PlantSim4 Startup Instructions

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Description and Startup

PlantSim 4 Model Description

PlantSim Unit #4 has a balanced draft **Carolina type Radiant Boiler** designed for pulverized coal firing. The unit has 54 dual-register burners arranged in three rows of inline burners each on both the front and rear walls.

The maximum continuous rating is 5,320,000 lb/hr of main steam flow at 2534 psig and 1005 F at the superheater outlet with a reheat flow of 4,410,000 lb/hr at 495 psig and 1005 F with a normal feedwater temperature of 541.8 F. Main steam and reheat steam temperatures are controlled to 1005 F from full load down to half load (3,368,900 lb/hr) by a combination of gas recirculation and spray attemperation.

The unit is designed for cycling service and is provided with a **full boiler bypass system**. The unit can be operated with either constant or variable turbine throttle pressure from 63% of full load on down.

The design pressures of the boiler, economizer and reheater are 2975, 3050, and 750 psig, respectively.

This PlantSim Unit 2 model consists of the following systems:

- **Fossil Boiler**
- **Air and Flue Gas System**
- **Fuel System**
- **Water-Steam Circuit**
- **Electrical System**
- **DCS Control System with Alarms**

PlantSim 4 Startup

These instructions assume that:

1. The PlantSim 4 Model has been loaded and is running.
2. The PlantSim 4 HMI is running.

The PlantSim 2 HMI typically follows these conventions:

1. Equipment (pumps, valves, etc) states are shown as:
   - **RED :** STARTED / OPEN
   - **GREEN :** STOPPED / CLOSED
   - **YELLOW :** TRIPPED
2. **Screen Targets** are noted with a RED letter, which can generally be loaded with key-stroke or by using the mouse.
3. In this instruction the HMI screens are accessed from the Main Menu (for example **Turbine Control** is accessed from **Turbine > Turbine Control**). The sub-menus are listed using the symbol: **>** .

Figure 1: The Main Menu

4. Some (primarily HMI) screens are accessed from the **Control Menu** (**Display > Unit Overview > Control Menu**).
5. The PlantSim installation includes an S_Master Initial Condition file **start.ic,** which should be loaded before starting the procedure.

Loading this file loads the following equipment states:

- The stator cooling water system is in service; from the **Stator Water System** screen pumps STATOR CLG PMP401 and STATOR CLG PUMP 402 are started.
- From the **Gas Recirc Fan** screen the DISCH DAMPER is closed, GRF 401 LO PMP 1 is started, and GRF 401 LO PMP 2 is set to auto.
- From the **PA Fan 401** screen the PA FAN LO PMP 1 is started; PA FAN LO PMP 2 is set to auto.
- From the **PA Fan 402** screen the PA FAN LO PMP 1 is started; PA FAN LO PMP 2 is set to auto.
- From the **Heater Drains** screen the HP HTR DRAIN PMP is set to LO SPD.
- From the **HP Htr Control** screen the HP HTR 406, 407, and 408 VALVE control stations are set to auto.
- From the **LP Htr Control** screen the LP HTR 402, 403 and 404 VALVE control stations are set to auto; the LP HTR DRN PUMP 401 control station in set to auto; the LP HTR DRN PP401 REC VLV control station is set to auto.
- From the **EHC Pumps** screen, the TBN 4 EHC CL WTR (38) fluid temperature Set Point is set to 115°F and the controller set to auto; EHC pump 401 is started.
- From the **FD Fan Master Control** screen, the SA APH WTR CV 401 and 402 are set to auto.
- From the **Standby Boiler Feed Pump L.O.** screen the Aux Lube Oil Pump 1 is started and pump 2 is set to auto.
- From the **Condenser Air Removal** screen the CND VAC BRKR VLV A and CND VAC BRKR VLV B valves are opened .
- From the **Primary Air Heater Water** screen the PA HTR PMP 401 is started and the PA HTR PMP 402 is set to auto.

1. Basic HMI Operation

1.1: To start a pump:

1.1.1: Select the **pump**; a control area should be displayed in the lower right part of the screen.

1.1.2: The control area should provide prompts for *START / RESET / STOP*. Typically select ■ from the toolbar to START and ☐ to STOP.

1.2: To open a valve:

1.2.1: Select the **valve**; a control area should be displayed in the lower right part of the screen.

1.2.2: The control area should provide prompts for *OPEN / STOP / CLOSE*. Typically select ■ from the toolbar to OPEN and ☐ to CLOSE.

