OPERATION AND MAINTENANCE MANUAL
LIQUID DELIEVERY SYSTEM FOR THE VIAL FILLING CELL EDUCATIONAL PLATFORM

PREPARED FOR:

CONNECTED SYSTEMS INSTITUTE (CSI)
UNIVERSITY OF WISCONSIN – MILWAUKEE
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GENERAL INFORMATION
LIQUID DELIEVERY SYSTEM FOR THE VIAL FILLING CELL EDUCATIONAL PLATFORM
CSI AT THE UNIVERSITY OF WISCONSIN - MILWAUKEE
MILWAUKEE, WI

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SPARE PARTS LIST
LIQUID DELIEVERY SYSTEM FOR THE VIAL FILLING CELL EDUCATIONAL PLATFORM
CSI AT THE UNIVERSITY OF WISCONSIN - MILWAUKEE
MILWAUKEE WI

The following list is Symbiont's recommendation of spare parts that the University of Wisconsin - Milwaukee should stock for the equipment installed as part of the Liquid Delivery System (LDS) for the Vial Filling Cell Educational Platform. These recommendations are based on past experience and equipment history. However, each equipment manufacturer's operation and maintenance manual should be consulted for a complete list of recommended spare parts.

	Qty.	Part No.
1. Liquiflo Gear Pump		
a. Liquiflo Repair Kit	1	KH7RS6PEES020000
b. Center Housing NPT	1	360002
2. Liquiflo Mag-Drive Gear Pump		
a. Liquiflo Repair Kit	3	KH3FS6PEE002000US
b. Center Housing NPT	1	320001
3. Swagelok Components		
a. 1/4" Needle Valve	1	SS-1RS4
b. 1/2" Needle Valve	1	SS-18RS8
c. 1/2" 1-Piece Ball Valve	1	SS-43GS8
d. 3/4" 1-Piece Ball Valve	1	SS-45S12
e. 1/8" Tube Fitting Union Elbow	1	SS-200-9
f. 1/4" Tube Fitting Union Elbow	1	SS-400-9
g. 1/2" Tube Fitting Union Elbow	1	SS-810-9
h. 1/4"x1/8" Tube Fitting Reducer	1	SS-400-6-2
4. Grainger Components		
a. 1/2" NPT Y-Strainer	1	20XM18
b. 3/4" NPT Y-Strainer	1	20XM19
c. 0-100PSI Pressure Gauge	1	19RZ17
5. Griffco Components		
a. 1/2" NPT Back Pressure Valve	1	BPM050-S-1
b. 3/4" NPT Back Pressure Valve	1	BPG075-S-1
6. Burkert Valves		
a. 1/8" Type 2873 Solenoid	1	236230 2873-A-00,8-FF-VA-NM81-024/DC-09
b. 1/4" Type 2873 Solenoid	1	236243 2873-A-03,0-FF-VA-NM82-024/DC-09
c. 3/8" Type 6213 Set 1 Kit	1	273626 SET 1
d. 3/8" Type 6213 Set 3 Kit	1	273626 SET 3
e. 3/8" Type 6213 Set 7 Kit	1	273626 SET 7

f.	3/8” Type 6213 Solenoid	1	273626 6213-EV-A10,0-FF-VA-NM83-6-024/DC-10
	(Alternative to Type 6213 repair kits)		

7. Allen-Bradley Control Panel Components

a.	Analog Input module w/ HART	1	1759-IF8H
	i. With Wiring Module	1	1492-AIFM8-F-5
	ii. With Pre-Wired Cables	1	1492-ACABLE025UD
b.	High Speed Counter Module	1	1756-HSC
	i. With Wiring Module	1	1492-AIFMCE4-F
	ii. With Pre-Wired Cables	1	1492ACABLE020XA
c.	ArmorBlock Ethernet/IP Modules		
	i. Analog Output Module	1	1732E-OF4M12R
	ii. Digital Output Module	1	1732E-OB8M8SR
d.	Powerflex 527 VFD	1	25B-V2P5N104

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Section 1.0
INTRODUCTION

Rockwell Automation has assembled a large partnership of companies in order to create a teaching program within the University of Wisconsin colleges. This program will be used for both education and research to further the advancement of the Connected Enterprise system.

As part of this endeavor, an automated system which will be used to fill small vials on trays with water and three colors of food dye has been installed. The system has three filling heads with slightly different configurations in order to support variety and student experimentation. The system also has an automated conveyor for moving the vials through various stations, along with robotic systems for manipulating the trays. All of this is overseen by a Connected Enterprise system.

The purpose of this manual is to provide the personnel responsible for the operation of the LDS and their supervisors with:

1. A description of the LDS and equipment used in the process.

2. A summary of the basic operation and control procedures required for successful operation of the system.

3. Information related to the operation and maintenance of the equipment used in the LDS.

As operating experience is gathered and with changing conditions, modification of some of the procedures discussed herein may become necessary. An operating guide, as originally written, is a supplement to, not a substitute for, long-term experience and judgment by the operating staff. In order to maintain its value, this document should be periodically reviewed and updated, as required. Updating the manual should be the responsibility of the operator in charge, and should be done on an annual basis, as a minimum.

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Section 2.0
SYSTEM DESCRIPTION

2.1 GENERAL DESCRIPTION

The liquid portion of the overall system is comprised of a Liquid Delivery Skid (LDS) and 3 separate Flow Plates. The LDS contains the four tanks and four pumps that feed the four flow types to the flow pates. It also contains various load cells, level switches, pressure controls, and temperature sensors. Finally, it contains the flow transmitters for the flow plates, and two control panels. One control panel houses the low voltage PLC, HMI, and IO devices. The other control panel houses the 120 volt and 230 volt components that supply power to the LDS and pumps.

The three flow plates contain the flow meters and electric analog solenoid control valves that will be used to regulate the flow to the filling points above the vials. They are each mounted to the three separate conveyers with filling points for the vials.

2.2 PHYSICAL LAYOUT

See the record drawings in Appendix B for a physical layout of the system.

Section 3.0

FUNCTIONAL DESCRIPTION

3.1 INTRODUCTION

This description of operation covers the LDS skid and three flow plates. The conveyer control system (by APT) will issue batch commands to the LDS control system with PLC to PLC peer communications over the network. The Connected Enterprise system will read data and logs from the LDS control system.

3.2 SYSTEM OPERATIONS

1 Controls Overview

1.1 Tank, Fill Station, and Sequence Overview

The LDS functionality is programmed utilizing the PlantPAx standard object library. The system and its control have been segregated into 3 Fill Stations, a Tank Skid, and Process Control Sequencers.

The LDS has 4 Tank Modules Located on the Tank Skid

- Tank 100 – Water
- Tank 200 – Red Food Coloring
- Tank 300 – Yellow Food Coloring
- Tank 400 – Blue Food Coloring

Each Tank Can Send Liquid to One of the Following Fill Stations:

- Fill Station 3 – Combined Filling
- Fill Station 4 – Simultaneous Filling
- Fill Station 5 – Sequential Filling

Each of the Tank Modules execute certain Sequences. In other words, each of the tanks would be able to execute these Sequences.

- Pressure Sequencers
  - Sequence - Analog Pressure Control – Maintain pressure using the pressure transmitter and controlling the pump speed.
  - Sequence - Mechanical Pressure Control – Run the pump at a fixed speed, let the mechanical regulator maintain pressure.
- Deliver Sequencers
  - Sequence – Fill Station 3 – Delivers liquid from the tank to station 3.
  - Sequence – Fill Station 4 – Delivers liquid from the tank to station 4.
  - Sequence – Fill Station 5 – Delivers liquid from the tank to station 5.

- Water Fill Sequence (for Tank 100 only)
  - Sequence – Fill Water – Delivers water from Tank 100 to selected Tank
  -

See section 2 for detailed descriptions of each Sequence.

1.2 General Sequence of Operation

The following describes a typical operation run for the LDS system.

