

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

TITLE: Beer Well

**AUTHOR: Troy Tian  
APPROVALS: Process Change Committee****DATE: January 3<sup>rd</sup>, 2012  
DATE:****A. Scope**

This SOP describes the procedure to clean and operate Beer Well during normal operation in order to collect streams from the CO<sub>2</sub> Scrubber, Propagators, Fermenters, Liquefaction Tank, and Hydrolyzate pH Adjustment Tank, and serve as the feed tank for Distillation and strain inactivation.

**B. Safety and Training Requirements**

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

Refer to UF Biosafety guidelines and the NIH Guidelines whenever handling biological cultures/genetically modified organisms.

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

**C. Related Documents and SOPs**

1. ~~Beer well agitator manual (XXXX)~~
2. Beer stripper feed pump manual (XXXX)
3. Clean in place SOP-8205
4. ~~Steam supply SOP 9305~~
5. ~~Distillation SOP 4905~~
6. ~~CO<sub>2</sub> Scrubber Operation SOP 7210~~
7. Sampling SOP-0511
8. ~~Fermentation Tank A SOP 3230~~
9. ~~Fermentation Tank B SOP 3235~~
10. ~~Fermentation Tank C SOP 3240~~
11. ~~Primary Propagator 2A SOP 3210~~
12. ~~Primary Propagator 2 SOP 3215~~
13. ~~Secondary Propagator 3A SOP 3220~~
14. ~~Secondary Propagator 3B SOP 3225~~
15. ~~Biomass Pretreatment SOP 2110~~

# STANDARD OPERATING PROCEDURE

## STAN MAYFIELD BIOREFINERY PILOT PLANT

TITLE: Beer Well

~~16. Pick Heater SOP XXXX~~

### D. Preparation/Materials/Equipment

1. Sterile sample containers
2. Non-sterile sample containers

### E. Detailed Procedure

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

Beer well				
Line	Line Number	Valve	Position	Check
Vent to Beer Well	VTP-3209-04-SS10	4601-V-01	Open	
	VTN-2303-10-SS10	4601-V-03	Open	
	VTP-3201-04-SS10	4601-V-04	Open	
	VTP-3210-02-SS10	4601-V-05	Open	
	VTP-3202-02-SS10	4601-V-06	Open	
	VTP-3203-02-SS10	4601-V-08	Open	
	VTP-3204-02-SS10	4601-V-09	Open	
		4601-V-10	Open	
	Spare valves	4601-V-02	Close	
		4601-V-07	Close	
		4601-V-11	Close	
Beer to Beer Well	Beer-3205-19-SS10	4601-V-12	Close	
	Beer-3206-19-SS10	4601-V-13	Close	
	Beer-3207-19-SS10	4601-V-14	Close	
	Spare valve	4601-V-15	Close	
	Recirculation loop	Beer-4601-03-SS10	4601-V-27	Close
Scrubbed Ethanol to Beer Well	ETHW-7201-04-SS10	4601-V-16	Close	
Hose Connection to Beer Well	Prop-4601-11-SS10	4601-V-17	Close	
CIP to Beer Well	CIPS-8202-10-SS10	8202-V-07	Close	
		4601-V-18	Close	
		4601-V-20	Close	
	CIPS-4601-09-SS10	4601-V-19	Close	
CIP to CIP Return Filter	CIPR-4601-10-SS10	4601-V-29	Close	
Beer to Beer Pump	Beer-4601-07-SS10	4601-V-43	Close	
	Drain	4601-V-41	Close	
Beer to Hose Connector	Beer-4601-13-SS10	4601-V-42	Close	

# STANDARD OPERATING PROCEDURE

## STAN MAYFIELD BIOREFINERY PILOT PLANT

TITLE: Beer Well

Beer well				
Line	Line Number	Valve	Position	Check
Beer to downstream process to Stripper Column to Decanter Feed Tank	Beer-4601-08-SS10	4601-V-38	Close	
	Drain	4601-V-40	Close	
	Beer-4601-04-SS10	4601-V-28	Close	
	Beer-4601-12-SS10	4601-V-31	Close	
Level Indicator		4601-V-45	Open	

### E.1 CIP (Clean in Place)

- Make sure the CIP system is ready according to SOP-8205.
- If necessary, drain beer well to wastewater.
  - Verify that the Decanter Feed Tank (TS-4901) is ready according to Decanter System Operation SOP-4905.
  - Start recirculation loop by:
    - ~~closing distribution~~ valves 4601-V-28, V-29, and V-31
    - ~~opening loop line~~ valves 4601-V-27, V-38 and V-43, and
    - starting the Beer Stripper Feed Pump (PC-4601) on the HMI.
  - Activate Pick heater according to Pick heater SOP-xxx**
  - Open valve 4601-V-31 to transfer the slurry to the Decanter Feed Tank (TS-4901) through the Pic Heater (HS-4601) in order to inactivate the microorganisms according to Decanter Operations SOP-4905.

**CAUTION: Decanter Feed Tank holds 1,500 gallons. DO NOT overfill.**

- Monitor the Beer Well level using LI-4601-05 and continue emptying the tank until the Beer Well is <10% full and the Beer Stripper Feed Pump (PC-4601) shuts down.
  - Close valve 4601-V-31 to the Decanter System.
- Open valves ~~8202-V-07~~, 4601-V-18, V-19, ~~V-20~~ to open the CIP supply.
  - Run the CIP rinse cycle according to CIP SOP-8205.
    - After the level has reached more than 10% in LI-4601-05, start the Beer Stripper Feed Pump (PC-4601) to circulate the rinse water.
    - Drain the Beer Well (TS-4601) according to Step E.1.2 above.
  - Run the caustic cycle according to the CIP SOP-8205.
    - After the level has reached more than 10% in LI-4601-05, start the Beer Stripper Feed Pump (PC-4601) to circulate the caustic solution.