1.3: To control a Manual/Auto Station, select the station and:

1.3.1: To set a Control Output (CO) select the **OUT** button and then use the up/down arrows or enter the value using the keyboard.

1.3.2: To set a Setpoint (SP) or bias (BI) select the **SET** button and then use the up/down arrows or enter the value using the keyboard.

1.3.3: To switch between Manual and Auto select the MAN AUTO button and, if allowed, the station status will change.

1.3.4: The BACK button will always return to the last screen viewed, so it can be used to switch back and forth between two screens.

2. Unit Startup Preparations

2.1: Load the start.ic file

From S_Master load the start.ic by selecting **File > Load Data Image > Initial Condition.**

Simulation Control Initial Condition: start.ic

2.2: MISC > Circulating Water > Circulating Pumps

Circulating Water Makeup Pumps are started to fill the cooling tower basin:

Set all CW PUMP DISC VLV valves to **AUTO** (25, 26, 27).

Start all 3 pumps.

2.3: Boiler > Condensate > Overview

Select Pump 401.

Start condensate pump **401**.

Open discharge valve (**013**). The valve will be yellow while traveling.

2.4: Boiler > Feedwater > Deaerator

Place the Condensate System in **AUTO**:

Select **DA LEVEL CONTROL,** set CND PMP 401 and CONDENSATE MASTER to **AUTO**.

If the Deaerator level is less than 0 inches, select the DEA 405 Fill VLV (target G) control station. Select the OUT button to set the control output (CO) to **75%**. Monitor the control station PV to fill the Deaerator to **0** inches and close the 405 fill valve (select the OUT button and set the target value back to 0%).

2.5: Boiler > Feedwater > Overview

Close the boiler feed pump discharge stop check valves. (Main 4003 and standby 4007).

2.6: Boiler > Steam > Boiler Vents/Drains

Open the following vents and drains:

- Primary superheater outlet north end (95 first, and then 94).
- Primary superheater outlet south (36 first, and then 04).
- Secondary superheater outlet south end (08 first, and then 07).
- Platen outlet (98 first, and then 99).
- Convection pass drain north end (54).
- Convection pass drain south end (48).

- Convection pass drain north end (46).
- Convection pass drain south end (62).
- Roof inlet drain (35).
- Secondary superheater platen inlet drain (97).
- Secondary superheater inlet drain north end (56).
- Secondary superheater inlet drain south end (42).
- Secondary superheater outlet drain (57).

2.7: Boiler > Steam > Main Steam

Open the following valves:

- BFPT D SO VLV (44).
- BFPT MS DRN VLV (45).
- MS DRN SO VLV (08).
- MS DRN VLV (09).

2.8: Boiler > Steam > Reheat

Open the hot reheat steam drain (*19* and *28*).

2.9: Turbine > Turbine Drains

Open the turbine drain valve Main steam stop, and then the seat drain valves (*34*, *30*, and *23*).

2.10: Boiler > Feedwater > Overview

Fill the Steam Drum:

- Select **CONTROL**
- Monitor the DRUM LEVEL. The SU FW CTL VLV control station PV shows the drum level in inches.
- Open the BLR FILL VLV 4015 by setting the control output (CO) to **20–50%** to begin to fill the drum.
- Once the drum level approaches **-2** inches, start closing the valve (set the CO to **5%**).
- Close the BLR FILL VLV 4015 once the drum level is at **0** inches.

3. Purge the Boiler

3.1: Boiler > Air Gas > Overview

Place both secondary air heaters in service:

• Select the **SAIR HTR 401** screen, start the ELECTRIC MOTOR, and verify that SECONDARY AIR HEATER **401** starts.

• Select the **SAIR HTR 402** screen, start the ELECTRIC MOTOR, and verify that SECONDARY AIR HEATER **402** starts.

3.2: Boiler > Air Gas > Induced Draft

Start ID Fans:

• Select ID FAN 401 and start it. Verify that the fan discharge damper opens 100% after starting fan.

*Fans may take several seconds to complete start sequences

• START ID Fans 402 and 403 similarly.

3.3: Boiler > Air Gas > ID Fans

Select **CONTROL**, verify furnace pressure at set point (-0.50) on IDF MASTER.

Place controllers in **AUTO** one at a time in the following order, and closely monitor furnace draft:

• IDF 401 INLET VANE

• IDF 402 INLET VANE

• IDF 403 INLET VANE

• IDF MASTER U4

3.4: Boiler > Air Gas > FD PA Fans

Start FD FAN 401:

• Verify the speed control (SPD CNTRL) is on **LO SPD**.