1. The system is off and empty.
2. The operator would close the drain valves on the tanks.
3. The operator will fill the tanks with the required water and dyes.
4. The operator will activate one of the pressure control sequencers for each of the tank units.
   a. The pumps will turn on and maintain pressure for the fill stations to run.
5. The operator may choose to measure water from the water tank into the dye tanks.
   a. The operator would start the Fill Water Sequencer
   b. The operator would select the desired tank to fill
   c. The LDS control system proceeds through necessary steps on Water Fill sequence, transferring the water to the selected tank.
   d. The operator may need to refill the water tank if enough volume is transferred.
6. The operator would manually Jog each of the Fill Station valves on each of the four tank Units.
   a. This will charge liquid to the fill heads.
   b. It is recommended that small buckets be placed under the fill heads to catch the fluid.
7. The APT conveyer system moves a vial to one of the filling stations.
8. The APT control system would issue a command to the LDS system.
   a. Specifying a vial is in position and volume of each of the four liquids to charge to the vial.
   b. Issue a Start command.
9. The LDS control system activates the necessary fill steps on the required tank units, simultaneously or in sequence, to charge the liquids to the vial in the station.
   a. When complete, the LDS system will respond to the APT control system that the delivery on the commanded fill station is complete.
10. This process repeats (from step 5).
11. When finished with the run…
12. The operator deactivates the pressure control sequencers for each of the tank units.
13. The operator empties the tanks out thru their bottom drains.
14. Rinsing of the system is recommended. The operator would:
    a. Rinse the tanks out with water thru their bottom drains.
    b. Closes the bottom drains.
    c. Fill the tanks with water.
    d. Activate one of the pressure control sequencers for each of the tank units.
    e. Manually jogs each of the Fill Station sequqncers on each of the tank units, until the lines run clear. It is recommended to rinse into a bucket under each filling nozzle.
    f. Open the bottom drains to drain the tanks out again.

1.3 Symbiont and APT Communications

The LDS will receive commands from the APT control system outlined below

Consumed REAL PLC Tags from APT

Tag	Engineering Units
Consumed_WetFillStation3_VolReq_Tank100	ml
Consumed_WetFillStation3_VolReq_Tank200	ml
Consumed_WetFillStation3_VolReq_Tank300	ml
Consumed_WetFillStation3_VolReq_Tank400	ml
Consumed_WetFillStation4_VolReq_Tank100	ml
Consumed_WetFillStation4_VolReq_Tank200	ml
Consumed_WetFillStation4_VolReq_Tank300	ml
Consumed_WetFillStation4_VolReq_Tank400	ml
Consumed_WetFillStation5_VolReq_Tank100	ml
Consumed_WetFillStation5_VolReq_Tank200	ml
Consumed_WetFillStation5_VolReq_Tank300	ml
Consumed_WetFillStation5_VolReq_Tank400	ml

Consumed Status DINTs From APT

Tag	Bit	Description
Consumed_Station3_WetFill_Status	0	Heartbeat
Consumed_Station3_WetFill_Status	1	Fill Station 3 OK To Fill
Consumed_Station3_WetFill_Status	2	Spare
Consumed_Station3_WetFill_Status	3	Spare
Consumed_Station3_WetFill_Status	4	Spare
Consumed_Station3_WetFill_Status	5	Remote Start Command
Consumed_Station3_WetFill_Status	6	Remote Reset Command

Consumed_Station3_WetFill_Status	7	Remote Restart Command
Consumed_Station3_WetFill_Status	8	Remote Abort Command
Consumed_Station3_WetFill_Status	9	Spare
Consumed_Station3_WetFill_Status	10	Red Beacon (Fault)
Consumed_Station3_WetFill_Status	11	Amber Beacon (Attention Required)
Consumed_Station3_WetFill_Status	12	Green Beacon (Running)
Consumed_Station3_WetFill_Status	13-31	Spare
Consumed_Station4_WetFill_Status	0	Hearbeat
Consumed_Station4_WetFill_Status	1	Fill Station 4 OK To Fill
Consumed_Station4_WetFill_Status	2-31	Spare
Consumed_Station5_WetFill_Status	0	Heartbeat
Consumed_Station5_WetFill_Status	1	Fill Station 5 Tank 4 OK To Fill
Consumed_Station5_WetFill_Status	2	Fill Station 5 Tank 3 OK To Fill
Consumed_Station5_WetFill_Status	3	Fill Station 5 Tank 2 OK To Fill
Consumed_Station5_WetFill_Status	4	Fill Station 5 Tank 1 OK To Fill

Produced REAL PLC Tags to APT

Tag	Engineering Units
Produced_WetFillStation3_VolDisp_Tank100	ml
Produced_WetFillStation3_VolDisp_Tank200	ml
Produced_WetFillStation3_VolDisp_Tank300	ml
Produced_WetFillStation3_VolDisp_Tank400	ml
Produced_WetFillStation4_VolDisp_Tank100	ml
Produced_WetFillStation4_VolDisp_Tank200	ml
Produced_WetFillStation4_VolDisp_Tank300	ml

Produced_WetFillStation4_VolDisp_Tank400	ml
Produced_WetFillStation5_VolDisp_Tank100	ml
Produced_WetFillStation5_VolDisp_Tank200	ml
Produced_WetFillStation5_VolDisp_Tank300	ml
Produced_WetFillStation5_VolDisp_Tank400	ml

Produced Status DINTs To APT

Tag	Bit	Description
Produced_Station3_WetFill_Status	0	Heartbeat
Produced_Station3_WetFill_Status	1	Fill Station 3 Sequence Running
Produced_Station3_WetFill_Status	2	Fill Station 3 Sequence Complete
Produced_Station3_WetFill_Status	3	Spare
Produced_Station3_WetFill_Status	4	Fill Station 3 Available
Produced_Station3_WetFill_Status	5	Fill Station 3 Sequence Held
Produced_Station3_WetFill_Status	6	Fill Station 3 Sequence Aborted
Produced_Station3_WetFill_Status	7	Fill Station 3 Sequence Program Control
Produced_Station3_WetFill_Status	8	Spare
Produced_Station3_WetFill_Status	9	Spare
Produced_Station3_WetFill_Status	10	Attention Required (Alarm Severity > 501)
Produced_Station3_WetFill_Status	11	Fault Present (Alarm Severity > 750)
Produced_Station3_WetFill_Status	12-31	Spare
Produced_Station4_WetFill_Status	0	Heartbeat
Produced_Station4_WetFill_Status	1	Fill Station 4 Sequence Running
Produced_Station4_WetFill_Status	2	Fill Station 4 Sequence Complete
Produced_Station4_WetFill_Status	3	Spare

Produced_Station4_WetFill_Status	4	Fill Station 4 Available
Produced_Station4_WetFill_Status	5	Fill Station 4 Sequence Held
Produced_Station4_WetFill_Status	6	Fill Station 4 Sequence Aborted
Produced_Station4_WetFill_Status	7	Fill Station 4 Program Control
Produced_Station4_WetFill_Status	8-31	Spare
Produced_Station5_WetFill_Status	0	Heartbeat
Produced_Station5_WetFill_Status	1	SV-151 Fill Running
Produced_Station5_WetFill_Status	2	SV-251 Fill Running
Produced_Station5_WetFill_Status	3	SV-351 Fill Running
Produced_Station5_WetFill_Status	4	SV-451 Fill Running
Produced_Station5_WetFill_Status	5	SV-151 Fill Complete
Produced_Station5_WetFill_Status	6	SV-251 Fill Complete
Produced_Station5_WetFill_Status	7	SV-351 Fill Complete
Produced_Station5_WetFill_Status	8	SV-451 Fill Complete
Produced_Station5_WetFill_Status	9	Fill Station 5 Available
Produced_Station5_WetFill_Status	10	Fill Station 5 Sequence Held
Produced_Station5_WetFill_Status	11	Fill Station 5 Sequence Aborted
Produced_Station5_WetFill_Status	12	Fill Station 5 Sequence Program Control
Produced_Station5_WetFill_Status	13-31	Spare

The general command sequence would be:

1. APT updates / populates the tank *Target Volumes* in the applicable consumed REAL to Symbiont.
2. APT aligns a vial at the fill station.
3. APT raises and maintains the *OK To Fill* bits for some or all of the tanks.
    a. So long as the bits are maintained, the LDS skid will deliver fluid up to the *Target Volumes*.
    b. If the *Start Fill* bits are dropped prematurely, the LDS will update the *Volume Filled*, but not raise the corresponding *Fill Complete* bits.
        i. Restarting the *Start Fill* will initiate a NEW fill with a reset totalizer.

4. The LDS delivers fluid up to the *Target Volumes*.
    a. As each tank completes, it will update the *Volume Filled* data and raise the corresponding *Fill Complete* bits.
    b. As APT sees the *Fill Complete* bits, it may drop the *Start Fill* bits to reset the station.

1.4 Filling Sequence

A few things to note about filling sequence:

- Multiple fill stations can be filled simultaneously and asynchronously.
- A fill station may be given individual component fill commands, or multiple commands at once.
- Fill Stations 4 and 5 can fill multiple components simultaneously, depending on an operator setting (simultaneous or sequence).
- Fill Station 3 will always fill components in sequence.
- Fill Station 3 has line push functionality that will be tracked internally a *Filling Vial* bit. This bit will latch on when a Tank 200, 300, or 400 color is injected, and cleared when the Tank 100 water is finished injecting. In other words, the water must be the last item injected.
- The HMI will have buttons on the Overview screens, where the operator can initiate fills. Using these buttons will allow a sequence to occur automatically.

