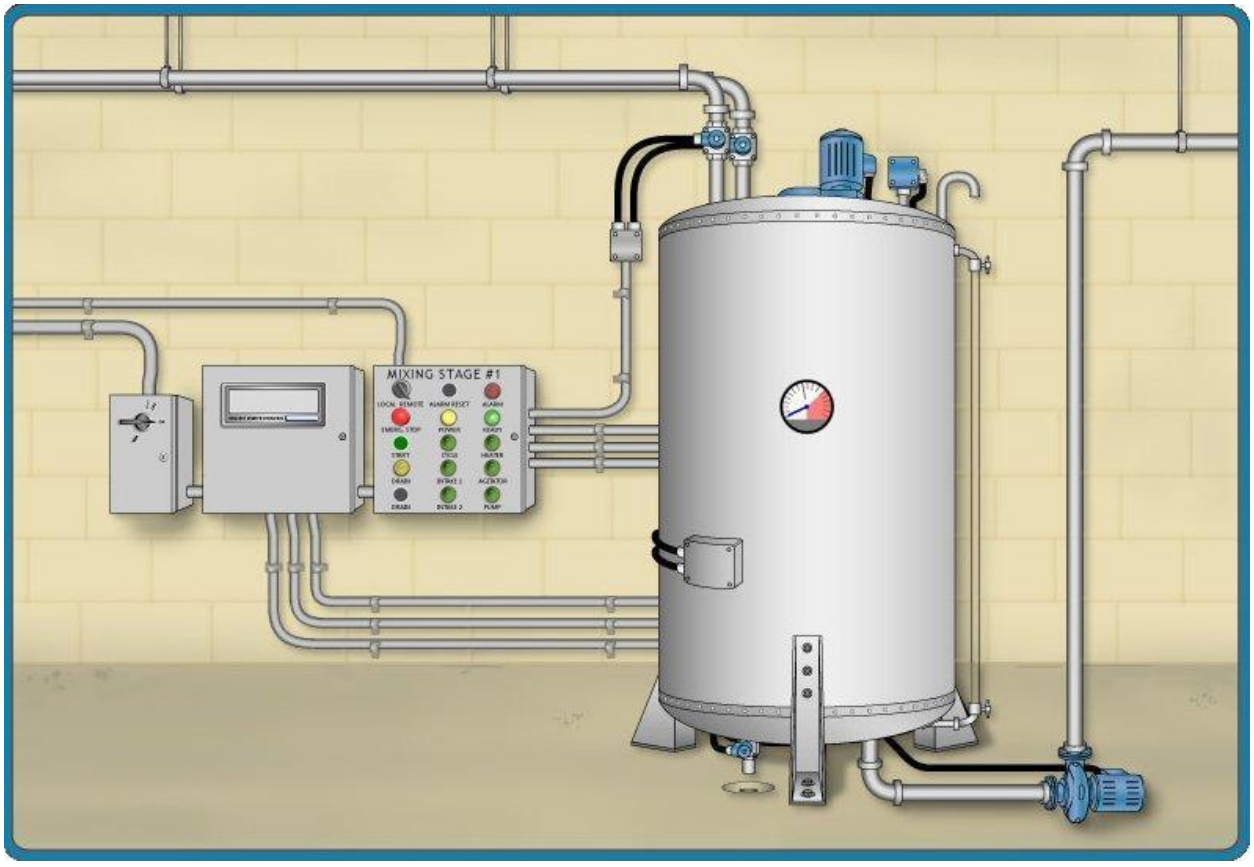
Fluid Processing System
FPS 4000

System Operations Manual



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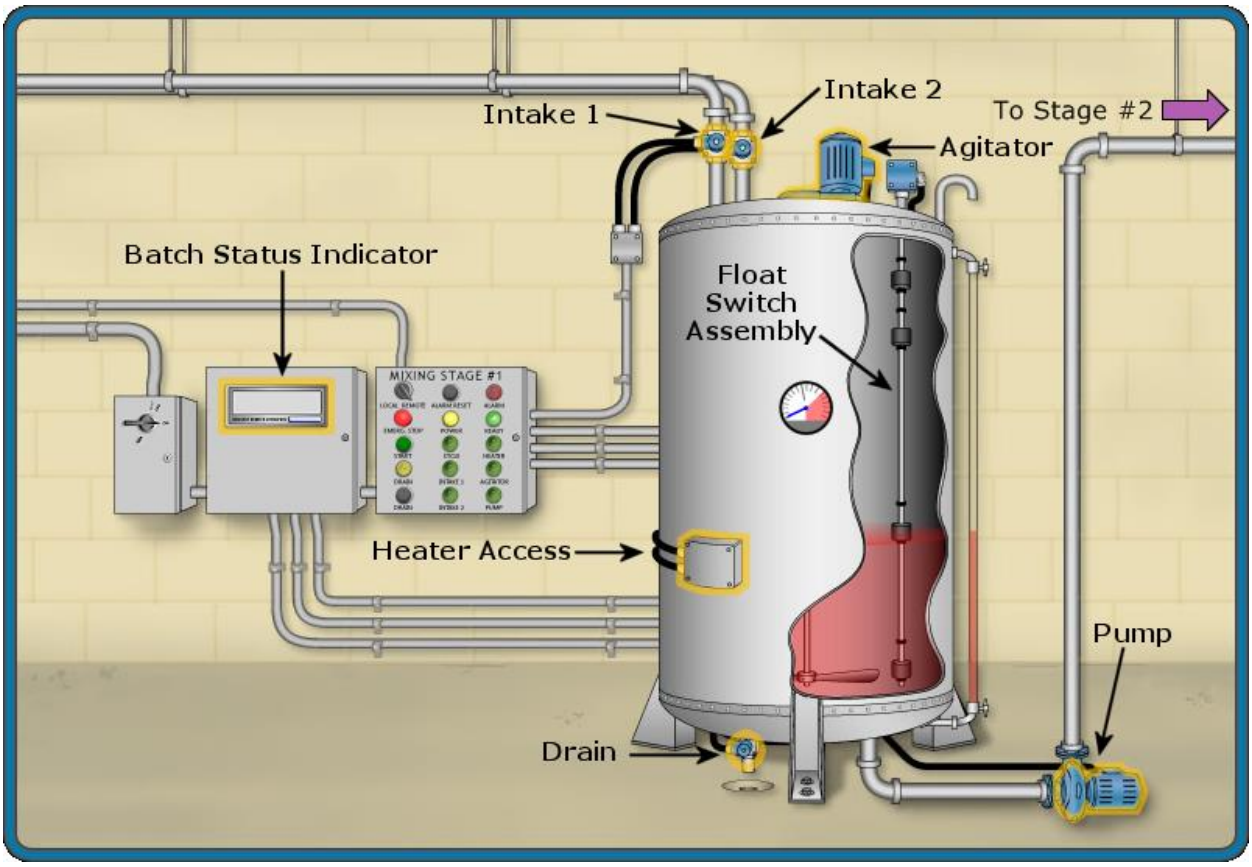
Fluid Processing System - FPS 4000

The FPS 4000 Simulator is designed to simulate the process of using a Programmable Logic Controller (PLC) to control the input, mixing, heating and settling of two different fluids before sending the mixture onto the next stage for additional processing or recycling.

Systems similar to this may be found anywhere the mixing of two fluids is required. It is well suited to certain chemical processes, as well as production lines in the food industry.



The Process

Input

The process depends on the program running in the PLC. Generally when the system starts, one or two fluids begin to enter the tank through intake #1 and/or intake#2. When the correct volume