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## THREE MILE ISLAND NUCLEAR STATION UNIT #2 OPERATING PROCEDURE 2106-2.4

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FEEDWATER

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1.0 REFERENCES

1.1 Drawings Applicable for Operation.

- 1.1.1 Main and Reheat Steam, B&R Dwg. 2002.
- 1.1.2 Auxiliary Steam, B&R Dwg. 2004.
- 1.1.3 Feedwater and Condensate, B&R Dwg. 2005.
- 1.1.4 Feedwater Heater Drains, B&R Dwg. 2009.
- 1.1.5 Lube Oil Purification and Transfer, B&R Dwg. 2011.
- 1.1.6 Gland Steam Seal System, B&R Dwg. 2634.

1.2 Operating Procedures Applicable for Operations.

- 1.2.1 2102-1.1 Unit Heatup.
- 1.2.2 2102-2.1 Power Operations.
- 1.2.3 2104-2.3 Instrument Air.
- 1.2.4 2104-2.4 Turbine Lube Oil Purification and Transfer.
- 1.2.5 2104-3.1 Service Air.
- 1.2.6 2104-3.2 Secondary Closed Cooling Water.
- 1.2.7 2104-5.3 Emergency Feedwater.
- 1.2.8 2105-1.4 Integrated Control System.
- 1.2.9 2105-1.1 Main and Reheat System.
- 1.2.10 2105-1.2 Extraction Steam and Stage Heater Vent and Drains.
- 1.2.11 2105-1.3 Auxiliary Steam.
- 1.2.12 2106-1.4 Gland Steam.
- 1.2.13 2106-2.1 Condensate.
- 1.2.14 2106-2.3 Condenser Air Extraction.

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1.2.15 2106-2.5 OTSG Secondary Fill, Drain and Lay-up.

1.3 Manufacturers' Instruction Manuals.

1.3.1 DeLaval Utility Drive Turbine Instruction Manual, 2081 (10.00).

1.3.2 Byron Jackson Pump Instruction Manual 5030 (9.00).

1.4 Applicable System Descriptions

1.4.1 Main and Reheat Steam, Index No. 1.

1.4.2 Auxiliary Steam, Index No. 3.

1.4.3 Feedwater and Condensate, Index No. 4A.

1.4.4 Feedwater Heater Drains, Index No. 7.

1.5 Curves, Tables, etc.

None.

2.0 LIMITS AND PRECAUTIONS

2.1 Equipment.

2.1.1 Do not allow steam (including gland seal steam) to enter the turbine with the rotor standing idle.

2.1.2 Do not attempt to engage the turning gear while either the turning gear itself or the turbine rotor is running.

2.1.3 Do not attempt to reset the overspeed trip with the turbine running until speed has fallen below 90% of rated speed.

2.1.4 Ensure the temperature of lube oil to the turbine bearings is above 70°F before starting the turbine.

2.1.5 If oil temperature leaving any turbine bearing exceeds 175°F or if the oil temperature differential across any bearing exceeds 50°F, the turbine should be shut down and the cause investigated.

2.1.6 If feedwater pump or turbine vibration, rubbing, unusual noise or any other abnormal conditions should develop, shut down the unit immediately and investigate the cause.

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- 2.1.7 Prior to starting the feed pumps insure condensate from the booster pumps discharge is lined up to the feed pumps stuffing box seal and is being controlled at 25 psid, inlet to outlet.
- 2.1.8 When an extended unit shutdown is planned, the feed pump turbines will remain on turning gear until the unit has cooled down to ambient temperature and no abnormal conditions exist, i.e., eccentricity normal. For short duration shutdowns, i.e. 1 to 2 weeks, the turbines will remain on turning gear (T.G.) for complete shutdown.
- 2.1.9 Steam generator feed pump speed must be maintained above or below the critical speed of the turbine which is 3480 RPM.
- 2.1.10 If condenser vacuum does not exist, do not allow flow through the feedpump, and do not establish stuffing box injection. Leakage past the seals will fill up the bracket leak off drain tank, and flood the bearing pedestals. Condenser vacuum must be established to vacuum drag the casing drain tank contents to the condenser.
- 2.2 Administrative.
- 2.2.1 Interlocks will not permit starting of a second feedwater pump unless two (2) condensate/condensate booster pump pairs are in operation.
- 2.2.2 During high power operation, if Heater Drains which normally flow through the Feedwater Heater Drain System is diverted to the condenser, power level must be reduced or a third condensate/condensate booster pump pair started per 2106-2.1 to avert a feedwater pump low suction pressure trip.

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- 2.2.3 Do not start a condensate pump or condensate/condensate booster pump pair unless the lube oil systems for both feedwater pumps are in operation and the feedwater pumps are on the turning gear, or the feedwater pump suction valve is closed.
- 2.2.4 Ensure that feedwater and condensate meet chemistry specifications per the TMI Chemistry Manual.
- 2.2.5 Ensure the turbine casing drain tank pumps are not operated for extended periods at no flow conditions.
- 2.2.6 The following conditions will trip the feedpump turbines:
1. Overspeed
    - a. "A": Mechanical Trip @ 6000 RPM; Electrical Trip @ 5900 RPM.
    - b. "B": Mechanical Trip @ 5900 RPM; Electrical Trip @ 5700 RPM.
  2. "A" feedpump will trip under the following conditions:
    - a. If CO-P2A automatically trips.
    - b. If CO-P2C automatically trips while fed from BUS 2-3.
  3. "B" feedpump will trip under the following conditions:
    - a. If CO-P2B automatically trips.
    - b. If CO-P2C automatically trips while powered from 2-4.
  4. Low lube oil pressure (8 psig).
  5. High exhaust temperature (230°F).
  6. Low suction pressure (265 psig for "A" feedpump and 280 psig for "B" feedpump).