• Start FD FAN 401

*Fans may take several seconds to complete start sequences

- Verify that the fan discharge damper opens **100%** after starting fan.

- **Boiler > Air Gas > Overview:**

  Select **CONTROL**; set the FDF 401 INLET VANE to **AUTO** then set the FDF U4 MASTER to **AUTO**.

3.5: Boiler > Air Gas > Induced Draft

Start remaining ID Fans:

- Select ID FAN 404.
- START the ID FAN. Verify that the fan discharge damper opens 100% after starting fan.

- **Boiler > Air Gas > ID Fans:**

  Select **CONTROL;** set the IDF 404 INLET VANE controller to **AUTO**.

3.6: Boiler > Air Gas > FD PA Fans

Start the other FD Fan (402):

- Verify the speed control (SPD CNTRL) is on LO SPD.
- Start FD FAN 402.
- Verify that the fan discharge damper opens **100%** after starting fan.

- **Boiler > Air Gas > Overview:**

  Select **CONTROL**; set the FDF 402 INLET VANE to **AUTO**.

  Set the U4 AIR FLOW MASTER to **AUTO**.

3.7: Boiler > Air Gas > Gas Recirc Fan

Start the GAS RECIRC 401 fan:

- Open the DISCH DAMPER and wait until it is at **100%**.
- Set GFR 401 IN VANE station to **MANUAL** and set the control output (CO) to **50%**.

3.8: BMS > Unit 4 Boiler Purge

Verify the Boiler Purge completes:

• Verify that the purge is in progress (PURGE TIME REMAINING should be counting down). Boiler purge takes 5 minutes.

• When the purge complete is highlighted, indicating purge complete, then select MFT RESET (target B) and RESET to reset MFT relays (MFT RESET indication should be RED).

• Select **MFT FIRST OUT,** and verify all Boiler Permissives are indicating that all trips have been reset (no red arrows indicating trips).

- **BMS > U4 Ignitor Header Status:**

  Select **IGNITER OIL**, place both igniter oil pump controls in the **MANUAL** position.

  Start one igniter oil pump and set it to **AUTO**.

  Open igniter oil safety shutoff valve 29 (target L).

  Place other igniter oil pump in the **AUTO** position.

  Set the IGNITER OIL FLOW CONTROL VALVE (target C) to **AUTO**. Verify the set point (SP) is **185 psig**; if not, set it to 185.

4. Firing the Boiler

4.1: DISP > Unit Overview

Before lighting the igniters to fire the boiler, the Drum Level should be set between **-6 and -2** inches to account for swell when firing the boiler. The DRUM LEVEL can be monitored in several places; use the **DISP > UNIT OVERVEW** screen.

If the Drum Level is HIGH (**> -2** in), then from the **BOILER > STEAM > BOILER VENTS/DRAINS** screen open the blowdown valve to drain the Drum (control valve 63).

*During this procedure, use the BACK button to switch between screens **UNIT OVERVIEW** and **BOILER VENTS/DRAINS**. The BACK button will always return to the last screen viewed, so it can be used to switch back and forth between two screens.

To drain water from the drum, set DWN BLOW (DN) DRN (target 1C) to **OPEN**. Set DWN BLOW (UP) DRN (target 1B) to **OPEN**.

The drum level should start to go down. When the level is near **-2** inches, close the blowdown valve.

4.2: DAS > Fuel > Fuel Overview

Start the lower 3 Igniters:

• Select Pulverizer 405; select target V and **reset all trips**.

• Select the controller for IGN GRP 403B (target M); or select the 403 PULVERIZER and target I for IGN GRP 403B. **Start** the **403B** igniter.

• Select the controller for IGN GRP 403A (target L) and **start** the **403A** igniter.

• Select the controller for IGN GRP 405B (target K) and **start** the **405B** igniter.

• Select the controller for IGN GRP 405A (target J) and **start** the **405A** igniter.

• Select the controller for IGN GRP 404B (target I) and **start** the **404B** igniter.

• Select the controller for IGN GRP 404A (target H) and **start** the **404A** igniter.

4.3: Drum Pressure

Once the Lower Igniters are started, the Drum will start to build pressure.
The target pressure for the Drum = **1000 psig**; target throttle pressure = **700 psig**.