of fluid has entered the tank, the appropriate intake closes. Many of the processes use the float assembly to determine the levels of the liquids. There are four preset levels that are fixed and cannot be adjusted. These are set at 0.1% (empty tank), 40%, 85% and 95% (alarm level) of the tank capacity. Changing these settings would require replacing the float assembly with one set to the desired values.

Processing

In all processes the liquids are agitated (mixed) at some point and in many processes are heated to 70°C. This temperature is fixed and changing it would require replacing the temperature switch with one set to the desired value.

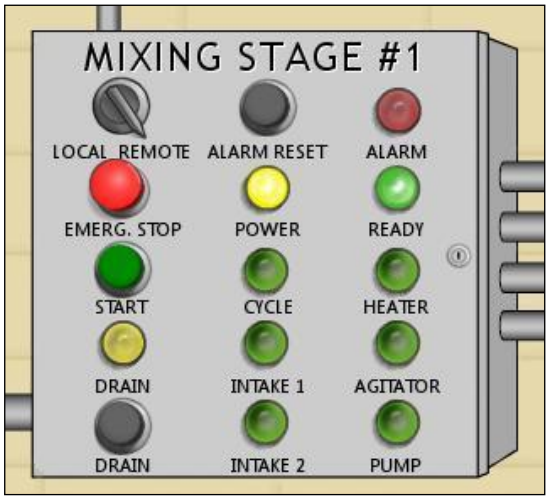
Mixing can occur without heating but all the current processes are designed to include mixing when the heater is engaged. The independent mixing time is determined by the program and can easily be changed.