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7. Low vacuum exhaust (0 psig).
8. Thrust bearing wear oil pressure (10 psig).

### 3.0 PREREQUISITES

Initial Each Step After Satisfactory Completion.

3.1 Insure power is available to 480V MCC 2-41A, and the following breakers are closed:

\_\_\_ 3.1.1 Unit 5B, FW-P-1A Turning Gear.

\_\_\_ 3.1.2 Unit 5C, FW-P-1A Main Oil Pump.

3.2 Insure power is available to 480V MCC 2-41B and the following breakers are closed.

\_\_\_ 3.2.1 Unit 8B, FW-P1A Aux. Oil Pump.

\_\_\_ 3.2.2 Unit 12A, FW-P-2B.

\_\_\_ 3.2.3 Unit 13A, FW-P-2D.

3.3 Insure power is available to 480V MCC 2-31A and the following breakers are closed:

\_\_\_ 3.3.1 Unit 4B, FW-P-1B Turning Gear.

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\_\_\_\_ 3.3.2 Unit 4C, FW-P-1B Main Oil Pump.

3.4 Insure power is available to 480V MCC 2-31B and the following breakers are closed.

\_\_\_\_ 3.4.1 Unit 8B, FW-P-1B Aux. Oil Pump.

\_\_\_\_ 3.4.2 Unit 6A, FW-P-2A.

\_\_\_\_ 3.4.3 Unit 7A, FW-P-2C.

\_\_\_\_ 3.5 Insure power is available to 2-1DC and Unit 213B for FW-P-1A  
Emergency oil pump is closed.

\_\_\_\_ 3.6 Insure power is available to 2-2DC and Unit 223B for FW-P-1B  
Emergency oil pump is closed.

\_\_\_\_ 3.7 Instrument Air available per 2104-2.3.

\_\_\_\_ 3.8 Service Air available per 2104-2.10.

\_\_\_\_ 3.9 Secondary Closed Cooling Water in operation per 2104-3.5.

\_\_\_\_ 3.10 Feedwater pump oil reservoirs at normal operating level.

\_\_\_\_ 3.11 Auxiliary Steam and Main and Reheat Steam valve lineup completed  
per 2106-1.3 and 2106-1.1.

\_\_\_\_ 3.12 Turning gear motor control switches in OFF.

\_\_\_\_ 3.13 Valve lineup complete per Appendix A.

\_\_\_\_ 3.14 Seal water supply to FW-P-2A, 2B, 2C, 2D lined up per 2104-2.2.

#### 4.0 PROCEDURE

##### 4.1 Start-Up.

NOTE: Valve and pump references assume FW-P-1A is to be started first. Numbers in brackets apply for FW-P-1B.

NOTE: Turbine lube oil reservoir purifiers should be in operation per 2104-2.4.

4.1.1 Starting Feedwater Pump Auxiliaries and Placing the Feedwater Pump on the Turning Gear.



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- \_\_\_ 4.1.1.1 If reactor coolant temperature is above 200°F CLOSE steam isolation valves MS-V21B (A) and MS-V28A (B).
  - \_\_\_ 4.1.1.2 Lubricate the emergency trip linkage, steam trip valves, nozzle valve operating gear, and sliding pedestal joints on the turbine as necessary.
  - \_\_\_ 4.1.1.3 Insure feedpump turbine casing drain tank (FW-T-1A (B)) is less than half full. Use drain valve MS-V232A (B) as necessary but do not completely empty tank.
  - \_\_\_ 4.1.1.4 Fill and vent the oil coolers and filters.
  - \_\_\_ 4.1.1.5 If oil temperature is below 70°F, heat the oil using the purifier or main lube oil pump. When oil temperature is 70°F or above, STOP the main lube oil pump if it was used.
  - \_\_\_ 4.1.1.6 INSURE the oil reservoir exhauster is in operation from panel 17.
  - \_\_\_ 4.1.1.7 START the D.C. motor-driven emergency oil pump from panel 17 by placing the control switch to AUTO. Check that oil is flowing freely in all sight flow indicators. Check lube oil pressure gauge for an oil pressure of from 7 to 10 psig.
  - \_\_\_ 4.1.1.8 START the A.C. motor driven auxiliary oil pump from panel 17. The D.C. motor driven emergency oil pump can then be manually stopped. Return control switch to "Auto". Insure auxiliary oil pump maintains sufficient bearing oil pressure.
  - \_\_\_ 4.1.1.9 START the main oil pump from panel 5, and immediately STOP the A.C. motor-driven auxiliary oil pump. Ensure oil is flowing in all sight glasses. From panel 5 or

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Local indicators, check the lube oil pressure at 10-15 psig and governor operating oil pressure at 100-110 psig.