1.5 Valve Filling Profiles

The fill station solenoid valves are analog control capable of opening 0 to 100%, not simply on off valves. The % open of the valve is intended to be varied over the course of a component fill, or order to minimize fill time without sacrificing accuracy. A default fill profile will be programmed into the system, but it can be modified later by editing tables in the PLC.

Each valve in each station has its own filling table, and they can be modified separately.

Table 1.5 – Default Valve Filling Profile

Fill % of Target Volume	Valve % Open
0	25
10	100
20	100
30	100
40	100
50	100
60	100
70	75
80	50
90	25
100	0

When the running totalizer has passed a Fill % threshold, the % output will be adjusted per the table. For instance, with the table above, when the totalizer has passed the 70% threshold, the will close from 100% to 75%.

The filling will be noted as complete when the totalizer has reached the *Target Volume*.

Closing the valve prior to reaching 100% may cause the fill to become stuck, as it will never complete.

A preact volume will be programmed such that the PLC target will be equal to the Target Volume - Preact Volume. The intention is to begin closing the valve prior to a complete fill, minimizing overshoot.

2 Sequencer Descriptions

The following is a description of each step of each unit type.

2.1 Tank 100

This unit operation type represents the water tank.

2.1.1 Sequence – Analog Pressure Controls

Description

This sequence is used to control the pump using the analog pressure sensor.

Parameters

Pressure Setpoint

- Operator adjustable on HMI
- 0 to 60 PSIG

States

2.1.1.1 Idle

Description

This is the state for the sequence when not in use.

Devices

P-101 is at zero % output.

Transition Conditions

Transition to Running

- Upon Operator Command - Start.
  - AND
- Sequence – Mechanical Pressure Controls is in Stopped state.

2.1.1.2 Running

Description

This is the state that maintains pressure on the system.

Devices

P-101 is controlled by PID using PT-101 as the process variable and the *Pressure Setpoint* parameter from the sequence as the setpoint.

Transition Conditions

Transition to Idle
- Upon Operator Command.

Transition to Held
- When LSL-101 does not make fluid contact.
  - OR
- WT-101 is in a Low Low Alarm state.
  OR
- E-Stop is in an Alarm state (as signaled from the APT system).
  - OR
- PT-101 is in a High High or Low Low Alarm state.

Steps

1. Check Pump Status
   a. Verify VFD is available and in Program Control Mode
2. Run Pump
   a. Operator Prompt to modify pressure setpoint enabled
      i. Pressure setpoint can be changed later by pressing “Adjust Pressure Setpoint” button
   b. Continue to Run Pump utilizing PIDE control at user defined pressure setpoint until sequencer is stopped.

2.1.1.3 Held

Description

This is the state that the system goes to when there is a fault that requires an operator reset.

Devices

P-101 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.1.1.4 Paused

Description

This is the state that the system goes to when the operator pushes the pause button

Devices

P-101 maintains previous setpoint

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.1.1.5 Aborted

Description

This is the state that the system goes to when the operator aborts the sequence

Devices

P-101 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command – Reset

Transition to Running
- Upon Operator Command – NA

2.1.2 Sequence – Mechanical Pressure Controls

Description

This sequence is used to control the pump using the mechanical regulator sensor.

Parameters

Pump Speed
- Operator adjustable on HMI
- 0 to 100 %

States

2.1.2.1 Idle

Description

This is the state for the sequence when not in use.

Devices

P-101 is at zero % output.

Transition Conditions

Transition to Running

- Upon Operator Command - Start.
  - AND
- Sequence – Analog Pressure Controls is in Stopped state.

2.1.2.2 Running

Description

This is the state that maintains pressure on the system.

Devices

P-101 is set to speed command output

Transition Conditions

Transition to Idle
- Upon Operator Command.

Transition to Held
- When LSL-101 does not make fluid contact.
  OR
- WT-101 is in a Low Low Alarm state.
  OR
- E-Stop is in an Alarm state (as signaled from the APT system).
  OR
- PT-101 is in a High High or Low Low Alarm state.

Steps

1. Check Pump Status
   a. Verify VFD is available and in Program Control Mode
2. Run Pump
   a. Operator Prompt to modify speed setpoint enabled
      i. Speed setpoint can be changed later by pressing “Adjust Speed Setpoint” button
   b. Continue to Run Pump overriding PIDE control with user defined speed setpoint until sequencer is stopped.
      i. Manually adjust needle valves to regulate line pressure

2.1.2.3 Held

Description

This is the state that the system goes to when there is a fault that requires an operator reset.

Devices

P-101 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command - Stop.

Transition to Running
- Upon Operator Command - Restart.

2.1.2.4 Paused

Description

This is the state that the system goes to when the operator pushes the pause button

Devices

P-101 maintains previous setpoint

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.1.2.5 Aborted

Description

This is the state that the system goes to when the operator aborts the sequence

Devices

P-101 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command – Reset

Transition to Running
- Upon Operator Command - NA

2.2 Tank 200

This unit operation type represents the red food coloring tank.

2.2.1 Sequence – Analog Pressure Controls

Description

This sequence is used to control the pump using the analog pressure sensor.

Parameters

Pressure Setpoint

- Operator adjustable on HMI
- 0 to 60 PSIG

States

2.2.1.1 Idle

Description

This is the state for the sequence when not in use.

Devices

P-201 is at zero % output.

Transition Conditions

Transition to Running
- Upon Operator Command - Start.
  - AND
- Sequence – Mechanical Pressure Controls is in Stopped state.

2.2.1.2 Running

Description

This is the state that maintains pressure on the system.

Devices

P-121 is controlled by PID using PT-201 as the process variable and the *Pressure Setpoint* parameter from the sequence as the setpoint.

Transition Conditions

Transition to Idle
- Upon Operator Command.

Transition to Held
- When LSL-201 does not make fluid contact.
  - OR
- WT-201 is in a Low Low Alarm state.
  OR
- E-Stop is in an Alarm state (as signaled from the APT system).
  - OR
- PT-201 is in a High High or Low Low Alarm state.

Steps

1. Check Pump Status
   a. Verify VFD is available and in Program Control Mode
2. Run Pump
   a. Operator Prompt to modify pressure setpoint enabled

i. Pressure setpoint can be changed later by pressing “Adjust Pressure Setpoint” button

b. Continue to Run Pump utilizing PIDE control at user defined pressure setpoint until sequencer is stopped.

2.2.1.3 Held

Description

This is the state that the system goes to when there is a fault that requires an operator reset.

Devices

P-201 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.2.1.4 Paused

Description

This is the state that the system goes to when the operator pushes the pause button

Devices

P-201 maintains previous setpoint

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.2.1.5 Aborted

Description

This is the state that the system goes to when the operator aborts the sequence

Devices

P-201 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command – Reset

Transition to Running
- Upon Operator Command – NA

2.2.2 Sequence – Mechanical Pressure Controls

Description

This sequence is used to control the pump using the mechanical regulator sensor.

Parameters

Pump Speed
- Operator adjustable on HMI
- 0 to 100 %

States

2.2.2.1 Idle

Description

This is the state for the sequence when not in use.

Devices

P-201 is at zero % output.

Transition Conditions

Transition to Running
- Upon Operator Command - Start.
  - AND
- Sequence – Analog Pressure Controls is in Stopped state.

2.2.2.2 Running

Description

This is the state that maintains pressure on the system.

Devices

P-201 is set to speed command output

Transition Conditions

Transition to Idle
- Upon Operator Command.

Transition to Held

- When LSL-201 does not make fluid contact.
  OR
- WT-201 is in a Low Low Alarm state.
  OR
- E-Stop is in an Alarm state (as signaled from the APT system).
  OR
- PT-201 is in a High High or Low Low Alarm state.

Steps

1. Check Pump Status
   a. Verify VFD is available and in Program Control Mode
2. Run Pump
   a. Operator Prompt to modify speed setpoint enabled
      i. Speed setpoint can be changed later by pressing “Adjust Speed Setpoint” button
   b. Continue to Run Pump overriding PIDE control with user defined speed setpoint until sequencer is stopped.
      i. Manually adjust needle valves to regulate line pressure

2.2.2.3 Held

Description

This is the state that the system goes to when there is a fault that requires an operator reset.

Devices

P-201 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command - Stop.

Transition to Running
- Upon Operator Command - Restart.

2.2.2.4 Paused

Description

This is the state that the system goes to when the operator pushes the pause button

Devices

P-201 maintains previous setpoint

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running

- Upon Operator Command - Restart.

2.2.2.5 Aborted

Description

This is the state that the system goes to when the operator aborts the sequence

Devices

P-201 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command – Reset

Transition to Running
- Upon Operator Command - NA

2.3 Tank 300

This unit operation type represents the yellow food coloring tank.