Output

Once the mixture has been processed there is usually a pause before the output commences. In most processes the pump starts and transfers the liquid from the tank to the next processing stage (Stage 2). Once Stage 2 is ready for a new batch, it sends a remote start signal to the control to begin a new batch.

When Stage 2 receives a batch, it is tested for quality. If the batch does not pass the quality check it is sent to the reclaiming unit. Also, if the batch does not reach Stage 2 within a certain time, it can still be used but production targets will be missed. The test results are sent to the Batch Status Indicator.

Control Panel



Control Panel Indicators:

- Power
- Ready
- Cycle
- Heater
- Agitator
- Pump
- Intake 1
- Intake 2
- Drain
- Alarm

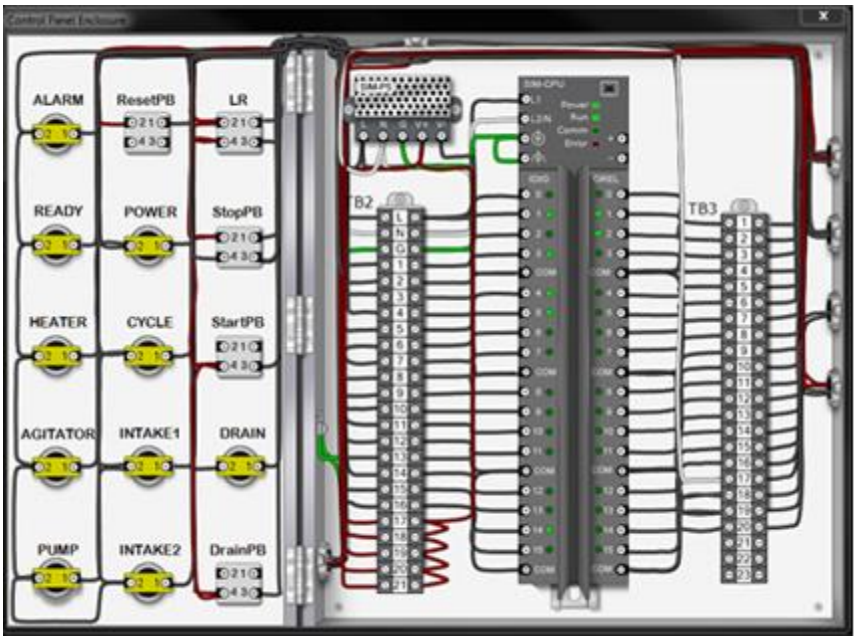
Operator Controls:

- Local / Remote – Selects Local or Remote system operation
- Emergency Stop – Stops the system when in either Local or Remote
- Start – Starts the system when operation is Local
- Drain – Drains the tank when in either Local or Remote

- Alarm Reset – Resets the alarm warning light

Programmable Logic Controller (PLC)

Inside the control panel enclosure is the PLC which is used to control the operation of the system.



The addition of a PLC to the FPS system allows for versatility and easier troubleshooting. There are sixteen inputs which are powered at 24 Volts DC. There are 16 outputs which are powered at 120 Volts AC.

Tank Indicators

There are two tank indicators:

- Temperature gauge on tank - this monitors the temperature of the contents of the tank
- Sight gauge on side of tank - shows the level of liquid in the tank

Batch Status Indicator

This device monitors and displays the status of each batch received by Stage 2 when in Remote Operation. There are six possible results as shown below, and the display shows the result of the most recent batch.

