, indicating the appropriate actions and/or locate information related to:

a. Startup
b. Normal Operations
c. Shutdown
d. Off-Normals

EO-2.3 Given N2-OP-8 and a loss of feedwater heating explain the required procedural actions.

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
I. INTRODUCTION		
A. Discuss with the class any recent plant events.	Review LER 88-01, LER 89-14. Discuss with class the root cause and corrective actions. (If more recent events are applicable, use them.)	
B. Review learning objectives.	Review objectives as listed in the front matter.	
C. Purpose		
1. Provide makeup water at sufficient pressure and flow to the Nuclear Boiler System to maintain reactor vessel water level during normal and certain abnormal reactor plant conditions.	System is designed to deliver 14.9 X 10^6 lb/hr at 1055 psig and 420° to the RPV with two pumps in operation. (115.5% NBR)	EO-1.1
2. Provides feedwater preheating, using feedwater heaters, to increase plant efficiency and minimize thermal stress to the reactor vessel feedwater inlet penetrations.		
3. Provides a means of feedwater cleanup be recirculating water through the condensate cleanup system during plant startup.		
D. System Overview/General Description		
1. Use Figure 1 to discuss system flowpaths, interconnections, and major components.	Discuss all flowpaths available for injection of water to the RPV. Also, discuss how pressure can be reduced to allow use of the condensate system as a source of water to the RPV. (TCO-02-REQ-90-129)	

II. SYSTEM DESCRIPTION

A. Feedwater Pumps

1. Three, 50% capacity, motor driven via step-up gear, 2 stage horizontal, centrifugal pumps.

2. Power Supplies

   a. P1A 2NPS-SWG001 (ACB1-8)

   b. P1B 2NPS-SWG003 (ACB3-7)

   c. P1C 2NPS-SWG001 (ACB1-13) and 2NPS-SWG003 (ACB3-12) with separate controls provided for each power source.

   d. This power supply design allows any two pumps to be run from separate power supplies under normal conditions and two pumps to be run from a single power supply in the event one source is lost.

3. The feedwater pumps take a suction on the LP heater strings discharge header and discharge high pressure feedwater through the sixth point feedwater heaters to the reactor. The suction lines contain a flow element and an isolation valve in each.

Air water cooled (CCS)
1785-3337 RPM
18,700 gpm at 2443 TDH
Cooled by CCS

Q: What is the design capacity of a single feedwater pump?

A: 68% of full rated power.

Q: What are the operating restrictions for plant operation with only on feed pump?

A: Plant operation above 60% power should be minimized (TCO-02-REQ-90-061, NRC identified knowledge deficiency).

Flow elements control the FV2 valves.

B. Reactor Feed Pump Lubricating Oil System (FWL) — EO-1.3b

1. Cools and lubricates the feed pump bearings and step up gear.

   3 complete systems each contain; reservoir 370 gallons max. — Suspended below the step-up gears.

   2 pumps which take a suction on strainers in the reservoir.

   a. Main pump - gear tooth type positive displacement driven by the step-up gear. — Connected to the low speed gear.

   b. Auxiliary pump - motor driven screw type positive displacement.

      Aux. pump - primes main pump, prelubes all bearings and gears, and acts as a back-up to the main pump.

2. Common header is protected by a 60 psig relief. Discharge of pumps goes through one of two duplex filters to remove particles (dirt, rust, scale, sand, & metal) with 3-way valve isolating the second filter. Oil then flows through a heat exchanger - cooled by (CCS). The system has a second relief valve which maintains pressure to bearings and gears at 20 psig. This valve is normally open - passes approx. 8 gpm. Oil flows to all bearings and is sprayed by nozzles onto the step-up gears. — Show TP-2

C. Reactor Feed Pump Seal Water and Leak Off (FWP) Supplied by condensate booster pump discharge, passes through a duplex strainer to remove particles then to the pump seals - manufacturer requires min. - of 5 gpm max. 10-12 gpm - 4psi min. above suction pressure max. 127 psi above pump suction pressure. This water minimizes pump mechanical seal leakage and cools the seals.