2.3.1 Sequence – Analog Pressure Controls

Description

This sequence is used to control the pump using the analog pressure sensor.

Parameters

Pressure Setpoint
- Operator adjustable on HMI
- 0 to 60 PSIG

States

2.3.1.1 Idle

Description

This is the state for the sequence when not in use.

Devices

P-301 is at zero % output.

Transition Conditions

Transition to Running
- Upon Operator Command - Start.

- AND
- Sequence – Mechanical Pressure Controls is in Stopped state.

Steps

1. Check Pump Status
   a. Verify VFD is available and in Program Control Mode
2. Run Pump
   a. Operator Prompt to modify pressure setpoint enabled
      i. Pressure setpoint can be changed later by pressing "Adjust Pressure Setpoint" button
   b. Continue to Run Pump utilizing PIDE control at user defined pressure setpoint until sequencer is stopped.

2.3.1.2 Running

Description

This is the state that maintains pressure on the system.

Devices

P-301 is controlled by PID using PT-301 as the process variable and the *Pressure Setpoint* parameter from the sequence as the setpoint.

Transition Conditions

Transition to Idle
- Upon Operator Command.

Transition to Held
- When LSL-301 does not make fluid contact.
  - OR
- WT-301 is in a Low Low Alarm state.
  OR
- E-Stop is in an Alarm state (as signaled from the APT system).
  - OR
- PT-301 is in a High High or Low Low Alarm state.

2.3.1.3 Held

Description

This is the state that the system goes to when there is a fault that requires an operator reset.

Devices

P-301 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.3.1.4 Paused

Description

This is the state that the system goes to when the operator pushes the pause button

Devices

P-301 maintains previous setpoint

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.3.1.5 Aborted

Description

This is the state that the system goes to when the operator aborts the sequence

Devices

P-301 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command – Reset

Transition to Running
- Upon Operator Command - NA

2.3.2 Sequence – Mechanical Pressure Controls

Description

This sequence is used to control the pump using the mechanical regulator sensor.

Parameters

Pump Speed
- Operator adjustable on HMI
- 0 to 100 %

States

2.3.2.1 Idle

Description

This is the state for the sequence when not in use.

Devices

P-301 is at zero % output.

Transition Conditions

Transition to Running

- Upon Operator Command - Start.
  - AND
- Sequence – Analog Pressure Controls is in Stopped state.

2.3.2.2 Running

Description

This is the state that maintains pressure on the system.

Devices

P-301 is set to speed command output

Transition Conditions

Transition to Idle

- Upon Operator Command.

Transition to Held

- When LSL-301 does not make fluid contact.
  OR
- WT-301 is in a Low Low Alarm state.
  OR
- E-Stop is in an Alarm state (as signaled from the APT system).
  OR
- PT-301 is in a High High or Low Low Alarm state.

2.3.2.3 Held

Description

This is the state that the system goes to when there is a fault that requires an operator reset.

Devices

P-301 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command - Stop.

Transition to Running
- Upon Operator Command - Restart.

2.3.2.4 Paused

Description

This is the state that the system goes to when the operator pushes the pause button

Devices

P-301 maintains previous setpoint

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

Steps

1. Check Pump Status
    a. Verify VFD is available and in Program Control Mode
2. Run Pump
    a. Operator Prompt to modify speed setpoint enabled
        i. Speed setpoint can be changed later by pressing “Adjust Speed Setpoint” button
    b. Continue to Run Pump overriding PIDE control with user defined speed setpoint until sequencer is stopped.
        i. Manually adjust needle valves to regulate line pressure

2.3.2.5 Aborted

Description

This is the state that the system goes to when the operator aborts the sequence

Devices

P-301 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command – Reset

Transition to Running
- Upon Operator Command – NA

2.4 Tank 400

This unit operation type represents the blue food coloring tank.

2.4.1 Sequence – Analog Pressure Controls

Description

This sequence is used to control the pump using the analog pressure sensor.

Parameters

Pressure Setpoint

- Operator adjustable on HMI
- 0 to 60 PSIG

States

2.4.1.1 Idle

Description

This is the state for the sequence when not in use.

Devices

P-401 is at zero % output.

Transition Conditions

Transition to Running

- Upon Operator Command - Start.
  - AND
- Sequence – Mechanical Pressure Controls is in Stopped state.

2.4.1.2 Running

Description

This is the state that maintains pressure on the system.

Devices

P-401 is controlled by PID using PT-401 as the process variable and the *Pressure Setpoint* parameter from the sequence as the setpoint.

Transition Conditions

Transition to Idle

- Upon Operator Command.

Transition to Held

- When LSL-401 does not make fluid contact.

- OR
- WT-401 is in a Low Low Alarm state.
  OR
- E-Stop is in an Alarm state (as signaled from the APT system).
  - OR
- PT-401 is in a High High or Low Low Alarm state.

Steps

1. Check Pump Status
   a. Verify VFD is available and in Program Control Mode
2. Run Pump
   a. Operator Prompt to modify pressure setpoint enabled
      i. Pressure setpoint can be changed later by pressing “Adjust Pressure Setpoint” button
   b. Continue to Run Pump utilizing PIDE control at user defined pressure setpoint until sequencer is stopped.

2.4.1.3 Held

Description

This is the state that the system goes to when there is a fault that requires an operator reset.

Devices

P-401 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.4.1.4 Paused

Description

This is the state that the system goes to when the operator pushes the pause button

Devices

P-401 maintains previous setpoint

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.4.1.5 Aborted

Description

This is the state that the system goes to when the operator aborts the sequence

Devices

P-401 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command – Reset

Transition to Running
- Upon Operator Command - NA

2.4.2 Sequence – Mechanical Pressure Controls

Description

This sequence is used to control the pump using the mechanical regulator sensor.

Parameters

Pump Speed
- Operator adjustable on HMI
- 0 to 100 %

States

2.4.2.1 Idle

Description

This is the state for the sequence when not in use.

Devices

P-401 is at zero % output.

Transition Conditions

Transition to Running
- Upon Operator Command - Start.
  - AND
- Sequence – Analog Pressure Controls is in Stopped state.

2.4.2.2 Running

Description

This is the state that maintains pressure on the system.

Devices

P-401 is set to speed command output

Transition Conditions

Transition to Idle
- Upon Operator Command.

Transition to Held
- When LSL-401 does not make fluid contact.
  OR
- WT-401 is in a Low Low Alarm state.
  OR
- E-Stop is in an Alarm state (as signaled from the APT system).
  OR
- PT-401 is in a High High or Low Low Alarm state.

Steps

1. Check Pump Status
   a. Verify VFD is available and in Program Control Mode
2. Run Pump
   a. Operator Prompt to modify speed setpoint enabled
      i. Speed setpoint can be changed later by pressing “Adjust Speed Setpoint” button
   b. Continue to Run Pump overriding PIDE control with user defined speed setpoint until sequencer is stopped.
      i. Manually adjust needle valves to regulate line pressure

2.4.2.3 Held

Description

This is the state that the system goes to when there is a fault that requires an operator reset.

Devices

P-401 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command - Stop.

Transition to Running
- Upon Operator Command - Restart.

2.4.2.4 Paused

Description

This is the state that the system goes to when the operator pushes the pause button

Devices

P-401 maintains previous setpoint

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.4.2.5 Aborted

Description

This is the state that the system goes to when the operator aborts the sequence

Devices

P-401 is at zero % output.

Transition Conditions

Transition to Idle
- Upon Operator Command – Reset

Transition to Running
- Upon Operator Command - NA

2.5 Tank Skid

This unit operation type represents filling the tank skid.

2.5.1 Sequence – Water Fill

Description

This sequence is used to add water to from tank T-100 to the color tanks T-200-400

Parameters

Fill Volume
- 1000 ml

States

2.5.1.1 Idle

Description

This is the state for the sequence when not in use.

Devices

SV-152 is closed
SV-201 is closed
SV-301 is closed
SV-401 is closed

Transition Conditions

Transition to Running
- Upon Operator Command - Start.

2.5.1.2 Running

Description

This is the state that fills the selected tank from T-100

Transition Conditions

Transition to Idle
- Upon Operator Command.

