

**STANDARD OPERATING PROCEDURE
STAN MAYFIELD BIOREFINERY PILOT PLANT**

TITLE: Steam Supply

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APPROVALS: Process Change Committee

DATE:

A. Scope

This SOP describes the procedure to operate the Steam Supply System in order to provide steam and return condensate for the processes. The Steam System contains high pressure (~225 PSI which is supplied from Boiler PK-9301), 150 PSI, intermediate pressure (~60 PSI) and low pressure (~30 PSI) all supplied from Buckeye steam at ~150 PSI.

B. Safety and Training Requirements

Refer to UF lab safety policies regarding equipment listed in section D below before starting any process work.

Review the location of fire extinguishers, fire blankets, safety showers, spill cleanup equipment and protective gear before beginning any process work.

During operations in the plant, the following safety gear will be utilized at all times:

- Safety Goggles or Face Shield
- Protective Gloves
- Hard Hat

CAUTION: High Steam Pressure (225 PSI) and Temperature (392 F)**C. Related Documents and SOPs**

1. Boiler manual XXXX
2. CIP System SOP-8205
3. Hot Water Operation System SOP-9605
4. Ethanol Distillation SOP-4005
5. Air System Operation SOP-9405
6. Biomass Pretreatment SOP-2110
7. Biomass Liquefaction SOP-2305
8. Biomass Storage and Handling SOP-1200
9. C5 Hydrolysate Storage SOP-2135
10. Liquid/Solid Separations SOP-2125
11. Hydrolysate pH Adjustment SOP-2325
12. Process Water System Operation SOP-9505
13. Fermentation Tank A SOP-3230

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14. Fermentation Tank B SOP-3235
15. Fermentation Tank C SOP-3240
16. Primary Propagator 2A SOP-3215
17. Primary Propagator 2B SOP-3215
18. Secondary Propagator 3A SOP-3225
19. Secondary Propagator 3B SOP-3225
20. Potable Water System SOP-9705

D. Preparation/Materials/Equipment

1. Electric Boiler
2. Steam Condensate Flash Package (PK-9302)
3. Clean Condensate Pump (PC-9302)

E. Detailed Procedure

E.1. Start Up Procedure

1. Initial valve positions settings are given in the table below.

Steam Supply System				
Line	Line Number	Valve	Position	Check
150 PSI Steam to Downstream Process	SL-9301-04-CS72	9301-V-01	Close	
		9301-V-03	Close	
	Drain	9301-V-02	Close	
		9301-V-09	Close	
	Steam Trap	9301-V-08	Open	
		9301-V-11	Close	
	Pressure Indicator	9301-V-18	Open	
to 150 PSI Steam Header	SM-9301-05-CS73	9301-V-17	Close	

Steam Supply System				
Line	Line Number	Valve	Position	Check
60 PSI Steam to Downstream Process	SL-9301-02-CS72	9301-V-14	Close	
to 60 PSI Steam Header	SL-9301-02-CS72	9301-V-14	Close	

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	Pressure Transmitter	9301-V-12	Open
to Hot Water Heater	SL-9302-50-CS72	9302-V-30	Close
to CIP Heater	SL-9302-03-CS72	9302-V-32	Close
to Beer Stripper Reboiler	SL-9302-31-CS72	9302-V-33	Close
	SL-9302-15-CS72	9302-V-34	Close
to Stripper Column	SL-9302-04-CS72	9302-V-35	Close
to Molesieve Superheater	SL-9302-18-CS72	9302-V-36	Close
to Rectifier Reboiler	SL-9302-14-CS72	9302-V-37	Close
to Sterilizing Filter	SL-9302-20-CS72	9302-V-38	Close
30 PSI Steam to Downstream Process	SL-9301-01-CS72	9301-V-13	Close
	Pressure Transmitter	9301-V-15	Open
to Fermenter A	SL-9302-05-CS72	9302-V-01	Close
to Fermenter B	SL-9302-23-CS72	9302-V-02	Close
to Fermenter C	SL-9302-24-CS72	9302-V-04	Close
to Propagators	SL-9302-10-CS72	9302-V-05	Close
to Propagator 3B	SL-9302-06-CS72	9302-V-06	Close
to Propagator 3A	SL-9302-09-CS72	9302-V-08	Close
to Propagator 2B	SL-9302-21-CS72	9302-V-10	Close
to Propagator 2A	SL-9302-10-CS72	9302-V-12	Close
to Liquefaction Tank	SL-9302-12-CS72	9302-V-14	Close
to Hydrolyzer	SL-9302-13-CS72	9302-V-15	Close
to Propagator 2B	SL-9302-28-CS72	9302-V-17	Close
to Hydrolysate pH Adjustment Tank	SL-9302-36-CS72	9302-V-18	Close
to Prep Tank Heater	SL-9302-37-CS72	9302-V-19	Close
to C5 Storage Tank	SL-9302-38-CS72	9302-V-20	Close
Spare Valves		9302-V-03	Close
		9302-V-07	Close
		9302-V-09	Close
		9302-V-11	Close