(There is a filter bypass)

D. The discharges of pumps P1A and P1B have a high pressure-low flow feedwater flow control valve (2FWS-LV55A/B) in parallel with the high pressure high flow valve. The high pressure - low flow valves provide control of the feedwater flow rate from the feedwater pumps during startup or shutdown when little steam (up to above 15%) is being produced and thus little feed flow is required.

E. A low pressure feed pump bypass line with a low pressure flow control valve (2CNM-LV137) is provided to control system flow when the reactor is at low pressure and a condensate booster pump provides sufficient pressure to maintain vessel water level. The valves and their control are discussed in the Feedwater Control Chapter.

F. Feedwater Pump Recirculation Flow Control Valves (2FWR-FV2A-C)

1. An instrument air operated 10 in. globe valve is located in the recirculation line off of the pump discharge.
2. Valve position is adjusted automatically to maintain 8,500 GPM minimum flow through a running pump by returning water to the main condenser as required.
3. FV2 is shut when the feed pump is secured due to SOVX2 being energized which will port instrument air to the valve controller.
4. When the feed pump control switch is taken to start, the SOVX2 will de-energize shifting the valve to control air. Since the flow element senses low flow, the min. flow valve will open and the feed pump will start when the min. flow valve is greater than 15% open.
5. During ATWS conditions they SOV2Y valve will energize, venting the FV2 operator, causing the valve to go full open.

EO-1.3d

Show operation of the FV2 valve using ESK7FWR01 and PID 6A.

Discuss operation relative to solenoid valve position for the following conditions:
Feed Pump secured
Feed Pump start
ATWS

Q: What is the effect on the FV2's when instrument air supply is lost.

A: FV2's go full open causing a loss of feedwater to the RPV.

G. Sixth Point Feedwater Heaters

1. Three, two pass, two zone shell, U-tube feedwater heaters.
2. Heating seam is supplied by fourth stage extraction steam and HP turbine steam chest drains. The relief valve discharges to the main condenser to protect the feedwater piping in the heater from over-pressurization due to heating with the line isolated.
3. Sixth point heaters discharge to a common header.

H. RPV Supply Headers - each of these lines has:

1. A Motor operated containment isolation valve (MOV21A/B).
2. A connection for the return of water from the Reactor Water Cleanup System (WCS) to the reactor.
3. Air testable containment isolation check valve (AOV23A/B) which prevents reverse flow through the line in the event of a feedwater system rupture.
4. A primary containment isolation check valve (V12A/B) which prevents reverse flow through the piping in the event of a feedwater break and thus prevents a vessel blowdown.

EO-1.3e

Q: What effect would a loss of extraction steam to the feedwater heaters have on the reactor plant.

A: Feedwater temp will decrease, reactor power will increase (TCO-02-REQ-90-173, NRC identified knowledge deficiency).

5. A primary containment manual isolation valve (HCV54A/B) which allows isolation for maintenance.
6. Each line divides into 3 risers (6 total) to supply the feedwater nozzles.

I. Feedwater Cleanup

1. Cleanup piping provides condensate/feedwater system cleanup by cycling water from the main condenser through the condensate demineralizers and the condensate/feedwater piping back to the main condenser. The supply connection for the cleanup piping taps off the sixth point heater common discharge header.

Q: When will the low energy cleanup system automatically isolate.

A: Supply pressure greater than 800 lbs.

2. Low energy cycle cleanup line
   a. Is used for flushing and cleanup when a feedwater pump is not running.
   b. The line contains a motor operated shutoff valve (MOV112), two parallel flow control valves (HVX113/HVY113), and a piping connection to each of the condenser shells.
   c. Line designed to pass full rated system flow with 2 condensate booster pumps running.

Using ESK 6FWS10, discuss how the system will isolate on high supply pressure.

3. High Energy Cycle Cleanup Line
   a. Used to return feedwater (up to operating temp/press) from the sixth point heater discharge header to the main condenser when a feedwater pump is operating.
   b. Line contains a motor operated valve (MOV110), and then branches to connect to each condenser shell. Each branch has a flow control valve (HVX111, HVY111, HVZ111) to regulate cleanup flow back to the Main Condenser.
   c. Water is sprayed into the main condenser shells through a sparger at the top of each shell.
   d. The high energy line has a capacity of 5,000,000 lb/hr.

