1 Purpose

1.1 Provide a standard procedure for safety, start-up, testing and shut-down of the Clean Steam Generator in the Process Systems shop test area.

2 Scope

2.1 This procedure applies to the following types of equipment: Clean Steam Generator(Boiler).

3 Responsibility

3.1 Process Systems Lead Project Engineer or the Shop Forman shall have overall responsibility for new equipment from procurement to start-up. The Lead Project Engineer is responsible for coordinating the following activities:

3.1.1 Review of customer and project testing specifications.

3.1.2 Coordinate testing and training schedule with all team members including (but not limited to): Shop Foremen, Start-up Service, Customer, and Safety (as needed).

3.2 Therma Start-up Service has responsibility for the following activities:

3.2.1 The start-up individual shall perform the start-up tasks as specified in this Standard Operating Procedure.

3.2.2 The start-up individual shall fully complete the start-up form FN 6.024.1 for each test daily. A copy of this sheet will be provided to the Lead Project Engineer with the turnover documents: A second copy will be filed by the Quality Control Manager.

4 Procedures

4.1 General: The start-up individual is responsible for filling out start-up sheet FN 6.024.1 for Boiler. A daily column on the start-up sheet will be completed for each testing session. Each sheet requires the following information:

4.1.1 Job identification: The job name and job number are to be completed by the start-up individual.

4.1.2 Section 5 - Start-up, Testing and Shutdown

4.1.3 Signature - As each set of start-up/test data is completed, the start-up individual must initial and date in the entry space for the task.

5 Process Systems Clean Steam Generator Start-up, Testing and Shutdown

5.1 This section should be completed by the start-up individual. Any design documentation specifying equipment should be recorded in this section. This includes: Specification number, Submittal number and Process and Instrumentation Diagram (P&ID)number.

5.2 For each of the following items: Write initials or N/A for not applicable.

5.3 Verify all present are aware of/review Lock-Out/Tag-Out procedures.

5.4 Review Operating Manual for Clean Steam Generator. This manual is to remain at the equipment.

5.4.1 The start-up individual and the owner (or rep.) shall initial and date after reviewing this SOP and prior to startup.

5.5 Inspect for visible signs of damage, leak, or defective parts. Note any discrepancies and notify the Project Manager.

5.6 Verify that required clearance, 1" on all sides, from combustibles is maintained.

5.7 Verify the design test pressure for current testing session is a lower pressure than the Pressure Relief Valve setting.

5.8 Verify the steam supply outlet piping, valves and clamps.

5.8.1 All hygienic clamps shall be 2-bolt High Pressure type.

5.8.2 All gaskets shall be RuberFab TufSteel® or equivalent.

5.9 Verify steam piping flow path with Equipment P&ID for proper points of connection for testing.

5.10 Verify steam hoses are rated for the testing duty. Sample Pressure & Temperature data:

5.10.1 For Saturated Steam (approx. data)

Press psig	Temp.°F
0	212
10	240
15	250
25	270
30	280
50	300

5.10.2 Clean steam hoses to be Afex Pharmaline "CHEMFLUOR" #WTLCT™ or equivalent.

5.11 Verify that make up water supply has proper shut-off.

5.12 Test water quality and record quality on form FN 6.024.1 in units of Mega-Ohms (MΩ).

5.13 Close the drain valve.

5.14 Check and record make-up water supply pressure.

5.15 Notify the Shop Forman and Lead Project Engineer of pending start-up.

5.16 Follow "Pre-Operation Check" procedure in manual.

5.16.1 Open all make-up water valves.

5.16.2 Switch steam generator power ON. Verify proper water level.

NOTE: Unit make-up water solenoid valve should open and fill until level is at the proper level, approximately half way up the sight glass.

5.16.3 Verify proper level control.

5.16.3.1 Slowly open drain valve until make-up water solenoid opens. Close drain valve and verify proper water level after filling.

5.16.4 Verify proper "Low Water Cutoff Switch" operation.

5.16.4.1 Open the drain valve completely.

NOTE: Unit water level will fall enough to cause the low water cutoff switch to de-energize the heating elements. All of the contactors will be in a de-energized or open state at this time.

5.16.4.2 Close the drain valve.

NOTE: Unit make-up water solenoid valve should open and fill until level is at the proper level and the contactors will re-energize.

5.17 Follow "Pressure Controls, Operation and Testing" procedure in manual.

NOTE: All boilers are provided with one 'High Limit Pressure Control' (HLPC) and one 'Operating Pressure Control' (OPC).

5.17.1 'Operating Pressure Control' (OPC) should be set at least 10 psi BELOW the make-up water supply pressure.