- \_\_\_ 4.1.1.10 Place the auxiliary oil pump control switch in AUTO.
- \_\_\_ 4.1.1.11 With the Aux Steam and Main Steam Isolation valves closed, test the emergency stopping system as follows:

1. Set the valve positioner to its minimum speed set point as indicated by green light on panel 5. Set the ICS speed controller to its minimum and verify station in Hand.
2. Latch the hydraulic trip with the electric reset solenoid by turning the panel 5 control switch to Reset.

NOTE: The hydraulic trip will not reset unless the valve positions (Manual Raise/Lower on Panel 5) is at its minimum setting. The Green light for the ICS Speed Controller is lit from valve minimum position to 99% Open; therefore, the Hand/Auto Station Indicator must be used to verify minimum setting.

3. After the two steam stop valves have opened, push the HP Stop Valve Test and the LP Stop Valve Test pushbuttons on panel 5. Check that the two steam stop valves operate freely.
4. Operate the valve positioner to open the turbine steam admission valves.

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5. Depress the trip pushbutton and check that the steam stop and steam admission valves have closed.

- 4.1.1.12 Set the valve positioner to its minimum speed set point as indicated by green light on panel 5.
- 4.1.1.13 Place the turning gear control switch on panel 5 to ON. The turning gear will engage automatically when lube oil pressure is greater than 5 psig and turbine speed is less than 1 RPM.
- 4.1.1.14 OPEN solenoid operated turbine drain valves MS-V210A (B), MS-V211A (B), and MS-V228A (B) from Turbine Drain OPEN pushbutton, panel 5.
- 4.1.1.15 If feedwater pump turbine casing drain tank level high level alarm 17.E20 (17.F20) is received, START the applicable casing drain pump, FW-P-2C or 2D (FW-P-2A or 2B) from panel 17.
- 4.1.1.16 Follow the second feedwater pump on its turning gear per step 4.1.1.1 through 4.1.1.15. If the second feedwater pump is out of service for maintenance or repair, then perform the following on the out of service pump:
1. Check CLOSED the feedwater pump discharge valve FW-V8A (B) and the feedwater pump suction valve CS-V52A (B).
  2. CLOSE feedpump turbine exhaust valve MS-V44 (AS).
  3. CLOSE the feedpump turbine gland steam supply valve GS-V2 (5).
  4. CLOSE the feedpump turbine gland steam exhaust valve GS-V9A (B).

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4.1.2 Starting a Feedwater Pump on Auxiliary Steam.

- \_\_\_ 4.1.2.1 Feedwater pump(s) on turning gear per Section 4.1.1.
- \_\_\_ 4.1.2.2 Ensure at least one pair of condensate/condensate booster pumps are in operation per 2105-2.1.
- \_\_\_ 4.1.2.3 Open Bypass AS-V219A(B) and allow pressure to equalize around AS-V207A(B). When pressure is equalized, open AS-V207A(B) and shut AS-V219A(B).
- \_\_\_ 4.1.2.4 Open the steam isolation valves MS-V218 (A) and MS-V236 (236) if not already open.
- \_\_\_ 4.1.2.5 Thoroughly warm the high pressure and low pressure steam lines. Completely drain the steam lines by opening and closing the following steam trap drip leg isolation valves:

<u>Trap</u>	<u>Valves</u>
MS-V31 (B)	MS-V171A(B) and MS-V174A(B)
MS-V174(B)	MS-V132A(B) and MS-V133A(B)
MS-V31 (B)	MS-V317 (325) and MS-V322 (350)

- \_\_\_ 4.1.2.6 Place Stand Sealing Steam in operation per 2106-1.4 on the feedpump(s) which is (are) on turning gear.
- \_\_\_ 4.1.2.7 Open Feedpump turbine exhaust valve to the condenser (MS-V44 (45)).
- \_\_\_ 4.1.2.8 Rotate the turbine using the turning gear for at least 1 hour with gland steam applied.
- \_\_\_ 4.1.2.9 Read rotor runout (eccentricity) at Panel 17 on FW-VT-4056-1 (FW-VT-4056-2).
- \_\_\_ 4.1.2.10 Verify the valve positioner is set at zero (green panel 5 indicating lights illuminated), and the Bailey ICS speed

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governor is in Manual and set at the minimum range position.

- 4.1.2.11 Reset the hydraulic trip from panel 5. The LP and HP stop valves (MS-V48A (B) and 49A (B)) will open.

NOTE: The hydraulic trip will not reset unless the valve positioner and governor are at the minimum settings, the HP and LP stop valves and steam control valves are closed, and suction pressure is greater than the low suction pressure trip setpoint.

- 4.1.2.12 Check OPEN the feedwater pump recirculation valve FW-V12A (12B).

NOTE 1: Check valve positioner motor pin is in the "motor" position, and manual valve positioner (knurled steel knob) should be in the motor position.

NOTE 2: Check manual speed changer (smooth aluminum knob) pulled fully out to auto control position.

NOTE 3: FW-V12A and B are jog valves, therefore, it is necessary to hold the open or close button depressed until the desired valve position is obtained.

- 4.1.2.13 START the feedwater pump turbine casing drain tank pump FW-P-2C or 2D (FW-P-2A or 2B) from panel 17.