Note: High energy cleanup system is not in use. Requires special evaluation and procedures.

III. INSTRUMENTATION

A. Temperature is monitored at the inlet and outlet of the sixth point feedwater heaters, on the combined discharge header, and on the A & B feedwater supply header. The temperatures read out on the 603 panel.

B. Pressure

1. Pressure switches (PS73A-C and PS74A-C) are used to protect the feedwater pump from cavitation due to low suction pressure.
2. Pressure switches (PS112 and PS113) are used to protect the low energy feedwater cycle cleanup lines.

C. Flow

1. Individual pump suction flows (FT68A-C) are used to generate the control signal for the respective feed pump recirculation control valve (FV2A-C) to ensure that the pump minimum flow requirements (8500 GPM) are met.
2. Total feedwater flow from the supply lines to the reactor vessel is sent to the feedwater control system and is indicated along with supply header A & B flow at PNL 603.

IV. CONTROLS

A. Feed Pump

1. Each reactor feed pump has a 4 position (START-NORMAL AFTER-STOP-PULL-TO-LOCK) control switch with pump PIC having a separate control switch for each of its power sources.

Using ESK 5FWS01, 05, 08. Discuss operation of 2FWS-P1A.

2. Feed Pump Interlocks

A reactor feed pump will trip if any of the following occur:

a. Reactor water level greater than the high level trip (202.3 in.).

b. Respective pump motor electrical fault occurs.

c. The respective supply bus has a sustained undervoltage.

d. Respective bearing oil pressure is low (8 psig) after a 10 sec. time delay with the feed pump running.

e. Suction pressure low 190-210 psig) after a time delay 45 sec. with the pump running.

f. Suction pressure low-low (<190 psig) with the pump running 18 sec. T.C.

g. Selective trip on loss of respective supply bus voltage.

B. Aux. Lube Oil Pump Interlocks

1. The auxiliary lube oil pump starts automatically when the pump control switch is in auto and any of the following exist for the respective feed pump:

EO-2.1

a. Feed pump control switch is in START
b. Feed pump stops running (aux. lube oil pump starts and will run for 5 min.)
c. Feed pump is running with the feed pump main lube oil pump discharge pressure low (15 psig)

V. SYSTEM OPERATION

A. Normal Operation

1. Two feedwater pumps in operation
2. All three sixth point feedwater heaters are in service
3. High pressure-high flow feedwater control valves are using the control signal from the feedwater control system to adjust flow to maintain reactor water level.

B. Start Up Operation

1. Feedwater is provided at sufficient pressure and flow to maintain reactor vessel water level.
2. During startup with the reactor at low pressure, the feedwater pump bypass is used. The condensate booster pumps provide sufficient head for makeup to the reactor The feedwater pumps are bypassed.

3. As reactor pressure increases, the condensate booster pumps are no longer sufficient for maintaining reactor level and a feed pump is required. Then a feed pump (P1A/B) is started. The high pressure-low flow valve is used to maintain vessel water level.
4. As the reactor power increases, the system is shifted as described in the feedwater control chapter to a normal operating lineup.

C. FW Effects on RPV Level/Pressure

(TCO-02-REQ-90-074, NRC Identified knowledge deficiency)

1. Review water level/pressure transient following a scram.
   a. Void collapse following a reactor scram causes initial level decrease.
   b. Feedwater flow to vessel increases to restore level.
   c. Increased feedwater flow causes temperature to decrease which will cause pressure to decrease.
   d. Level swells as water expands.

Note: Setpoint setdown prevents overfilling RPV during this transient.

VI. TECHNICAL SPECIFICATIONS

A. Review T/S 3/4 3.9 Plant System Actuation Instrumentation including bases.

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
VII. PROCEDURES		EO-2.2
A. N2-OP-3, Condensate and Feedwater System		
1. Review precautions and off-normals.		
B. N2-OP-8		
1. Discuss off-normal sections pertaining to a loss of feedwater heating.	Discuss plant response and required actions. (TCO-02-REQ-90-062, NRC identified knowledge deficiency)	EO-2.3