Transition to Held
- When target volume is not completed within allotted time

Steps

1. Check Start Mode
    a. By default, the system will always default to manual mode. Automatic commands from APT have not been integrated.
        i. If Automatic Mode Selected Continue to Step 2
        ii. If Manual Mode Selected Branch to Step 3
2. Select Fill Tank
    a. Operator Prompt to select Fill Tank (Tank to be Filled)
3. Enter Fill Volume
    a. Operator Prompt to enter Fill Volume
        i. Note: by default, this step is bypassed – fill volume is entered automatically in program at 1000 ml
4. Check Tank Selection
    a. Sequence will check operator prompt to determine selected tank
        i. If Tank T-200 selected Branch to Step 7; Else Continue to Step 5
5. Check Tank Selection
    a. Sequence will check operator prompt to determine selected tank
        i. If Tank T-300 selected Branch to Step 12; Else Continue to Step 6
6. Check Tank Selection
    a. Sequence will check operator prompt to determine selected tank
        i. If Tank T-400 selected Branch to Step 17; Else Transition to Held
7. T-200 Water Fill

a. Open SV-152
8. Open SV-201
9. Fill Tank T-200
    a. Fill Tank T-200 utilizing FIT-151-Dose PlantPAx object
        i. Dose object will totalize flow from FIT-151 and output a complete bit when target volume is reached
    b. Branch to Step 20
10. Spare
11. Spare
12. T-300 Water Fill
    a. Open SV-152
13. Open SV-301
14. Fill Tank T-300
    a. Fill Tank T-300 utilizing FIT-151-Dose PlantPAx object
        i. Dose object will totalize flow from FIT-151 and output a complete bit when target volume is reached
    b. Branch to Step 20
15. Spare
16. Spare
17. T-400 Water Fill
    a. Open SV-152
18. Open SV-401
19. Fill Tank T-400
    a. Fill Tank T-400 utilizing FIT-151-Dose PlantPAx object
        i. Dose object will totalize flow from FIT-151 and output a complete bit when target volume is reached
20. Fill Complete
    a. Close SV-201 if open
    b. Close SV-301 if open
    c. Close SV-401 if open
    d. Close SV-152 if open

2.5.1.3 Held

Description

This is the state that the system goes to when there is a fault that requires an operator reset.

Devices

SV-152 is closed
SV-201 is closed
SV-301 is closed
SV-401 is closed

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.5.1.4 Paused

Description

This is the state that the system goes to when the operator pushes the pause button

Devices

SV-152 maintains previous position
SV-201 maintains previous position
SV-301 maintains previous position
SV-401 maintains previous position

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.5.1.5 Aborted

Description

This is the state that the system goes to when the operator aborts the sequence

Devices

SV-152 is closed
SV-201 is closed
SV-301 is closed
SV-401 is closed

Transition Conditions

Transition to Idle
- Upon Operator Command – Reset

Transition to Running
- Upon Operator Command – NA

2.6 Fill Station 3

This unit operation type represents fill station 3

2.6.1 Sequence – Fill 300

Description

This sequence is used to dose water to from Tanks T-100-400 to vials at Fill Station 3

Parameters

Fill Volumes

- T-100 Volume
- T-200 Volume
- T-300 Volume
- T-400 Volume
- Push Water Volume

States

2.6.1.1 Idle

Description

This is the state for the sequence when not in use.

Devices

SV-131 is closed
SV-231 is closed
SV-331 is closed
SV-431 is closed
SV-032 is open
SV-031 is closed

Transition Conditions

Transition to Running

- Upon Operator Command - Start.
  - OR
- APT Command – Start

2.6.1.2 Running

Description

This is the state that fills the vials

Transition Conditions

Transition to Idle

- Upon Operator Command.

Transition to Held

- When target volume is not completed within allotted time

Steps

1. Automatic Mode Check
   a. If Sequencer is started Automatically (from APT) branch to Step 3; Else continue to Step 2
2. Enter Fill Volumes
   a. Enable Operator Prompt to enter Fill Volume to be dosed from each Tank.

3. Check Fill Mode
    a. Check whether Fill Mode is Set as Simultaneous or Sequential
        i. Note: For Fill Station 3 Sequential Mode is always chosen
4. Divert to Drain
    a. Open SV-032
5. Add T-200 Volume
    a. Utilize Symbiont Valve Control AOI and FIT-031 pulse count to dose T-200 Volume
        i. If Push Water Volume is reached
            1. Close SV-032
            2. Open SV-031
6. Add T-300 Volume
    a. Utilize Symbiont Valve Control AOI and FIT-031 pulse count to dose T-300 Volume
        i. If Push Water Volume is reached
            1. Close SV-032
            2. Open SV-031
7. Add T-400 Volume
    a. Utilize Symbiont Valve Control AOI and FIT-031 pulse count to dose T-400 Volume
        i. If Push Water Volume is reached
            1. Close SV-032
            2. Open SV-031
8. Add T-100 Volume
    a. Utilize Symbiont Valve Control AOI and FIT-031 pulse count to dose T-100 Volume
        i. If Push Water Volume is reach
            1. Open SV-032
            2. Open SV-031
    b. Branch to Step 10
9. Fill from All Tanks
    a. Step is bypassed for Fill Station 3; This step is only used during Simultaneous fills.
10. Shift Data Logs
11. Reset Totalizers
    a. Send APT Fill Complete Bit and Flow Totals
12. Clear Outputs
    a. Close SV-131
    b. Close SV-231
    c. Close SV-331
    d. Close SV-431
    e. Open SV-032
    f. Close SV-031

2.6.1.3 Held

Description

This is the state that the system goes to when there is a fault that requires an operator reset.

Devices

SV-131 is closed
SV-231 is closed
SV-331 is closed
SV-431 is closed
SV-032 maintains last position
SV-031 maintains last position

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.6.1.4 Paused

Description

This is the state that the system goes to when the operator pushes the pause button

Devices

SV-131 maintains previous position
SV-231 maintains previous position
SV-331 maintains previous position
SV-431 maintains previous position
SV-031 maintains previous position
SV-032 maintains previous position

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.6.1.5 Aborted

Description

This is the state that the system goes to when the operator aborts the sequence

Devices

SV-131 is closed
SV-231 is closed
SV-331 is closed
SV-431 is closed
SV-032 is open
SV-031 is closed

Transition Conditions

Transition to Idle
- Upon Operator Command – Reset

Transition to Running
- Upon Operator Command – NA

2.7 Fill Station 4

This unit operation type represents fill station 4

2.7.1 Sequence – Fill 400

Description

This sequence is used to dose water to from Tanks T-100-400 to vials at Fill Station 4

Parameters

Fill Volumes

- T-100 Volume
- T-200 Volume
- T-300 Volume
- T-400 Volume

States

2.7.1.1 Idle

Description

This is the state for the sequence when not in use.

Devices

SV-141 is closed
SV-241 is closed
SV-341 is closed
SV-441 is closed

Transition Conditions

Transition to Running

- Upon Operator Command - Start.
  - OR
- APT Command – Start

2.7.1.2 Running

Description

This is the state that fills the vials

Transition Conditions

Transition to Idle

- Upon Operator Command.

Transition to Held

- When target volume is not completed within allotted time

Steps

1. Automatic Mode Check
    a. If Sequencer is started Automatically (from APT) branch to Step 3; Else continue to Step 2
2. Enter Fill Volumes
    a. Enable Operator Prompt to enter Fill Volume to be dosed from each Tank.
3. Check Fill Mode
    a. Check whether Fill Mode is Set as Simultaneous or Sequential
        i. If Simultaneous mode is set Branch to Step 8
4. Add T-400 Volume
    a. Utilize Symbiont Valve Control AOI to modulate SV-441
    b. Count FIT-441 pulses to record dosed volume
5. Add T-300 Volume
    a. Utilize Symbiont Valve Control AOI to modulate SV-341
    b. Count FIT-341 pulses to record dosed volume
6. Add T-200 Volume
    a. Utilize Symbiont Valve Control AOI to modulate SV-241
    b. Count FIT-241 pulses to record dosed volume
7. Add T-100 Volume
    a. Utilize Symbiont Valve Control AOI to modulate SV-141
    b. Count FIT-141 pulses to record dosed volume
    c. Branch to Step 9
8. Fill from All Tanks
    a. Utilize Symbiont Valve Control AOIs and Fill Station 4 Flow Meter pulse counts to dose selected volumes simultaneously
9. Shift Data Logs
10. Reset Totalizers
    a. Send APT Fill Complete Bit and Flow Totals
11. Clear Outputs
    a. Close SV-141
    b. Close SV-241
    c. Close SV-341
    d. Close SV-441

2.7.1.3 Held

Description

This is the state that the system goes to when there is a fault that requires an operator reset.

Devices

SV-141 is closed
SV-241 is closed
SV-341 is closed
SV-441 is closed

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.7.1.4 Paused

Description

This is the state that the system goes to when the operator pushes the pause button

Devices

SV-141 maintains previous position
SV-241 maintains previous position
SV-341 maintains previous position
SV-441 maintains previous position

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.7.1.5 Aborted

Description

This is the state that the system goes to when the operator aborts the sequence

Devices

SV-141 is closed
SV-241 is closed
SV-341 is closed
SV-441 is closed

Transition Conditions

Transition to Idle
- Upon Operator Command – Reset

Transition to Running
- Upon Operator Command – NA

2.8 Fill Station 5

This unit operation type represents fill station 5

2.8.1 Sequence – Fill 500

Description

This sequence is used to dose water to from Tanks T-100-400 to vials at Fill Station 5

Parameters

Fill Volumes

- T-100 Volume
- T-200 Volume
- T-300 Volume
- T-400 Volume

States

2.8.1.1 Idle

Description

This is the state for the sequence when not in use.