- 4.1.2.14 Slowly OPEN the steam control valves using the SGFP Turb Startup/Load Limiting Control Switch on Panel 5. Bring the turbine up to 500 to 1000 RPM using the valve positioner (Speed is indicated on panel 4).

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4.1.2.15 The turning gear will automatically disengage as the turbine starts. Place the control switch for the turning gear to OFF, and verify green Disengage light and green motor OFF light are on.

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- 4.1.2.16 Operate the turbine at 500 to 1000 RPM for not less than one-half hour. During the warmup period, listen for any rubbing, unusual noises or vibration. If any such sounds are heard, decrease turbine speed until the condition clears, determine and correct the source of trouble. During the warmup period, check oil pressure, oil temperatures, oil flow to bearings, and general mechanical performance of the turbine.
- 4.1.2.17 Check the gland steam supply pressure at 3 to 5 psig and the gland exhauster vacuum at 6.0 in water from locally mounted indicators.
- 4.1.2.18 After the turbine has been thoroughly warmed up and the temperature of the lubricating oil has reached at least 90°F, gradually OPEN the steam control valves and slowly increase the turbine speed until turbine speed is being controlled by the speed governor (approximately ~ 3000 RPM).

Go to cabinet F-161, in Relay Room, bottom-center, to the two small blue boxes (for FW-P-1A C-1, for FW-P-1B C-2) and place the auto manual (left hand side) switches in the auto position fully up. Note this is to be done only after reaching min speed on the governor.

NOTE: This change over in controls will be noted by a zero speed change when the valve position limiter is positioned to increase speed.

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- 4.1.2.19 Once the feedpump turbine is controlled by the Bailey ICS hand station, RAISE the Manual valve position to the upper limits using the panel 5 Raise/Lower switch until the red light on panel 5 is lit.
- 4.1.2.20 Read rotor vibration at Panel 17 on FW-VT-4056-1 (FW-VT-4056-2).
- 4.1.2.21 Check oil system operation and maintain oil supply temperature between 100°F and 120°F with temperature controller on panel 5.
- 4.1.2.22 CLOSE startup recirculation valves FW-V12A (B).
- 4.1.3 Shifting the Main Feedwater Pump from Auxiliary to Main Steam.
  - 4.1.3.1 Ensure the RC temperature at least 532°F.
  - 4.1.3.2 Gradually secure auxiliary steam to the main feedwater pump turbine by closing AS-V219A (B) and AS-V207A (B).  
NOTE: The feedwater pump turbine will shift to main steam as auxiliary steam is secured. When sufficient reheat steam becomes available the turbine will automatically shift from main steam to reheat steam.
  - 4.1.3.3 After the turbine has been operating for at least one hour, CLOSE turbine drain valves MS-210A (210B), MS-V211A (211B), and MS-V223A (223B) from panel 5.
- 4.1.4 Startup of a Second Feedwater Pump (FW-P-1B (A)).  
NOTE: A second feedwater pump should be started prior to reactor power reaching 40%.
- 4.1.4.1 Ensure two condensate/condensate booster pump pairs are in operation per 2106-2.1.



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- \_\_\_ 4.1.4.2 Ensure the feedwater pump turbine is on the turning gear per Section 4.1.1.
- \_\_\_ 4.1.4.3 Open the Steam Isolation Valves MS-V21A(B) and MS-V28 B(A) if not already open.
- \_\_\_ 4.1.4.4 Thoroughly warm the high pressure and low pressure steam lines. Completely drain the steam lines by opening and closing the following steam trap drip leg isolation valves:
 

<u>Trap</u>	<u>Valves</u>
MS-U36B(A)	MS-V171 B(A) and MS-V174 B(A)
MS-U37B(A)	MS-V180 B(A) and MS-V183 B(A)
MS-U69(67)	MS-V325 (317) and MS-V330 (322)
- \_\_\_ 4.1.4.5 Place Gland Sealing Steam in operation for the second feedwater pump per 2106-1.4.
- \_\_\_ 4.1.4.6 OPEN MS-V45 (44), turbine exhaust line to the condenser.
- \_\_\_ 4.1.4.7 Rotate the turbine using the turning gear for one hour with gland steam applied.
- \_\_\_ 4.1.4.8 Read Rotor run out (eccentricity) at Panel 17 on FW-VT-4056-2 (FW-VT-4056-1).
- \_\_\_ 4.1.4.9 Verify the valve positioner is set at zero (panel 5 green indicating lights illuminated), and the Bailey ICS speed governor is in Manual and set at the minimum range position.
- \_\_\_ 4.1.4.10 Reset the hydraulic trip from panel 5. The LP and HP stop valves will open.

NOTE: The hydraulic trip will not reset unless the valve positioner and governor are at the minimum settings, the HP and LP Stop valves and steam

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control valves are closed, and suction pressure is greater than the low suction pressure trip setpoint.

4.1.4.11 Check OPEN the feedwater pump recirculation valve FW-V12B (12A).

NOTE 1: Check valve positioner motor pin in the "motor" position, and manual valve positioner knurled steel knob should be in the motor position.

NOTE 2: Check manual speed changer (smooth aluminum knob) "pulled fully" out to auto control position.

4.1.4.12 Slowly OPEN the steam control valves using the SGFP Turb Startup/Load Limiting control switch on panel 5. Bring the turbine up to 500 to 1000 RPM using the valve positioner (speed is indicated on panel 4).