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

**TITLE: Beer Well**

- 
- b. Drain the caustic solution back to the Dilute Caustic Tank (TS-8202) according to CIP SOP-8205.
        - i. Open valve 4601-V-29.
        - ii. Close valve 4601-V-27.
        - iii. Monitor the level in the Beer Well using LI-4601-05 and continue emptying the tank until it reaches <10% full and the Beer Stripper Feed Pump (PC-4601) shuts down.
        - iv. Close valve 4601-V-29 to CIP return.
        - v. Open valve 4601-V-27 on circulation loop.
    6. Run the UV water cycle according to the CIP SOP-8205.
      - a. After the level has reached more than 10% in LI-4601-05, start Beer Stripper Feed Pump (PC-4601) to circulate the water.
      - b. Drain the caustic solution back to the Rinse Tank (TS-8203) according the CIP SOP-8205.
        - i. Open valve 4601-V-29.
        - ii. Close valve 4601-V-27.
        - iii. Monitor the level in the Beer Well using LI-4601-05 and continue emptying the tank until it reaches <10% full and the Beer Stripper Feed Pump (PC-4601) shuts down.
        - iv. Close valve 4601-V-29 to CIP return.
        - v. Open valve 4601-V-27 on circulation loop.
    7. Once finished with the CIP cycle, close valves ~~8202-V-07~~, 4601-V-18, V-19, ~~V-20, V-43~~.

***E.2 Startup (Filling Beer well)***

1. The Beer Well (TS-4601) collects streams from fermenters, propagators, CO<sub>2</sub> scrubber, liquefaction tank, and pH adjustment tank.
2. ~~Assure all valves are in the positions as specified in the initial valve configuration table.~~
3. ~~Open valves 4601 V 12, V 13, V 14 to let the beer transfer from fermenter A, B, and C to the Beer Well.~~
4. ~~Open valve 4601 V 16 to let the scrubber liquid transfer from CO<sub>2</sub> scrubber to the Beer Well.~~
5. ~~Open valves 4601 V 05, V 06, V 08, V 09, V 10 to open the vent lines from the propagators and the Hydrolysate pH Adjustment Tank to the Beer Well.~~
6. ~~Open valve 4601 V 03 to open the vent line from the Hydrolysate pH Adjustment Tank to the Beer Well.~~
7. At HMI, monitor the Beer Well level in LI-4601-05. ~~The level indicator has the following alarms and interlocks.~~

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

**TITLE: Beer Well**

- 
- a. ~~On High High Level (90% full) an alarm is activated by a high level alarm (LSHH 4601-04) and the Beer Well Pump (PC 4601) will be turned on.~~
  - b. ~~On High Level (85%) an alarm is activated only. Assure the Beer Stripper Feed Pump (PC 4601) is turned on.~~
  - c. ~~On Low Level (15% full) an alarm is activated, and the Beer Well Agitator (AG 4601) will be shut down. The agitator can only restart once the level has exceeded 15%.~~
  - d. ~~On Low Low Level (10% full) an alarm is activated and an interlock will shut down the Beer Well Pump. This is to protect the pumps from cavitation damage~~
  - 8. At HMI, turn on beer well agitator (AG-4601) when the beer well level has exceeded 15%.
  - 9. Recirculate the beer.
    - a. ~~Open recirculation loop valves 4601-V-27, V-38, and V-43.~~
    - b. ~~At the HMI, turn on Beer Stripper Feed Pump (PC 4601).~~

***E.3 Operation (Beer goes to distillation)***

- 1. The beer is transferred to the Distillation system according to Ethanol Distillation SOP-4005.
- 2. At HMI, monitor the beer well level in LI-4601-05 to assure that it is between 15 – 80%.
- 3. Open valve 4601-V-28, 4602-V-02 to open the line to the Distillation System.
- 4. **Close valve 4601-V-27 to the recirculation line.**
- 5. Transfer the beer to the Distillation system according to Ethanol Distillation SOP-4005.

***E.4 Operation (Beer goes to decanter feed tank)***

- 1. If the beer contains low ethanol content and distillation is not applied, it is transferred to the Decanter Feed Tank (TS-4901) according to Decanter Operation SOP-4905.
- 2. Assure the Beer Well is in recirculation according to Step E.2.8 above.
- 3. Open valves 4601-V-31 and 4901-V-13 to open the line to the Decanter Feed Tank (TS-4901).
- 4. Close valve 4601-V-27 to close the recirculation line.
- 5. Transfer the beer to the Decanter System according to Decanter Operations SOP-4905.

**CAUTION: Decanter Feed Tank holds 1,500 gallons. DO NOT overfill.**

- 6. When transfer is complete, return the Beer Well to recirculation according to Step E.2.7 above.

**E.5 Shut Down**

- 1. When operations are complete and the tank is empty, clean the Beer Well according to Step E.1.3 – E.1.7 above.
- 2. Turn off Beer Well agitator (AG-4601) and pump (PC-4601).
- 3. Return the valves to the initial valve settings table in Step E.1. above.

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

TITLE: Beer Well

---

**F. Data Collection and Archive**

1. The Beer Well is to be sampled according to the Experimental Plan and Sampling SOP-0511
  - a. Assure the Beer well is in recirculation according to Step E.2.7.
  - b. Place sample container under sample port at 4601-V-40.
  - c. Slowly open sample valve 4601-V-40 to fill container.
  - d. Close sample valve 4601-V-40.
  - e. If the Beer Well needs to be shut down, refer to step E.5. above.