- **DISP > Unit Overview:**

  Monitor the Drum Level and Deaerator Level. Deaerator level should control at **0** inches. The Drum Level must be manually controlled at **+/- 4** inches using the Blowdown valve (063).

- **Boiler > Steam > Boiler Vents/Drains:**

  If the Drum Level is HIGH (**> 4** in) then open the Blowdown valve to drain the Drum (as described above in section 4.1).

  At **> 25 psig** drum pressure **close** the following vents:

  • NTH STM DRM VNT (target 2C) (this will close valves 24 and 23)

  • STH STM DRM VNT (target 2D) (this will close valves 15 and 16).

  • Primary superheater outlet north end (94) (target B).

  • Primary superheater outlet south (04) (target P).

  • Convection pass drain north end (54) (target Y).

- Convection pass drain south end (48) (target 1A).
- Convection pass drain north end (46) (target X).
- Convection pass drain south end (62) (target Z).
- Roof inlet drain (35) (target V).

At **100 psig** drum pressure **close** the following vents:

- SSH OUT CTL (target 2E)
- PLATEN CTL (target 2B)
- Secondary superheater platen inlet drain (97) (target S).
- Secondary superheater inlet drain north end (56) (target T).
- Secondary superheater inlet drain south end (42) (target U).
- Secondary superheater outlet drain (57) (target W).

Boiler > Feedwater > Standby Boiler Feed Pump:

At **100 psig** drum pressure, **start** the Standby BFP to control the drum level:

- Select SBFP OPER U4/U5 SELECT (target X) and select U4SEL.
- Start the two pump motors (targets C and D).
- Select **SB BFP VALVING** and open the SBFP DISC CHK V 4007 (target L).

Boiler > Steam > Boiler Vents/Drains:

Open the blowdown valve (control valve 63) target 1C and target 1B.

Boiler > Feedwater > Overview:

- Select **CONTROL**
- Select SBFP (target B); set the control output (CO) to 40% and set the controller to **AUTO**; verify that the setpoint (SP) is set to **300 psig**.
- Set the SU FW CTRL VALVE 4011 (target C) to **AUTO**. The drum level should now be controlled at **0"** by the Startup BFP.

- **Boiler > Condensate > Deaerator:**

  - Select **DA LEVEL CONTROL**
  - Set the CONDENSATE MASTER setpoint (SP) to **0** inches; set the controller to **AUTO**.
  - Set the DEA 405 FILL VLV (target G) control output (CO) to **15%**.

- **Turbine > Turbine Seals and Drains:**

  At **200 psig** drum pressure, open the AUX STMFDRM valve GE-S6 (target D).

- **Turbine > Condenser Air Removal:**

  - Close the CND VAC BRKR VLV A valve (3).
  - Close the CND VAC BRKR VLV B valve (6).
  - Start the CONDENSER VACUUM PUMP 401
  - Start the CONDENSER VACUUM PUMP 402
  - Start the CONDENSER VACUUM PUMP 403

Monitor the HP CONDENSER and LP CONDENSER pressure. Once the pressure is **> 22** inches HG:

- **DISP > Unit Control:**

  Select **TURBINE CONTROL** and **reset** the TURBINE RESET (target A).

- **Boiler > Steam > Bypass System:**

  - Set the U4 BP TO CND VLV 502 control station to **AUTO** (target E).
  - Close valves SEC SH STM BLK VLV 500A (target U) and 500B (target V).
  - Set SEC SH BLK VLV BYPASS valves 501A (target S) and 501B (target T) to **AUTO**.

  Select **CONTROL**. Set the SSH 500 BLK VLVS BYP VLV MASTER control station to **AUTO** (target F).

At **250 psig** drum pressure:

- **Turbine > Turbine Control:**

  • Select ROTOR PRE-WARM (target C) and ROTOR.

  • Select ROTOR WARM RATE (target D) and set to **10%**.

At **300 psig** drum pressure:

- **Boiler > Steam > Main Steam:**

  Open the MS WARM LINE VALVES: 31, 29, 27, 53.

- **DISP > Unit Control:**

  • Set DRUM PRESSURE MODE (target S) to **AUTO**.

  • Set the THROTTLE PRESS TARGET PR setpoint (SP) to **700 psig** (target E, SET).

  • Set the DRM PRESS SETPOINT BIAS setpoint to **300 psig** (target I). This sets the target drum pressure to 1000 PSIG (700 PSIG throttle pressure + 300 PSIG).

4.4: DAS > Environmental > Environmental Data

Turn on the precipitators:

• Select PREC 1 CONTROL (target A) and **START**.