4.1.4.13 The turning gear will automatically disengage as the turbine starts. Place the turning gear control switch to OFF, and verify green disengage light, and green motor OFF light are on.

4.1.4.14 Operate the turbine at 500 to 1000 RPM for not less than one-half hour. During the warmup period, listen for any rubbing, unusual noises or vibration. If any such sounds are heard, decrease turbine speed until the condition clears, determine and correct the source of trouble. During the warmup period, check oil pressures, oil temperatures, oil flow to bearings, and general mechanical performance of the turbine.

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- 4.1.4.15 Check the gland steam supply pressure at 3 to 5 psig and the gland exhauster vacuum at 6.0 in water from locally mounted indicators.
- 4.1.4.16 After the turbine has been thoroughly warmed up and the temperature of the lubricating oil has reached at least 90°F, gradually OPEN the steam control valves and slowly increase the turbine speed until turbine speed is being controlled by the speed governor (approximately ~ 3000 RPM).
- Go to cabinet F-161, in Relay Room, bottom-center, to the two small blue boxes (for FW-P-1A C-1, for FW-P-1B C-2) and place the auto manual (left hand side) switches in the auto position fully up. Note this is to be done only after reaching min speed on the governor.
- NOTE: This change over in controls will be noted by a zero speed change when the valve position limiter is positioned to increase speed.
- 4.1.4.17 Once the feedpump turbine is controlled by the Bailey ICS hand station, RAISE the Manual valve position to the upper limits using the panel 5 Raise/Lower switch until the red light on panel 5 is lit.
- 4.1.4.18 Read rotor vibration at Panel 17 on FW-VT-4056-2(4056-1).
- 4.1.4.19 Check oil system operation and maintain oil supply temperature between 100°F and 120°F with controller on panel 5.
- 4.1.4.20 Close startup recirculation valve FW-V12B (A).
- 4.2 Normal Operation.

The two feedwater pumps take a suction on a common suction header, to which condensate is supplied by the condensate/condensate booster pumps and heater drain pumps, and discharge feedwater through the 3rd stage heaters to the feedwater regulating valves and the OTSG's. Turbine speed and the feedwater regulating valves are controlled by ICS. Check oil temperatures and levels, vibration, exposed linkage, oil filter and coolers at least daily. Check stop valve exerciser circuits periodically.

4.3 Shutdown

4.3.1 Shutdown of First of Two Operating Feedwater Pumps.

- 4.3.1.1 Ensure reactor power is between 40% and 50%.
- 4.3.1.2 Manually reduce speed on one feedwater pump to minimum first with the Feedpump Speed controller on panel 4, and then with the Turb Startup/Load Limiting panel 5 control switch.

NOTE: Go to Cabinet F-161 in the Relay Room and at the blue boxes (C-1 for FW-P-1A, and C-2 for FW-P-1B), place the switch for the feedpump to be shutdown, in "Manual" to remove ICS Control. Note this must be done before going below minimum governor speed.

- 4.3.1.3 Place the turning gear control switch on panel 5 to Off for feedwater pump to be shutdown.
- 4.3.1.4 Trip the feedwater pump turbine selected for shutdown using the turbine control switch on panel 5.
- 4.3.1.5 OPEN turbine drain valves MS-V210A (MS-V210B), MS-V211A (MS-V211B), and MS-V228A (MS-V228B) with the Turbine Drain OPEN pushbutton on Panel 5.

- 4.3.1.6 Check that the turning gear engages automatically when turbine speed drops to less than one RPM. The red indicating light for the turning gear motor and the red engage light should come on.
- 4.3.1.7 Secure applicable casing drain tank pump, FW-P-2A or 2B for Feedpump "B" or FW-P-2C or 2D for Feedpump "A".
- 4.3.2 Shutdown of Second Feedwater Pump.
- 4.3.2.1 Ensure the reactor is shut down and steam generator pressure is below 500 psi.
- 4.3.2.2 Ensure all emergency feedwater pump control switches are in PULL-TO-LOCK.
- 4.3.2.3 Manually reduce speed on one feedwater pump to minimum first with the Feedpump Speed controller on Panel 4, and then with the Turb Startup/Load Limiting Panel 5 control switch.
- NOTE: Go to cabinet F-161 in the Relay Room and at the blue boxes (C-1 for FW-P-1A, and C-2 for FW-P-1B), place the switch for the feedpump to be shutdown, in "Manual" to remove ICS Control. Note this must be done before going below minimum governor speed.
- 4.3.2.4 Place the turning gear control switch on panel 5 to ON.
- 4.3.2.5 Trip the feedwater pump turbine using the turbine control switch on panel 5.
- 4.3.2.6 OPEN turbine drain valves MS-V210A (MS-V210B), MS-V211A (MS-V211B), and MS-V228A (MS-V228B) with the Turbine Drain OPEN pushbutton on panel 5.