5.17.2 'High Limit Pressure Control'(HLPC) should be set approximately 10 psi ABOVE the desired normal operating pressure.

5.17.3 OPC Check:

5.17.3.1 With the power OFF, close the steam outlet valve.

5.17.3.2 Adjust OPC to the lower of 20 psig or Make-up pressure less 10 psi.

5.17.3.3 Adjust HLPC to lower of 30 psig or OPC plus 10 psi.

5.17.3.4 Switch the power to ON to allow steam pressure to build.

5.17.3.5 Verify that the OPC de-energizes the heater contactor when the pressure exceeds the set point.

5.17.3.6 Open the steam outlet valve to decrease the pressure and verify the contactor re-energizes the contactor.

5.17.4 HLPC Check:

5.17.4.1 FOR TEST PURPOSES ONLY, SET THE HLPC TO 10 psi BELOW THE OPC.

5.17.4.2 With the power OFF, close the steam outlet valve.

5.17.4.3 Switch the power to ON to allow steam pressure to build.

5.17.4.4 When the pressure rises to the HLPC setpoint, the manual reset button will pop-up and the control will de-energize the heater contactor.

5.17.4.5 Open the steam outlet valve to decrease the pressure.

5.17.4.6 The contactor should not re-energize on pressure drop. The contactor should not energize until the pressure has dropped and the High Limit Pressure Control RESET button is depressed.

5.18 Follow "Operation" procedure in manual.

5.18.1.1 Set the desired operating pressure and differential pressure on the OPC.

5.18.1.2 Set the HLPC.

5.18.1.3 Open the make-up water supply.

5.18.1.4 Turn the main disconnect switch to ON.

5.18.1.5 Turn the boiler control switch ON.

NOTE: The water feed will begin and continue until the water level reaches half way up the gauge glass. The water feed will automatically shut off and the contactor(s) will energize.

5.18.1.6 Boiler steam pressure will gradually increase to the operating pressure control set point, at which time the contactor(s) will de-energize. Record the actual steam pressure.

5.18.1.7 With steam demand, the boiler steam pressure will decrease. When the boiler pressure has dropped

below the operating pressure control differential set amount, the contactor(s) will de-energize.

5.18.1.8 The boiler is equipped with float type liquid level controls employing micro switches. They are extremely sensitive and reliable and will maintain the proper water level within the boiler pressure vessel automatically during boiler operation.

5.18.1.9 The boiler should be blown down daily. (See blowdown instructions.)

5.18.1.10 Check all steam connections for leaks.

5.19 Follow "Manual Blowdown Instructions" procedure in manual.

5.19.1 At the end of the working day, while boiler is still operating, turn boiler main switch to the “OFF” position, close water supply valve and open disconnect switch.

5.19.2 If blow down valve is plumbed into a blowdown tank, the boiler can be discharged at operating pressure.

5.19.3 If the blowdown valve is not plumbed into a blowdown tank, consult with local plumbing codes regarding boiler discharge.

5.19.4 When discharge is complete and boiler is drained, close the blowdown valve, open the water supply valve, turn boiler main switch to “ON” position and close disconnect switch.

5.19.5 When refilling is complete, turn off the boiler unless further operation is needed.

5.19.6 If boiler is equipped with a “Manual Re-set Auxiliary Low Water Cut-off” (as required in some states) the re-set button must be pushed before the boiler will begin developing steam. Do not push re-set button until the boiler has refilled with water.

5.19.7 Notify shop forman and project manager of clean steam generator shutdown.

5.20 Maintenance

5.20.1 Daily blowdown at pressure is essential for ideal boiler performance. Extended periods of operation may require more frequent blowdown. If the boiler is not equipped with an automatic blowdown, in order to safeguard the heating elements, it is

recommended to turn both the main disconnect switch and the boiler switch to the off position before manually blowing down the boiler.

5.20.2 The sight glass should be checked frequently to assure the boiler has adequate water.

5.20.3 The sight glass should be checked daily for damage (i.e. scratches, erosion, leaks etc.) The sight glass should be replaced if damaged.

5.20.4 A monthly inspection should be made of the internal wiring. Open the access door and check all electrical connections for tightness. Replace any wires that show signs of damage.

NOTE: The electrical power MUST be shut off during this maintenance procedure.

5.21 Record start up operating parameters in the Clean Steam Generator form, FN 6.024.1.

Document Approval

Process Systems Manager — Date: 27 Aug 12

Service Manager — Date: 8/29/12

Health & Safety Manager — Date: 8/30/12

Piping Operations Manager — Date: 9-4-12

Quality Assurance Manager — Date: 09-04-12