• Select PREC 2 CONTROL (target B) and **START**. The STACK OPACITY should start to decrease.

4.5: Boiler > Steam > Boiler Vents/Drains

At **500 psig** drum pressure:

Close the blowdown valve (control valve 63) target 1C and target 1B. Monitor the DRUM LEVEL and verify that it is controlled to **0** inches. The level will increase but should max out below 5 inches and then start to come down

4.6: Turbine > Turbine Control

At **700 psig** drum pressure:

Select ROTOR PRE-WARM (target C) and **NORMAL**.

Once the target pressure of 1000 PSIG DRUM PRESSURE; 700 PSIG THROTTLE PRESSURE is reached, start the turbine.

5. Start the Turbine

A typical plant startup would at this point address turbine rotor pre-warming, turbine chest warming and other temperature mismatch concerns. For the purposes of this instruction, we will continue straight to turbine startup.

5.1: Turbine > Turbine Control

Select TURBINE RESET SELECT (target A) and **reset**.

Select CLOSE ALL VALVES (target T) and **NORMAL**.

Select 1000 RPM SELECT (target F) and **ON**.

Select ACCEL RATE (target E) and **FAST**.

Once the turbine speed reaches 1000 RPM, select 3000 RPM SELECT (target G) and **ON**

Once the turbine speed reaches 3000 RPM, select 3600 RPM SELECT (target H) and **ON**.

5.2: Boiler > Air Gas > Primary Air Heater

Start the primary air heater (target B). The AH LO PUMP 401 should be started and AH LO PUMP 402 should be in **AUTO**.

Set the PA HTR 401 GAS OUT DAMPER (target A) to **AUTO**.

5.3: Boiler > Air Gas > PA Fan 401

Start the PA fan:

- Close the DISCH DAMPER for fan 401 (target E) and set the control station to **AUTO**.
- Start the PA FAN 401 (target D).
- After the DISCH DAMPER opens, select the PA FAN 401 INLET VANE and set to **AUTO**.

5.4: Boiler > Air Gas > PA Fan 402

Start the PA fan:

- Close the DISCH DAMPER for fan 402 (target E) and set the control station to **AUTO**.
- Start the PA FAN 402 (target D).
- After the DISCH DAMPER opens, select the PA FAN 402 INLET VANE and set to **AUTO**.

5.5: Boiler > Air Gas > FD PA Fans

Select **PA FAN CONTROL**. Set the PA FAN MASTER to **AUTO**.

6. Start a Pulverizer

6.1: DAS > Fuel > Pulv 403 Lube Oil

Select PULV 403 LO PMP (target A) and **START**.

6.2: BMS > 403 > Pulv 403 Startup

Start mill 403:

Select step 1. PULV 403 SEQ (target X) and **START**.

Select step 4. PULV 403 PA FLOW (target C) and **START**.

Select step 5. PULV 403 BURNER SWING VALVES (target D) and **OPEN**.

Select step 6. PULV 403 MOTOR (target E) and **START**.

Select step 7. PULV 403 FEEDER (target F) and **START**. Wait for the time counters to expire.

Select step 8. PULV 403 IGN (target B) and **STOP**. Wait for the time counters to expire.

6.3: Control Menu > Pulv 403 Control

Start the coal feeder:

Select the COAL FDR 403 FLOW and set the output CO to **30%** and set the controller to **AUTO**.

7. Synchronize the Generator

7.1: Generator > Generator Overview

Select EXCITER FIELD BREAKER and set to **CLOSE**.

Select EXCITER MODE and set to **AUTO**.

7.2: Turbine > Turbine Control

Select SPEED CONTROL (target K) and set the setpoint (SP) to **3602 RPM**.

7.3: DISP > PS4 HP1

Close the GENERATOR BREAKER 3233**:**

• Set the GENERATOR BREAKER 3233 SNYC SWITCH to **MANUAL** (just click on the switch to set the position).

• With the turbine speed set to 3602 RPM, the SYNCHROSCOPE should be moving in the FAST direction. The three yellow lights must be ON to close the GENERATOR BREAKER 3233. SYNC SLIP FREQ and SYNC VOLTS OK should be ON. SYNC VOLTS OK refers to the GENERATOR VOLTS and SYSTEM VOLTS differential. SYNC SLIP FREQ refers to the grid frequency and turbine speed differential. SYNC PHASE ANGLE OK is ON when the SYNCHROSCOPE is at 12 o'clock.