Devices

SV-151 is closed
SV-251 is closed
SV-351 is closed
SV-451 is closed

Transition Conditions

Transition to Running

- Upon Operator Command - Start.
  - OR
- APT Command – Start

2.8.1.2 Running

Description

This is the state that fills the vials

Transition Conditions

Transition to Idle

- Upon Operator Command.

Transition to Held

- When target volume is not completed within allotted time

Steps

12. Automatic Mode Check
    a. If Sequencer is started Automatically (from APT) branch to Step 3; Else continue to Step 2
13. Enter Fill Volumes
    a. Enable Operator Prompt to enter Fill Volume to be dosed from each Tank.
14. Check Fill Mode
    a. Check whether Fill Mode is Set as Simultaneous or Sequential

i. If Simultaneous mode is set Branch to Step 8
b. By default Fill Station 500 is set to sequential fill mode; Note that a mechanical piping change is required to change to simultaneous mode

15. Add T-400 Volume
    a. Utilize Symbiont Valve Control AOI to modulate SV-451
    b. Count FIT-451 pulses to record dosed volume
16. Add T-300 Volume
    a. Utilize Symbiont Valve Control AOI to modulate SV-351
    b. Count FIT-351 pulses to record dosed volume
17. Add T-200 Volume
    a. Utilize Symbiont Valve Control AOI to modulate SV-251
    b. Count FIT-251 pulses to record dosed volume
18. Add T-100 Volume
    a. Utilize Symbiont Valve Control AOI to modulate SV-151
    b. Count FIT-151 pulses to record dosed volume
    c. Branch to Step 9
19. Fill from All Tanks
    a. Utilize Symbiont Valve Control AOIs and Fill Station 5 Flow Meter pulse counts to dose selected volumes simultaneously
20. Shift Data Logs
21. Reset Totalizers
    a. Send APT Fill Complete Bit and Flow Totals
22. Clear Outputs
    a. Close SV-151
    b. Close SV-251
    c. Close SV-351
    d. Close SV-451

2.8.1.3 Held

Description

This is the state that the system goes to when there is a fault that requires an operator reset.

Devices

SV-151 is closed
SV-251 is closed
SV-351 is closed
SV-451 is closed

Transition Conditions

Transition to Idle

- Upon Operator Command – Stop

Transition to Running

- Upon Operator Command - Restart.

2.8.1.4 Paused

Description

This is the state that the system goes to when the operator pushes the pause button

Devices

SV-151 maintains previous position
SV-251 maintains previous position
SV-351 maintains previous position
SV-451 maintains previous position

Transition Conditions

Transition to Idle
- Upon Operator Command – Stop

Transition to Running
- Upon Operator Command - Restart.

2.8.1.5 Aborted

Description

This is the state that the system goes to when the operator aborts the sequence

Devices

SV-151 is closed
SV-251 is closed
SV-351 is closed
SV-451 is closed

Transition Conditions

Transition to Idle
- Upon Operator Command – Reset

Transition to Running
- Upon Operator Command – NA

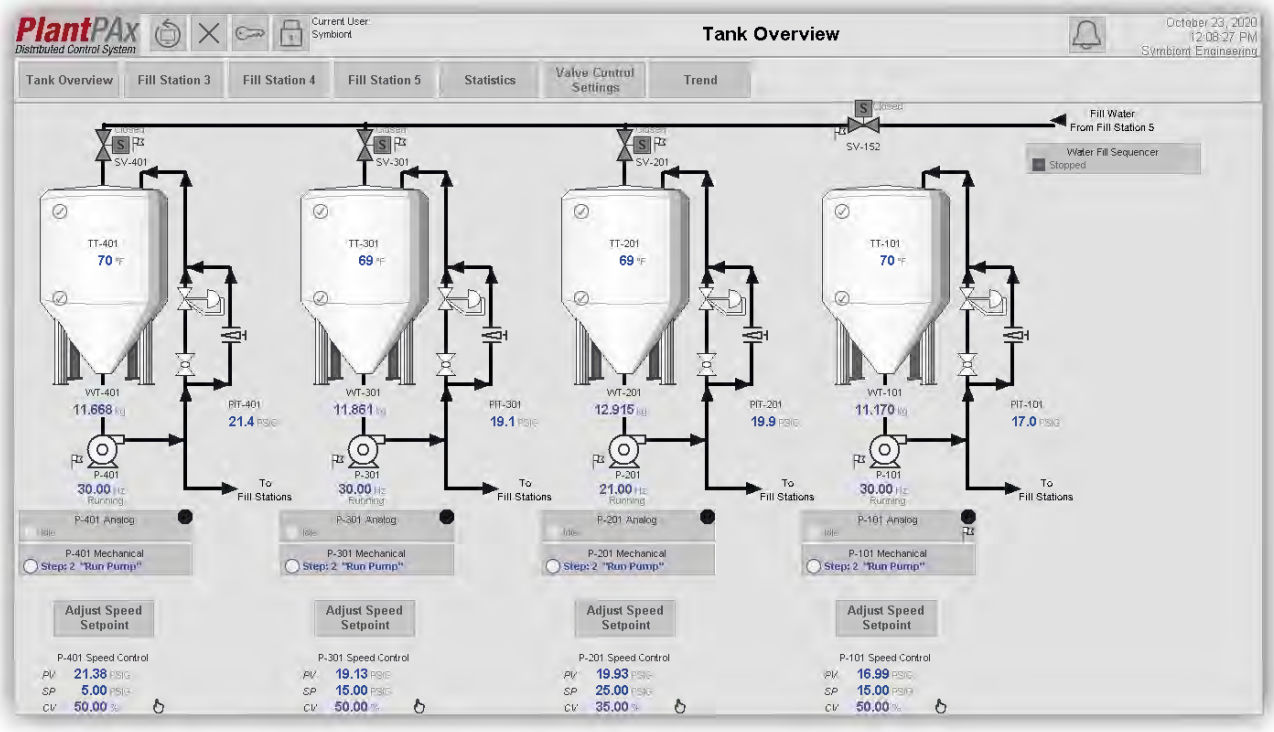
3 P&ID

Description

In Appendix B, please find the process flow diagram referenced in this document.

Section 4.0
HMI SYSTEM

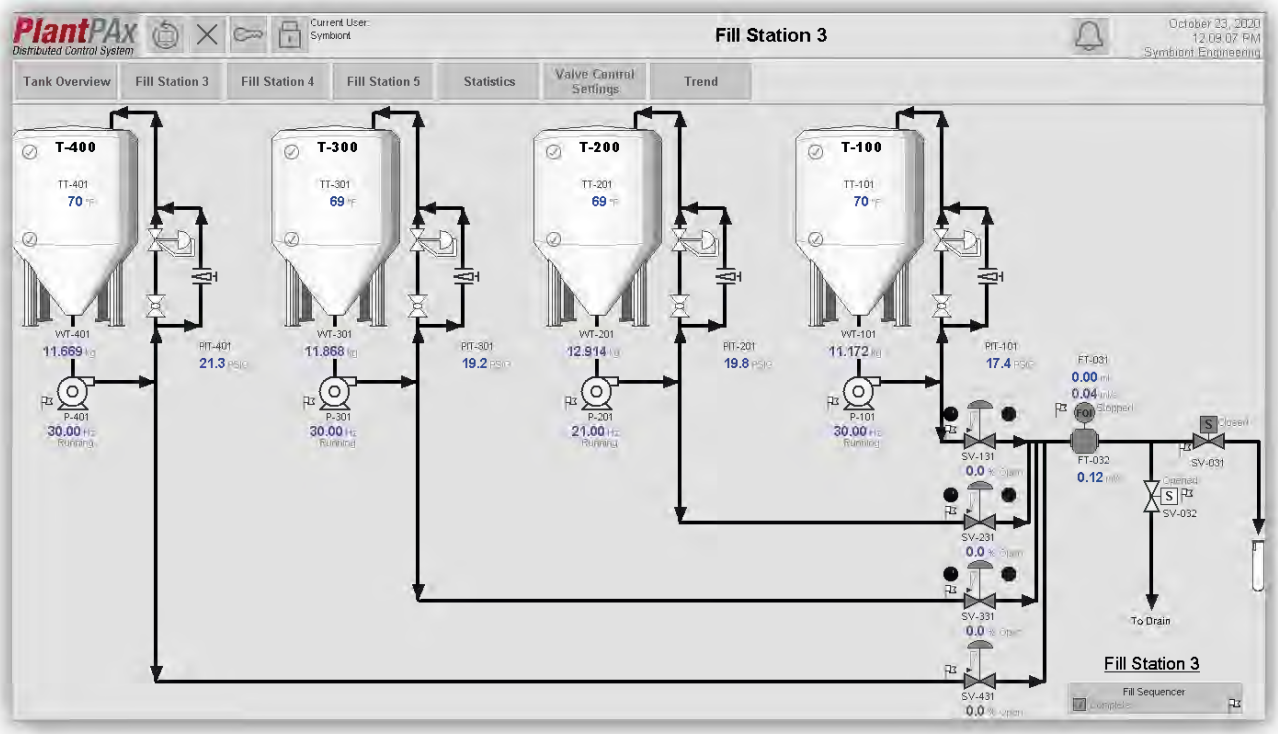
Tank Overview



The Tank Overview Screen provides an overview of the tank skid, including pump and water fill control. Each pump has the option to be operated using either a mechanical or analog sequencer object. The PIDE tuning is also displayed for each pump for analog control mode. When the pumps are running in mechanical control mode, a static speed will be set to the PIDE Control Variable.