Steam Supply System				
Line	Line Number	Valve	Position	Check
Process Water to Boiler Package	RCW-9501-49-SS98			
		9301-V-04	Close	
		9301-V-06	Close	
Potable Water to Boiler Package	PW-9701-21-SS98	9301-V-16	Close	

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Process Water Drain Line	RCW-9301-10-SS10	9301-V-05	Close
Condensate to Process Water Tank		9302-V-43	Open
to Process Water Tank	CP-9302-29-CS72	9302-V-42	Open
225 PSI Steam to Downstream			
to High Pressure Steam Header	SM-9301-03-CS73	9301-V-10	Close
to C5 Hydrolyzer	SM-9302-22-CS73	9302-V-40	Close
to Steam Condensate Flash Tank	CL-9302-21-CS72	9302-V-44	Open
Condensate to Steam Condensate Flash Tank	CL-9601-18-CS72	9302-V-22	Close
	CL-8201-05-CS72	9302-V-26	Close
	CL-9302-01-CS72	9302-V-45	Open
	CP-4602-15-CS72	9302-V-46	Close
	CP-4603-15-CS72	9302-V-47	Close
	CP-4604-15-CS72	9302-V-48	Close
Condensate Drain Line		9302-V-21	Close
		9302-V-25	Close
		9302-V-29	Close

Steam Supply System				
Line	Line Number	Valve	Position	Check
Steam Filter	SL-9302-20-CS72	9402-V-13	Close	
		9402-V-14	Open	
		9402-V-15	Open	
		9402-V-16	Open	
		9402-V-17	Close	
		9402-V-18	Open	
		9402-V-19	Close	

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9402-V-21	Close
9402-V-22	Close
9402-V-39	Close

2. The steam supply is provided by Buckeye and the Boiler (PK-9301).
3. Buckeye supplies 150 PSI saturated steam. Assure valves 9301-V-02, -09 are closed.

CAUTION: Assure drain valves are CLOSED before proceeding.

4. Open valves 9301-V-01, ~~-03~~ to supply the steam to the 150 PSI steam header.
 - a. Locally monitor the pressure in **PI-9301-09** to assure the Buckeye steam is at 150 PSI.

E.1.a. Intermediate Pressure Section (60 PSI)

1. At HMI, set pressure to 60 PSI in PIC-9301-02.
 - a. PIC-9301-02 regulates the pressure valve PV-9301-02 and reduces 150 PSI steam to 60 PSI.
 - b. Steam at 60 PSI is supplied to several systems. These systems also return condensate to Steam Condensate Flash Package (PK-9302). Refer to the respective SOP for valve operation.
2. Open valves 9301-V-11, -14 to open the intermediate steam pressure line.
3. ~~Open valves 9302-V-39 and 9501-V-06 to collect the condensate and return it to the Process Water Tank (TS-9501).~~
4. To supply intermediate steam for the lab instruments and the air sterilizing filter;
 - a. Open valves ~~9302-V-38~~ and 9402-V-17.
 - b. Monitor the pressure differential across the Steam Filter (FL-9405) using PI-9405-01 and PI-9405-02, located outside on the chiller services pad.

E.1.b. Low Pressure section (30 PSI)

1. At HMI, set pressure to 30 PSI in PIC-9301-01.
 - a. PIC-9301-01 regulates the pressure valve PV-9301-01 and reduces 60 PSI steam to 30 PSI.
 - b. Steam at 30 PSI is supplied to several systems. Refer to the respective SOPs for valve operation.
2. Open valve 9301-V-13 to feed the 60 PSI steam to the 30 PSI pressure reducing station.

E.1.c. High Pressure Steam Section (225 PSI)

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1. The Electric Boiler Package can use process water or city water to supply 225 PSI steam for pretreatment.
 - a. If using process water for the boiler:
 - i. assure process water is ready according to the Process Water System Operation SOP-9505, and
 - ii. open valves ~~9501-V-21~~ and 9301-V-04, -06.
 - b. If using city water for the boiler:
 - i. assure potable water is ready according to the Potable Water System SOP-9705, and
 - ii. open valves ~~9701-V-33~~, 9301-V-06, -16.
2. Turn on the Boiler Package according to the vendor manual XXXX.
 - a. Set the pressure to 225 PSI.
3. Once the desired pressure is reached, slowly open valve 9301-V-10 to supply the steam to the high pressure steam header.
 - a. The 225 PSI steam is supplied to C5 hydrolyzer. Refer to the Biomass Pretreatment SOP-2110 for the corresponding valve operation.
4. For short term shut down (less than a week):
 - a. Close valve 9301-V-03 to close 150 PSI steam supply from Buckeye.
 - b. Turn off the Boiler Package according to the vendor manual XXXX and close valve 9301-V-10 to shut off the 225 PSI steam supply.
5. For long term shut down (more than a week):
 - a. Close valve 9301-V-03 to close 150 PSI steam supply from Buckeye.
 - b. Turn off the Boiler Package according to the vendor manual XXXX and close valve 9301-V-10 to shut off the 225 PSI steam supply.
 - c. Restore all valves to the initial positions according to the initial valve configuration table.