• Once the GENERATOR BREAKER 3233 is set to **CLOSE** then click on the time display in the upper left of the hard panel screen to return to the PS4 HMI.

7.4: Turbine > Turbine Drains

After synchronizing, **close** the following valves:

• MSV 1 BEFS DRN VLV 4034 (target E)

• MSV 2 BEFS DRN VLV 4030 (target G)

• MSV 3 BEFS DRN VLV 4023 (target A)

• MSV 1 AFTS DRN VLV 4036 (target D)

• MSV 2 AFTS DRN VLV 4032 (target F)

• MSV 3 AFTS DRN VLV 4025 (target B)

• STM LEAD DRNDV 4027 (target C)

8. Initial Unit Loading to 100 Megawatts

8.1: Boiler > Air Gas > Gas Recirc Fan

Select the GRF 401 IN VANE (target T) and set the station to **MANUAL**. Set the control output (CO) to **65%**.

8.2: DISP > Unit Control

Select THROTTLE PRESS SETPOINT (target E); set the pressure set point SP to **1000 psig**.

8.3: Turbine > Turbine Control

Select TURBINE MASTER (target L) and set the setpoint SP to **10%**.

8.4: Boiler > Steam > Bypass System

Select RH SAT STM 519B BLK VLV (target X) and **CLOSE**.

8.5: Boiler > Steam > Main Steam

Close the MS WARM LINE DV 4053 CONTROL (target K). Valves 4031, 4029, and 4027 should close after the 4053 valve.

8.6: Boiler > Steam > Main Steam

Close the following valves:

- MS DRN SO VLV 4008 (target C)
- MS DRN VLV 4009 (target D).

8.7: Control Menu > Boiler Control

Place the U4 AIR FLOW MASTER in **AUTO**.

Place the O2 TRIM STATION in **AUTO**.

8.8: Control Menu > Fuel Control

Place the CMPT 403 MASTER controller output (CO) to **50.0%**. Make sure the bias (BI) is **0%**.

8.9: DISP > Unit Control

Once the pressure reaches setpoint:

1000 psig – Throttle pressure

1300 psig – Drum pressure

Select THROTTLE PRESS SETPOINT (target E); set the pressure set point SP to **1200 psig** and the TARGET PR (target I) SP to **200 psig**.

8.10: DISP > Unit Control

Once the pressure reaches setpoint:

1200 psig – Throttle pressure

1400 psig – Drum pressure

select THROTTLE PRESS SETPOINT (target E); set the pressure set point SP to **1500 psig** and the TARGET PR (target I) SP to **100 psig.**

8.11: DISP > Unit Control

Once the pressure reaches setpoint:

1500 psig – Throttle pressure

1600 psig – Drum pressure

Select THROTTLE PRESS SETPOINT (target E); set the pressure set point SP to **1800 psig** and the TARGET PR (target I) SP to **0 psig**.

8.12: Boiler > Steam > Reheat

Close the COLD RH STM D VLV 4001 CONTROL (target D).

8.13: Unit Control > Fuel Control

Place the CMPT 403 MASTER controller output (CO) to **60.0%** and set the controller to **AUTO**.

Place the FUEL MASTER controller in **AUTO**.

8.14: Boiler > Steam > Bypass System

Wait for the Throttle pressure and Drum pressure to settle near the set points. Once the Drum pressure has increased to **1800 psig** (the THROTTLE PRESS may still be low), set the U4 BP TO CND VLV 502 control station to **MANUAL** (target E) and close the valve by setting the output (CO) to **0%**.

8.15: DISP > Unit Control

Select BOILER and set the BLR MASTER (target V) to **AUTO**.

8.16: DISP > Unit Control

Select **TURBINE CONTROL**. Set the MW LOOP (target U) to **IN** and set the MW LOOP SP (target V) to **70 MW**.

Once MEGAWATTS has settled at 70 MW, increase the MW LOOP SP (target V) to **80 MW**.

8.17: Boiler > Steam > Bypass System

Open the SEC SH STM BLK VLV 500A (target U) and 500B (target V).

Set SEC SH BLK VLV BYPASS valves 501A (target S) and 501B (target T) to **MANUAL** and set the controller output (CO) to **100.0%**.

8.18: DISP > Unit Control

Select **TURBINE CONTROL** and increase the MW LOOP SP (target V) to **100 MW**.