The figure represents the Tank Overview screen from a Human-Machine Interface (HMI) System, part of a section titled "HMI SYSTEM". It shows a graphical representation of a tank skid system, which includes multiple tanks and their associated pumps. Each tank is depicted with corresponding fill levels, and each pump has adjustable speed controls. The diagram illustrates the option for each pump to be operated in either mechanical or analog control mode, with PID (Proportional-Integral-Derivative) tuning parameters displayed for analog control. The PID values maintain the process variables at a set point within a control system.

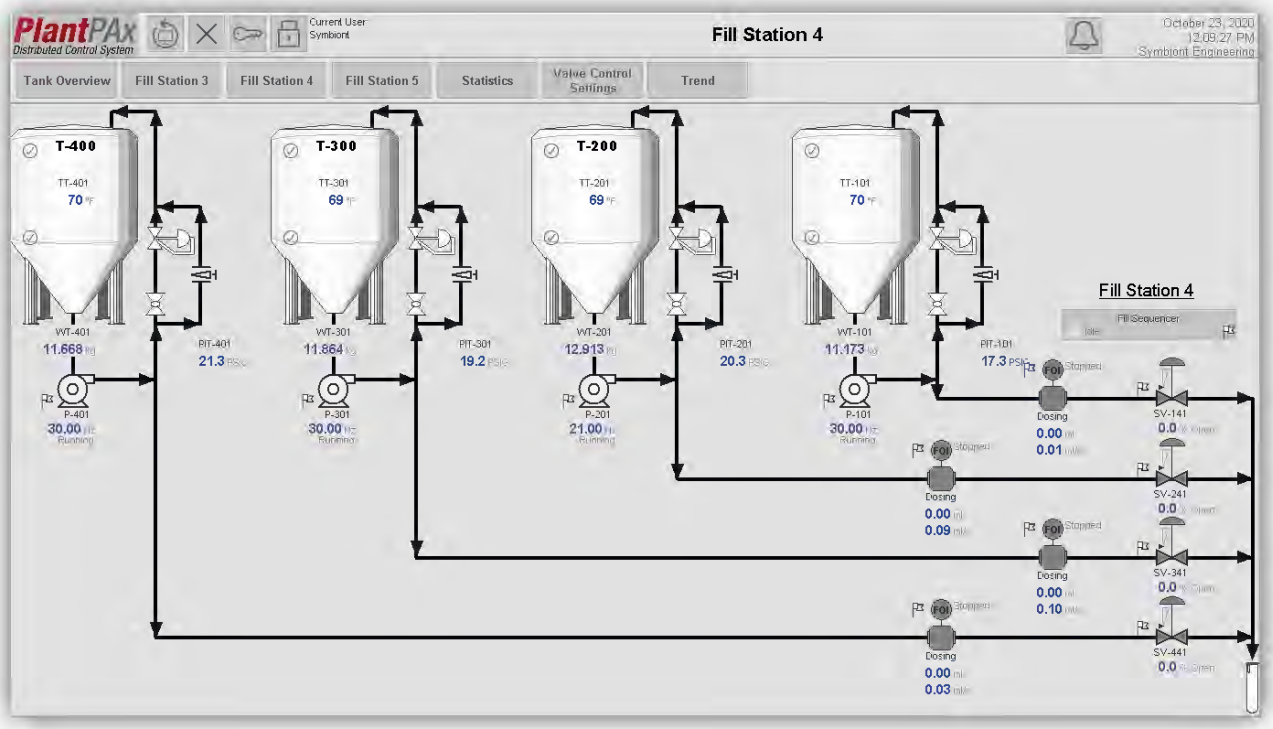
Fill Station 3



The Fill Station 3 Overview Screen provides an overview of the tank skid as well as an overview and sequencer control for Fill Station 3. Under normal operation, Fill Station 3 will be in program mode and triggered automatically. However, the ability is present to operate the fill sequence manually for testing purposes.

The figure shows the "Fill Station 3 Overview Screen" from a Human-Machine Interface (HMI) system. It visualizes part of a tank skid system, specifically focusing on Fill Station 3. It shows a series of tanks, each with level indicators and control valves. There is a sequencer control for Fill Station 3, which, under normal operations, would trigger the filling process automatically. Additionally, there is an option for manual operation of the fill sequence, which can be used for testing. Each tank is represented with real-time data on fill level and status, providing an interactive and informative dashboard for monitoring and control.

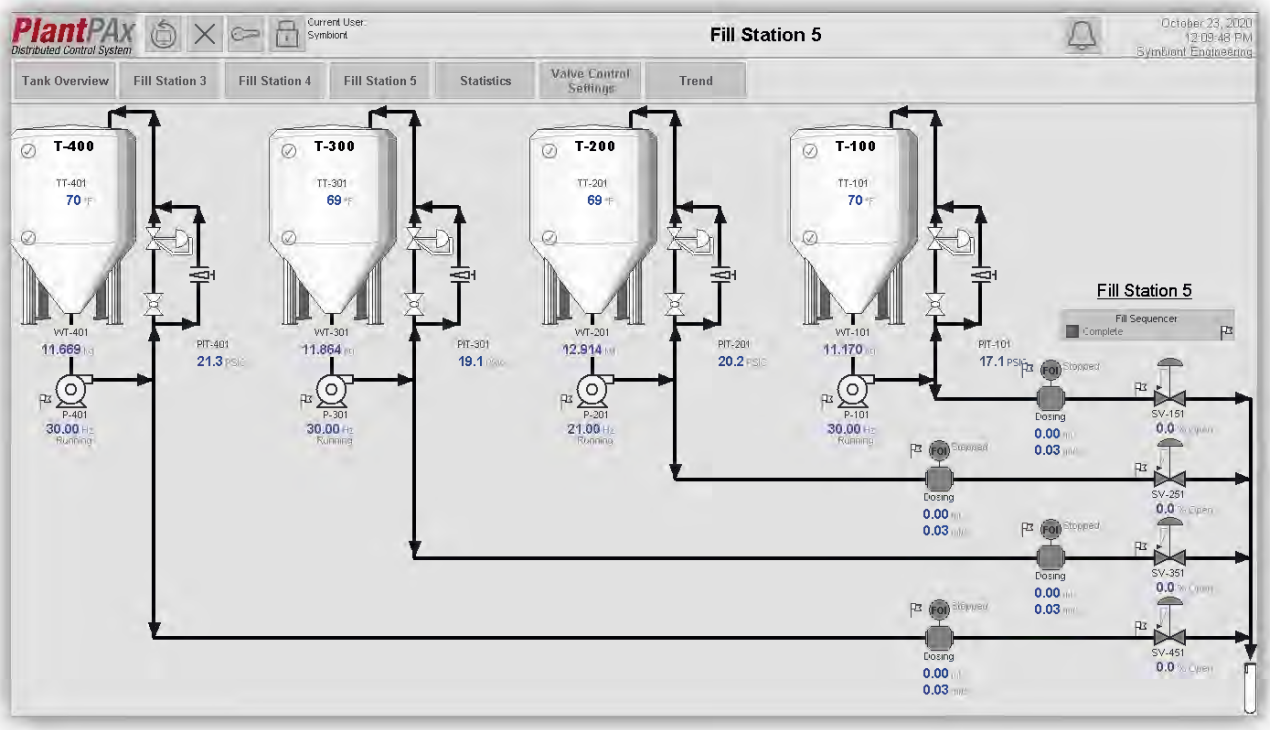
Fill Station 4



The Fill Station 4 Overview Screen provides an overview of the tank skid as well as an overview and sequencer control for Fill Station 4. Under normal operation, Fill Station 4 will be in program mode and triggered automatically. However, the ability is present to operate the fill sequence manually for testing purposes.