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- 4.3.2.7 Check that the turning gear engages automatically when turbine speed drops to less than one RPM. The red indicating light for the turning gear motor, and the red engage light should come on.
- 4.3.2.8 Secure applicable casing drain tank pump, FW-P-2A or 2B for Feedpump "B" or FW-P-2C or 2D for Feedpump "A".
- 4.3.3 Securing Feedwater Pumps and Auxiliaries.
- 4.3.3.1 When the Condenser Air Extraction System is secured (condenser vacuum broken) or MS-V44 (45) closed, CLOSE the gland steam supply valves GS-V5 (GS-V2).
- 4.3.3.2 CLOSE the Gland Steam isolation valve to the G.S. Condenser GS-V8A (GS-V8B).
- 4.3.3.3 Continue turning gear operation to ensure even cooling of the turbine rotor for both feedwater pumps. During the cooldown period do not allow lubricating oil temperature from the cooler to fall below 90°F.
- 4.3.3.4 After the reactor coolant system has been placed on the Decay Heat Removal System, all the condensate/condensate booster pumps are secured, and the turbines are sufficiently cooled, STOP the main oil pump for each feedwater pump and check that each auxiliary oil pump starts automatically.
- 4.3.3.5 Place the turning gear control switch for each turbine to OFF.
- 4.3.3.6 STOP the auxiliary oil pump for each feedwater pump and check that each DC emergency oil pump starts automatically.
- 4.3.3.7 STOP each DC emergency oil pump.

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4.3.3.8 STOP each oil reservoir exhaust fan, and secure each oil cooler.

#### 4.4 Single Feedwater Pump Operation Below 55% Power.

NOTE: If operation with a single feedpump is required, reduce power below 55% and proceed with the following steps.

4.4.1 Manually reduce speed on selected feedwater pump to minimum, first with the Feedpump speed controller on panel 4, then with the Turb Startup/Load Limiting panel 5 control switch.

NOTE: Go to Cabinet F-161 in the Relay Room and at the blue boxes (C-1 for FW-P-1A, and C-2 for FW-P-1B), place the switch for the feedpump to be shutdown, in "Manual" to remove ICS Control. Note this must be done before going below minimum governor speed.

4.4.2 Place the turning gear control switch on panel 5 to ON for the feedwater pump to be shutdown.

4.4.3 Trip the feedwater pump turbine selected for shutdown using the turbine control switch on panel 5.

4.4.4 Open turbine drain valves MS-V210A, (210B), MS-V211A (211B), and MS-V228A (228B) with the Turbine Drain OPEN pushbutton on panel 5.

4.4.5 Check that the turning gear engages automatically when turbine speed drops to less than one RPM. The red indication light for the turning gear motor, and the red engage light should come on.

4.4.6 If required CLOSE feedwater pump turbine exhaust valve MS-V44 (MS-V45).

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- \_\_\_ 4.4.7 If required CLOSE gland steam supply valve GS-V5 (GS-V2).
  - \_\_\_ 4.4.8 If required CLOSE gland steam exhaust valve GS-V8A (GS-V8B).
  - \_\_\_ 4.4.9 Continue turning gear operation to ensure even cooling of the turbine rotor. During cooldown period do not allow lubricating oil temperature from the cooler to fall below 90°F.
  - \_\_\_ 4.4.10 After the turbine is sufficiently cooled, STOP the main oil pump and check that the auxiliary oil pump starts automatically.
  - \_\_\_ 4.4.11 Place the turning gear control switch to OFF.
  - \_\_\_ 4.4.12 STOP the auxiliary oil pump for the feedwater pump and check that the DC emergency oil pump starts automatically.
  - \_\_\_ 4.4.13 STOP the DC emergency oil pump.
  - \_\_\_ 4.4.14 STOP the oil reservoir exhaust fan and secure the oil cooler.
- 4.5 Operation With One Third Stage FW Heater Out of Service.
- \_\_\_ 4.5.1 STOP Extraction Steam flow to selected third stage heater per 2106-1.2.
  - \_\_\_ 4.5.2 Secure drains from selected third stage heater to heater drain tank per 2106-1.2.
  - \_\_\_ 4.5.3 OPEN third stage heater bypass valve FW-V15.
  - \_\_\_ 4.5.4 CLOSE third stage heater inlet valve, FW-V9A, (B) and outlet valve, FW-V13A (13B).
  - \_\_\_ 4.5.5 Verify closed FW-V12A (FW-V12B).
  - \_\_\_ 4.5.6 The loss of a third stage feedwater heater unbalances the feedwater temperature to the two steam generators. The



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Integrated Control System should act to compensate for this unbalance by modulating feedwater control valves to equalize reactor coolant Tc. Verify that the ICS compensates for the heater loss.

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## Feedwater System Valve Line-Up