8.19: Boiler > Steam > Bypass System

Once MEGAWATTS has reached 100 MW, **close** the PRI SH BYP 542 SHUTOFF VLV (target C). The SH BYP 297 WARM VLV should remain **OPEN**.

8.20: Boiler > Steam > Reheat

Close hot reheat steam drain 19 (target E) and 28 (target F).

8.21: Boiler > Steam > Bypass System

Open the following valves:

- SGA4001 SUP ATEMP FLW BLK VLV (target R)
- SH ATEMP 4002 SOV (target F)

- SH ATEMP 4006 SOV (target H)
- SH ATEMP 4007 SOV (target J)
- SH ATEMP 4009 SOV (target L)
- SH ATEMP 4008 SOV (target N)
- SH ATEMP 4004 SOV (target P)

8.22: Boiler > Steam > Bypass System

Set the following valves to **AUTO**:

- SH SPRAY 401-2 (target G)
- SH SPRAY 401-1 (target I)
- SH SPRAY 402-1 (target O)
- SH SPRAY 401-2 (target Q)

Place Pulverizer 405 in service as described in section 08-0.

8.23: Control Menu > Pulv 405 Control

Select the COAL FDR 405 FLOW and set the controller to **AUTO**.

Select the CMPT 405 MASTER and set the controller to **AUTO**. Make sure the bias (BI) is **0%**.

8.24: Turbine > Turbine Valve Drains

Close RHIV 1 ASD VLV 4061 (target N).

Close RHIV 2 ASD VLV 4063 (target M).

9. Load Unit to 300 Megawatts

9.1: DISP > Unit Control

Select **TURBINE CONTROL** and increase the MW LOOP SP (target V) to **200 MW**.

Once the unit is at **200 MW**, place Pulverizer 406 in service as described in section 0-0.

9.2: Control Menu > Pulv 406 Control

Select the COAL FDR 406 FLOW and set the controller to **AUTO**.

Select the CMPT 406 MASTER and set the controller to **AUTO**. Make sure the bias (BI) is **0%**.

10. Place the Feedwater Heaters in Service

10.1: Boiler > Condensate > LP Heaters

Open the LP HTR 4 BYPASS VLV (target D).

Set the DEA 405 FILL VLV (target B) to **MANUAL** and set the controller output (CO) to **0%**.

Open the LP HTR 4 OUTLET VLV (target C).

Open the LP HTR 4 INLET VLV (target E).

Open the LP HTR 4 BYPASS VLV (target D).

Open the LP HTR 1 INLET VLV (target K).

Open the LP HTR 1 OUTLET VLV (target G).

10.2: Boiler > Feedwater > HP Heaters

Place these HP feedwater heaters in service:

- OPEN the HP HTR 6 OUTLT VLV (target G).
- OPEN the HP HTR 7 OUTLT VLV (target E).
- OPEN the HP HTR 8 OUTLT VLV (target A).
- Set the HP HTR 6 IN/BP VLV (target X) to HEATER.
- Set the HP HTR 7 IN/BP VLV (target F) to HEATER.
- Set the HP HTR 8 IN/BP VLV (target B) to HEATER.

10.3: Boiler > Air Gas > Gas Recirc Fan

Select the GRF 401 IN VANE (target T) and set the station to **MANUAL**. Set the control output (CO) to **85%**.

10.4: DISP > Unit Control

Select **TURBINE CONTROL** and increase the MW LOOP SP (target V) to **300 MW**.

Let the unit settle at **300 MW** and **1800 psig** throttle pressure.

11. Place the Main Boiler Feed Pump in Service

11.1: Boiler > Steam > Main Steam

Close the following drain valves:

- BFPT MS DRN SO VLV 4044 (target A)
- BFPT MS DRN VLV 4045 (target B).

11.2: Boiler > Feedwater > Overview

Open the following valves:

- BFP SUCT VLV 4001 (target B)
- BFP DISCH SC VLV 4003 (target J)

11.3: Control Menu > Misc Control 2

Put the BFPT 401 LO CONTROL VLV in **AUTO**.

11.4: Boiler > Feedwater > Overview

Select **MAIN BFP** and select STARTUP SEQUENCE.

Verify STEP 1 permissives are satisfied.

Select STEP 2 (target B) and **RESET**.

11.5: DISP > WGC HP

Select **RUN**.

Press the ADJ ▲ button until the Limit is set to **100%**. The Speed readout should increase to **250 RPM**.

Place the Woodward Control in remote by selecting F3 and **YES** (1).