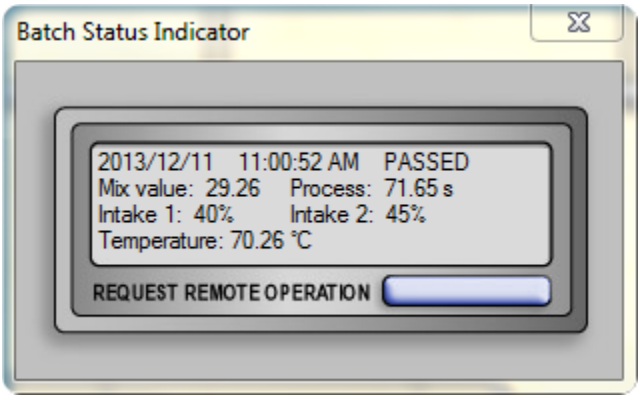
- Passed: meets quality control specifications
- Failed: does not meet quality control specifications
- Incomplete: received only a partial batch
- Delayed: received a batch but not within the allowed time

- Timed Out: batch was requested but no batch received
- Too Fast: process finished ahead of expected time

This device also displays the following for the last run batch:

- The amount of each liquid used, as a percentage of the tank volume
- The maximum temperature reached
- The total mixing time
- The total time the process required to finish

This device also has a control to allow a request to be sent to the system operator for a Remote Operation.