Valve No	Description	Position	Initials
<u>REACTOR BUILDING 201' ELEVATION SOUTH</u>			
FW-V23A	SG 1A FW Inlet Drain Isolation	CL	_____
FW-V41A	SG 1A FW Inlet Drain	CL	_____
FW-V23B	SG 1B FW Inlet Drain Isolation	CL	_____
FW-V41B	SG 1B FW Inlet Drain	CL	_____
<u>REACTOR BUILDING INSIDE WEST "D" RING ON SIDE OF SG</u>			
FW-V33A	SP-1A-LT Rt. Vlv. (SG 1A Level)	OP	_____
FW-V40A	SP-1A-LT Rt. Vlv. (SG 1A Level)	OP	_____
FW-V37C	SP-1A-LT Rt. Vlv. (SG 1A Level)	OP	_____
FW-V39C	SP-1A-LT Rt. Vlv. (SG 1A Level)	OP	_____
FW-V37A	SP-1A-LT Rt. Vlv. (SG 1A Level)	OP	_____
FW-V38A	SP-1A-LT Rt. Vlv. (SG 1A Level)	OP	_____
FW-V42A	SP-1A-LT Rt. Vlv. (SG 1A Level)	OP	_____
<u>REACTOR BUILDING EAST "D" RING ON SIDE OF SG</u>			
FW-V39B	SP-1B-LT Rt. Vlv. (SG 1B Level)	OP	_____
FW-V40B	SP-1B-LT Rt. Vlv. (SG 1B Level)	OP	_____
FW-V37D	SP-1B-LT Rt. Vlv. (SG 1B Level)	OP	_____
FW-V39D	SP-1B-LT Rt. Vlv. (SG 1B Level)	OP	_____
FW-V37B	SP-1B-LT Rt. Vlv. (SG 1B Level)	OP	_____
FW-V38B	SP-1B-LT Rt. Vlv. (SG 1B Level)	OP	_____
FW-V42B	SP-1B-LT Rt. Vlv. (SG 1B Level)	OP	_____

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Feedwater System Valve Line-Up

Valve. No	Description	Position	Initials
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TURBINE BUILDING 281' ELEVATION  
FW-P-1A AREA

FW-V46	3rd Stage FW Htr 6A Inlet Drain Isolation	CL	_____
FW-V47	3rd Stage FW Htr 6A Inlet Drain	CL	_____
CO-V88A	Cond. Booster Disch. to FW-P-1A stuffing Box	OP	_____
FW-V1A	FW-P-1A Disch Warmup	OP	_____
FW-V2A	FW-P-1A Disch Warmup	OP	_____
FW-V3A	FW-PT-1143 Rt. Vlv. (FW-P-1A Disch)	OP	_____
FW-V107C	FW-P-2C Seal Water Supply	OP	_____
FW-V5A	FW-P-1A Recirc.	OP	_____
FW-V107D	FW-P-2D Seal Water Supply	OP	_____
FW-V8A	FW-P-1A Disch.	OP	_____
FW-V9A	3rd Stage FW Htr. 6A Inlet	OP	_____
FW-V27A	FW-P-1A Disch Vent Isolation	CL	_____
FW-V28A	FW-P-1A Disch Vent	CL	_____

TURBINE BUILDING 281' ELEVATION  
FW-P-1B AREA

CO-V88B	Cond. Booster Disch. to FW-P-1B Stuffing Box	OP	_____
FW-V1B	FW-P-1B Disch Warmup	OP	_____
FW-V2B	FW-P-1B Disch Warmup	OP	_____
FW-V3B	FW-PT-1145 Rt. Vlv. (FW-P-1B Disch)	OP	_____
FW-V5B	FW-P-1B Recirc.	OP	_____
FW-V8B	FW-P-1B Disch	OP	_____

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Feedwater System Valve Line-Up

Valve. No	Description	Position	Initials
FW-V98	3rd Stage FW Htr 6B Inlet	OP	_____
FW-V27B	FW-P-1B Disch Vent Isolation	CL	_____
FW-V28B	FW-P-1B Disch Vent	CL	_____
<u>TURBINE BUILDING 281' ELEVATION</u> <u>EAST END OF CONDENSER</u>			
FW-V16A	FW-P-1A Recirc to Condenser	A	_____
FW-V16B	FW-P-1B Recirc to Condenser	A	_____
FW-V64A	FW-P-1A Recirc to Condenser Isolation	OP	_____
FW-V64B	FW-P-1B Recirc to Condenser Isolation	OP	_____
CO-V203A	CO-V204A Inlet Isolation	OP	_____
CO-V203B	CO-V204B Inlet Isolation	OP	_____
CO-V204A	FW-P-1A Bracket Leak Off Tank Control Vlv.	A	_____
CO-V204B	FW-P-1B Bracket Leak Off Tank Control Vlv.	A	_____
CO-V205A	CO-V204A Outlet Isolation	OP	_____
CO-V205B	CO-V204B Outlet Isolation	OP	_____
<u>TURBINE BUILDING 305' ELEVATION</u> <u>3rd Stage FW Htr 6A AREA</u>			
FW-V10A	3rd Stage FW Htr 6A Inlet Px	CL	_____
FW-V11A	FW-PT-1135 Rt. Vlv. (FW Htr. 6A)	OP	_____
FW-V12A	FW-P-1A Startup Recirc.	OP	_____
FW-V67A	FW-P-1A Startup Recirc. O <sub>2</sub> Sample Isolation	OP	_____
FW-V48	FW-P-1A Startup Recirc Drain	CL	_____
FW-V49	FW-P-1A Startup Recirc Drain Isolation	CL	_____

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Feedwater System Valve Line-Up

Valve. No	Description	Position	Initials
FW-V13A	3rd Stage FW Htr 6A Outlet	OP	_____
FW-V52	3rd Stage FW Htr 6A Outlet Vent Isolation	CL	_____
FW-V53	3rd Stage FW Htr 6A Outlet Vent	CL	_____
FW-V54	3rd Stage FW Htr 6A Outlet Drain Isolation	CL	_____
FW-V55	3rd Stage FW Htr 6A Outlet Drain	CL	_____