Click the time label in the upper right of the display to switch back to the **BFP TURBINE STARTUP SEQUENCE** screen:

- **BFP Turbine Startup Sequence:**

Complete Step 4, select BFPT WOODWARD SPEED SP (target E) and set the setpoint to **500 RPM**.

*Soak time may be overridden (target I).

Once the 15 MIN soak is over, complete STEP 5, select BFPT WOODWARD SPEED SP (target F) and set the setpoint to **1300 RPM**.

*Soak time may be overridden (target J).

Once the 30 MIN soak is over, complete STEP 6, select OPERATOR ACK STARTUP COMPLETE (target G) and **COMPLT**.

12. Swap the Startup BFP / Main BFP

12.1: Control Menu > Feedwater Control > Feedpump Transfer

Place the BFP 401 CONTROL STATION in **AUTO**.

Wait for the FEEDPUMP DISCH PRESS from the MAIN to increase; the SBFP should start to decrease once the main BFP pressure builds up.

12.2: Boiler > Feedwater > Overview

Select **CONTROL**.

Select the SBFP CONTROL STATION and set the SP to **150 psig**.

Select **FEEDWATER MODES**, select BLR FW BLK VLV 4023 MODE (target L) and set to **DP/TMP**.

13. Load Unit to 750 Megawatts

13.1: Place Pulv 404 In Service

Place Pulverizer 404 in service as described in section 0-0.

13.2: Control Menu > Pulv 404 Control

Select the COAL FDR 404 FLOW and set the controller to **AUTO**.

Select the CMPT 404 MASTER and set the controller to **AUTO**. Make sure the bias (BI) is **0%**.

13.3: DISP > Unit Control

Select THROTTLE PRESS SETPOINT (target E); set the pressure set point SP to **2400 psig**.

13.4: DISP > Unit Control

Select **TURBINE CONTROL** and increase the MW LOOP SP (target V) to **450 MW**.

13.5: Place Pulv 407 In Service

Place Pulverizer 407 in service as described in section 0-0.

13.6: Control Menu > Pulv 407 Control

Select the COAL FDR 407 FLOW and set the controller to **AUTO**.

Select the CMPT 407 MASTER and set the controller to **AUTO**. Make sure the bias (BI) is **0%**.

13.7: Boiler > Condensate > Overview

Select Pump 402 and **START** condensate pump 402.

Select **DA LEVEL CONTROL** and set the CND PMP 402 control station in **AUTO** and select CASC from the toolbar.

13.8: DISP > Unit Control

Put the Unit in **Coordinated Manual mode**; select the TURBINE MASTER (target U). Put the control station in **cascade mode** by selecting the CASC button from the toolbar.

13.9: Boiler > Air Gas > Overview

Select FD FAN 401 and set the fan speed control (target X) to **HI SPD**.
Watch the FURN PRESS and let it settle out.

Select FD FAN 402 and set the fan speed control (target X) to **HI SPD**.
Watch the FURN PRESS and let it settle out.

Select ID FAN 401 and set the fan speed control (target X) to **HI SPD**.
Watch the FURN PRESS and let it settle out.

Select ID FAN 402 and set the fan speed control (target X) to **HI SPD**.
Watch the FURN PRESS and let it settle out.

Select ID FAN 403 and set the fan speed control (target X) to **HI SPD.**

Let the unit settle at **450 MW** and **2400 psig** THROTTLE PRESS.

Set the HIGH LIMIT (target B) to **760 MW**.

Set the TARGET MW (target A) to **550 MW**.

Let the unit settle at 550 MW and **2400 psig** THROTTLE PRESS.

Set the TARGET MW (target A) to **650 MW**.

Place Pulverizer 402 in service as described in section 0-0.

13.10: Control Menu > Pulv 402 Control

Select the COAL FDR 402 FLOW and set the controller to **AUTO**.

Select the CMPT 402 MASTER and set the controller to **AUTO**. Make sure the bias (BI) is **0%**.

Let the unit settle at **650 MW** and **2400 psig** THROTTLE PRESS.

13.11: Boiler > Air Gas > Gas Recirc Fan

Select the GRF 401 IN VANE (target T) and set the control output (CO) to **90%**.

13.12: DISP > Unit Control

Select THROTTLE PRESS SETPOINT (target E); set the pressure set point SP to **2500 psig**.

Select ID FAN 404 and set the fan speed control (target X) to **HI SPD**.

Set the TARGET MW (target A) to **750 MW** (full power).