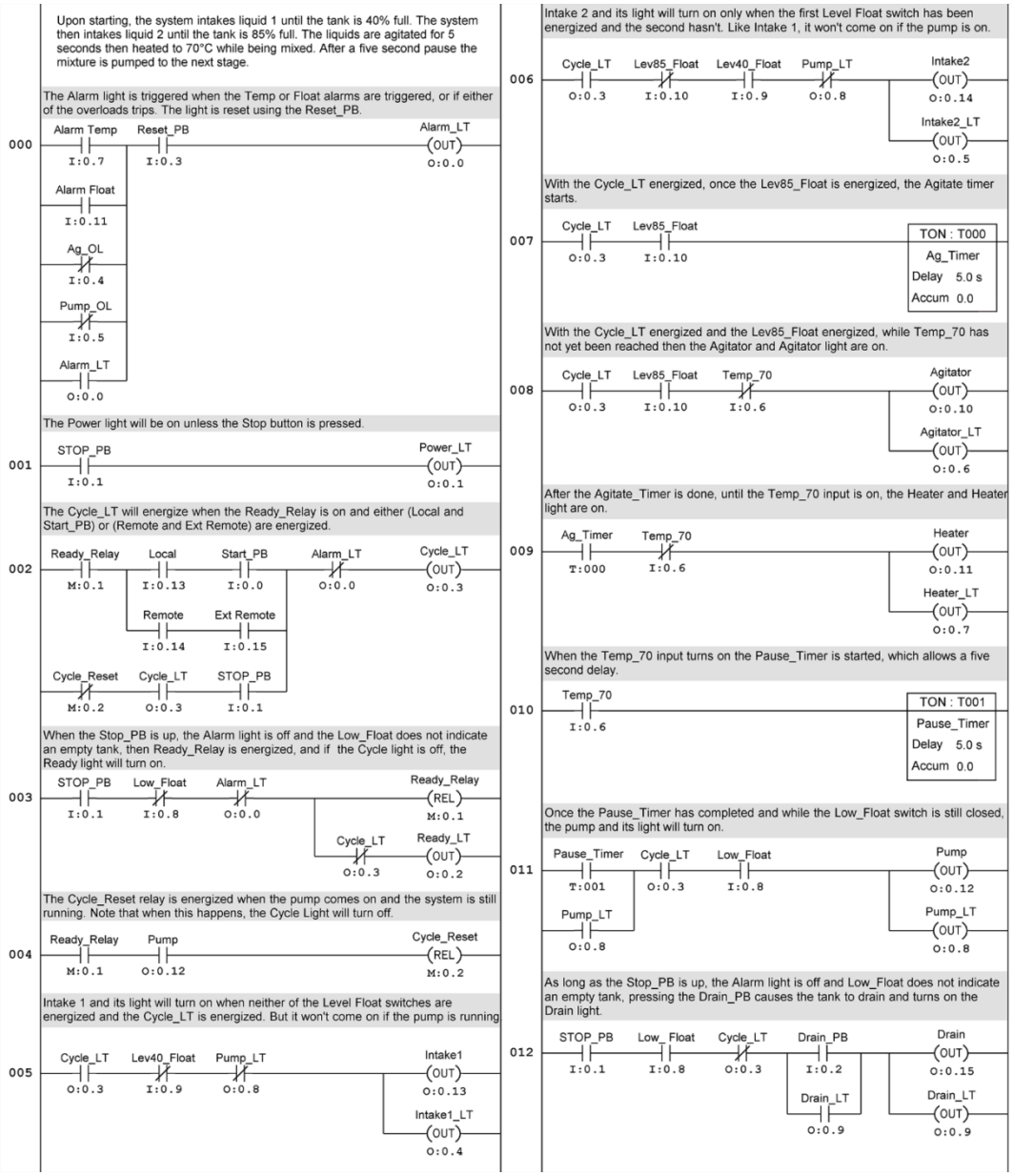
Batch Status Indicator

System Operation

The control system processes one batch at a time. The system can be started either locally or remotely and proceeds through one cycle. In most processes the system must receive a start signal to begin another cycle however, the PLC can be programmed to continually create batches. There are many programs written for the FPS 4000. The default program is Program 1.

Program 1

Program 1 is the PLC program that replicates the process used in the FPS 3000 system. There are a few minor variations such as the inclusion of the agitator and pump overloads in the alarm circuit.



The following describes the process through one cycle of Program 1.

Automatic Operation

Initially:

- Power indicator indicates power is on
- Ready light indicates system is ready
- Control Switch Set to Remote

When Control receives a remote start signal:

- Cycle indicator comes on
- Ready indicator goes off
- Intake 1 opens
- Intake 1 indicator comes on
- Tank liquid level increases
- Float switch 1 closes

When level in tank reaches 40% (approx. 8 seconds):

- Float switch 2 operates
- Intake 1 closes
- Intake 1 indicator goes off
- Intake 2 opens
- Intake 2 indicator comes on

When level in tank reaches 85% (approx. 9 seconds):

- Float switch 3 operates
- Intake 2 closes
- Intake 2 indicator goes off
- Agitator motor starts
- Agitator indicator comes on

After a 5 second delay:

- Heater is energized
- Heater indicator comes on
- Liquid temperature begins to rise

Once liquid reaches a temperature of (70 °C) (approx. 24 seconds):

- Heater turns off
- Heater indicator goes off
- Agitator turns off
- Agitator indicator goes off

After a 5 second delay:

- Discharge pump starts
- Pump indicator comes on
- Liquid level decreases

When liquid level reaches 0 %: (approx. 21 seconds)

- Float switch 1 operates
- Discharge pump stops
- Pump indicator goes off
- System stops
- Ready light goes on

When the control receives another remote start signal, the process repeats.

Manual Operation

The system can also be manually operated:

- The ready light must be on
- Set the control switch to local - this also prevents the control from responding to the remote start signal and the batch results are not set to the Batch Status Indicator
- To start the system, press the start pushbutton
- The same sequence of events occurs as the automatic operation

Draining the System

If there is a malfunction in the system or if it is stopped part way through the cycle, the tank must be drained before it can be operated again:

- The tank can only be drained while the cycle light is off and power light is on
- Press the drain pushbutton
- If there is fluid in the tank and the cycle is not running, the drain solenoid is energized
- Drain solenoid closes when the tank is empty

Note: When the tank is drained, the mixture is sent to be reclaimed

Emergency Stop and Alarms

The system can be shut down at any time by pressing the Emergency Stop button. This works in both Remote and Local control switch settings.

The system has four alarm conditions:

- If liquid level reaches 95%, the system shuts down and the alarm light comes on
- If temperature exceeds 90 °C, the system shuts down and the alarm light comes on
- If the Agitator motor overloads, (OL1) trips
- If the Pump motor overloads, (OL2) trips

The process cannot be started while in the alarm condition. When the condition causing the alarm has cleared, the alarm can be reset by pressing the alarm reset button on the control panel.

Note: The tank is also equipped with a safety check valve in the breather which prevents tank overflows.

Operational Parameters

- It is important that the fluids be mixed correctly. The next stage (stage 2), that receives the finished batch, will detect any substandard mixtures and stop operations. Any batch

that does not pass quality control will be reclaimed. The batch status indicator (located on the power panel) shows the status and details of the previous batch. The specifications of a proper batch are:
    - Liquids must be in the proper proportion
    - Liquid mixture must be agitated for the correct amount of time
    - The mixture must be heated to the correct level (in most cases 70 °C)
    - The entire process must be finished within a specified time
- Once the tank begins to fill, if the process is stopped before completing the cycle, the tank contents must be drained before the process can be restarted.
- When tank contents are drained they are sent to the reclaiming unit.
- Heaters are designed to be immersed in liquid when operating. If these elements are operated for a significant amount of time without being submersed, they will overheat and burn out.