TURBINE BUILDING 305' ELEVATION  
3RD STAGE FW HTR 6B AREA

FW-V10B	3rd Stage FW Htr 6B Inlet Px	CL	_____
FW-V11B	FW-PT-1132 Rt. Vlv. (FW HTR 6B)	OP	_____
FW-V12B	FW-P-1B Startup Recirc	CP	_____
FW-V67B	FW-P-1B Startup Recirc O <sub>2</sub> Sample Isolation	OP	_____
FW-V13B	3rd Stage FW Htr 6B Outlet	OP	_____
FW-V15	3rd Stage FW Htr 6A/6B Bypass	CL	_____
FW-V50	3rd Stage FW Htr Bypass Drain Isolation	CL	_____
FW-V51	3rd Stage FW Htr Bypass Drain	CL	_____

TURBINE BUILDING 305' ELEVATION  
NORTH EAST IN CEILING

FW-V34A	SP-8A-DPT Rt. Vlv. (FW Flow)	OP	_____
FW-V34B	SP-8B-DPT Rt. Vlv. (FW Flow)	OP	_____
FW-V34C	SP-8A-DPT Rt. Vlv. (FW Flow)	OP	_____
FS-V34D	SP-8B-DPT Rt. Vlv. (FW Flow)	OP	_____
FW-V57	FW HTR 3A Outlet Sample	OP	_____
FW-V58	FW HTR 3A Outlet Sample	OP	_____

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Feedwater System Valve Line-Up

Valve No	Description	Position	Initials
FW-V59	FW HTR 3B Outlet Sample	OP	_____
FW-V60	FW HTR 3B Outlet Sample	OP	_____
<u>TURBINE BUILDING 331' ELEVATION</u>			
FW-V14A	SG 1A FW Control Valve Inlet Isolation	CL	_____
FW-V17A	SG 1A FW Control Valve Outlet Isolation	OP	_____
FW-V19A	SG 1A FW Startup Control Valve Outlet Isolation	OP	_____
FW-V22A	FW HDR Drain	CL	_____
FW-V25A	SG 1A FW Startup Control Valve Neutral, Bypass Airline Closed, and Manual Operator Pin Removed		_____
FW-V26A	SG 1A FW Startup Control Valve Inlet Isolation	OP	_____
FW-V29A	SP-7A-DPT Rt. Vlv. (FW Startup Flow)	OP	_____
FW-V29C	SP-7A-DPT Rt. Vlv. (FW Startup Flow)	OP	_____
FW-V30A	SG 1A FW Control Valve Neutral, Bypass Airline Closed, and Manual Operator Pin Removed		_____
FW-V35A	SP-11A-DPT Rt. Vlv (SG 1A FW Cont. Vlv)	OP	_____
FW-V36C	SP-11A-DPT Rt. Vlv (SG 1A FW Cont Vlv)	OP	_____
FW-V56A	SG 1A FW Startup Control Valve Drain	CL	_____
FW-V61A	SG 1A FW Control Valve Vent	CL	_____
FW-V62A	SG 1A FW Control Valve Vent Isolation	CL	_____
FW-V63A	SG 1A FW Startup Control Vlv Vent Isolation	CL	_____
FW-V66A	SG 1A FW Startup Control Valve Bypass	CL	_____
FW-V14B	SG 1B FW Control Valve Inlet Isolation	CL	_____
FW-V17B	Sg 1B FW Control Valve Outlet Isolation	OP	_____
FW-V19B	SG 1B FW Startup Control Valve Outlet Isolation	OP	_____
FW-V22B	FW HDR Drain	CL	_____
FW-V102A	FW HDR Drain	CL	_____
FW-V102B	FW HDR Drain	CL	_____

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Feedwater System Valve Line-Up

Valve. No	Description	Position	Initials
FW-V25B	SG 1B FW Startup Control Valve	Neutral, Bypass Airline Closed, and Manual Operator Pin Removed	_____
FW-V26B	SG 1B FW Startup Control Valve Inlet Isolation	OP	_____
FW-V29B	SP-7B-DPT Rt. Vlv. (FW Startup Flow)	OP	_____
FW-V29D	SP-7B-DPT Rt. Vlv. (FW Startup Flow)	OP	_____
FW-V30B	SG 1B FW Control Valve	Neutral, Bypass Airline Closed, and Manual Operator Pin Removed	_____
FW-V35B	SP-11B-DPT Rt. Vlv (SG 1B FW Control Valve)	OP	_____
FW-V36D	SP-11B-DPT Rt. Vlv (SG 1B FW Control Valve)	OP	_____
FW-V56B	SG 1B FW Startup Cont. Vlv. Drain	CL	_____
FW-V61B	SG 1B FW Control Valve Vent	CL	_____
FW-V62B	SG 1B FW Control Valve Vent Isolation	CL	_____
FW-V63B	SG 1B FW Startup Control Valve Vent Isolation	CL	_____
FW-V66B	SG 1B FW Startup Control Valve Bypass	CL	_____

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APPENDIX 3

Signatures of those performing/supervising valve line-up  
Valve Line-up Signature Sheet

Operator Initials	Operator Signature	Shift	Date	Shift Foreman or Supervisor Sig.	Remarks



TMI DOCUMENTS

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W.R.M.  
Wilda R. Mullinix, NRC

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