The image is a Human-Machine Interface (HMI) screen for Fill Station 4, showing the tank skid system associated with this particular fill station. It includes a graphical representation of tanks with real-time data on levels and status, valves, and pipelines. The HMI screen illustrates the automated process control system with sequencer control for Fill Station 4, which is normally set to operate in an automatic mode but also has the capability for manual override, allowing operators to manually trigger the fill sequence for testing or operational purposes.

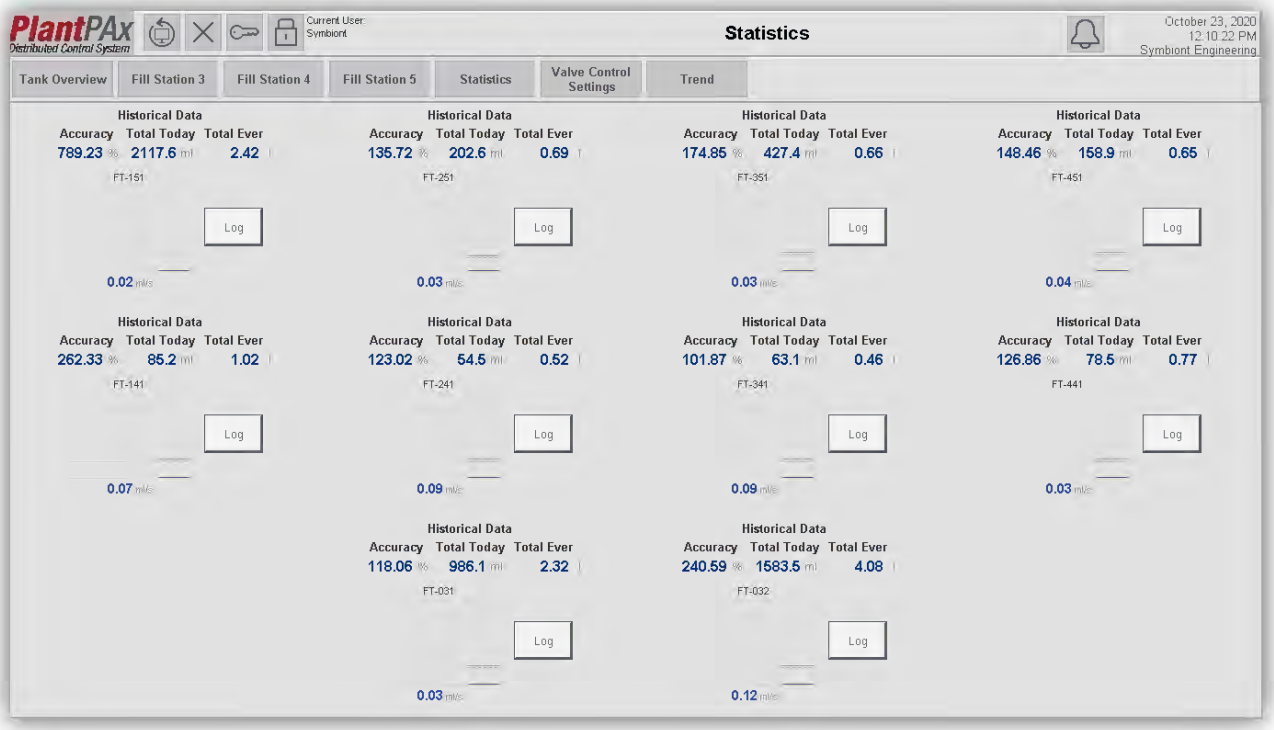
Fill Station 5



The Fill Station 5 Overview Screen provides an overview of the tank skid as well as an overview and sequencer control for Fill Station 5. Under normal operation, Fill Station 5 will be in program mode and triggered automatically. However, the ability is present to operate the fill sequence manually for testing purposes.

The figure is a Human-Machine Interface (HMI) screen capture for Fill Station 5. It displays a process control interface with an overview of a tank skid, detailing tanks' fill levels, control valves, and associated piping. The interface shows that Fill Station 5 is typically automated, with processes triggered automatically, but it also has functionality for manual operation. This manual feature allows operators to engage the fill sequence on demand, which is useful for testing or manual intervention in the filling process.

Statistics



The Statistics Screen provides a trend snapshot for each flow meters as well as historical data for Accuracy (Actual Volume/Target Volume*100), Total Flow Today, and Total Flow Ever. There is a Log button available for each flow meter which provides additional details.

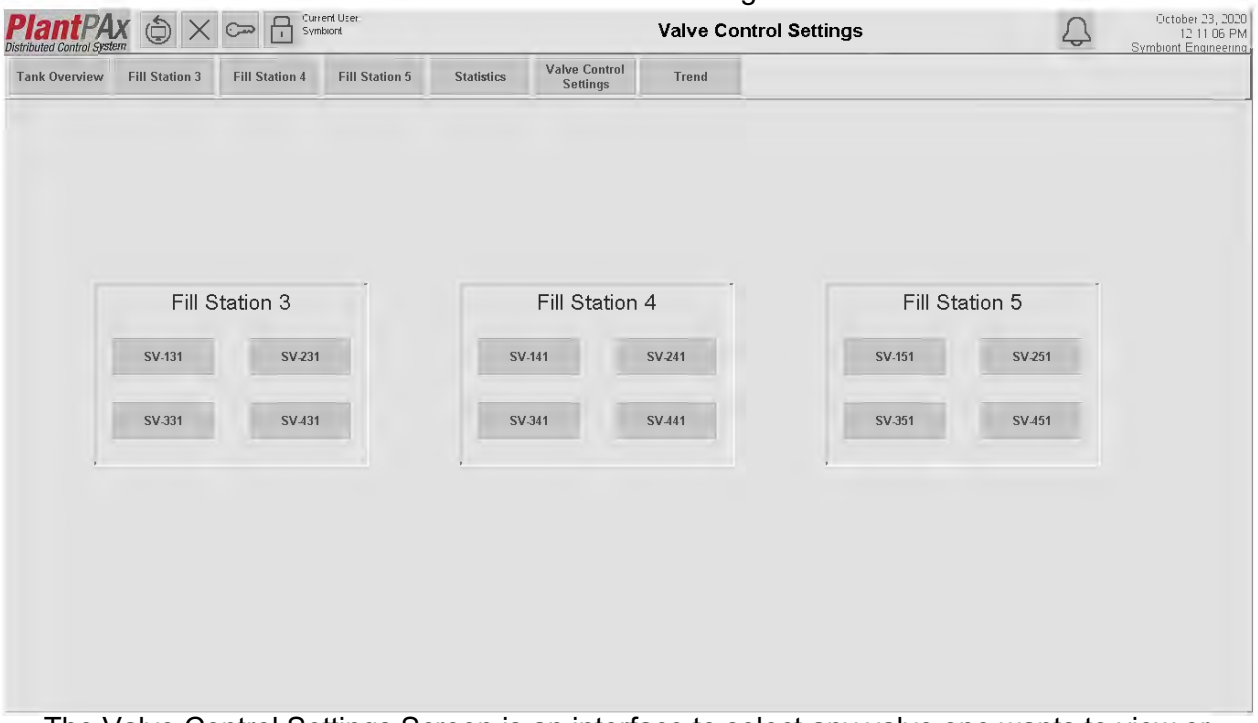
The figure represents a "Statistics" screen from a Human-Machine Interface (HMI) system. It provides real-time and historical data for flow meters, including 'Accuracy' calculated as (Actual Volume/Target Volume*100), 'Total Flow Today,' and 'Total Flow Ever' for each meter. Each section displays current readings and provides a 'Log' button for accessing detailed records. This screen is crucial for monitoring and logging the performance of flow meters within a system.

Log

The Log Popup displays the last 10 flow commands for the selected flow meter. Each command line will display the Target Flow, Actual Flow, and Accuracy (Actual Volume/Target Volume*100). While only 10 entries are displayed, the log is 2000 entries long. Pushing the “Clear Log” button will clear all 2000 entries.

The figure is a screenshot of a "Historical Flow Log" from an HMI system, specifically for a flow meter labeled "FT-151". It lists the last ten flow commands, detailing each entry's 'Target Flow,' 'Actual Flow,' and 'Accuracy'. 'Accuracy' is calculated as (Actual Volume/Target Volume*100). The log holds 2000 entries, but only 10 are displayed at a time. The 'Total Flow Today' and 'Total Flow Ever' values are given at the bottom, along with the 'Historical Accuracy' percentage. A "Clear Log" button is provided to clear all entries in the log.

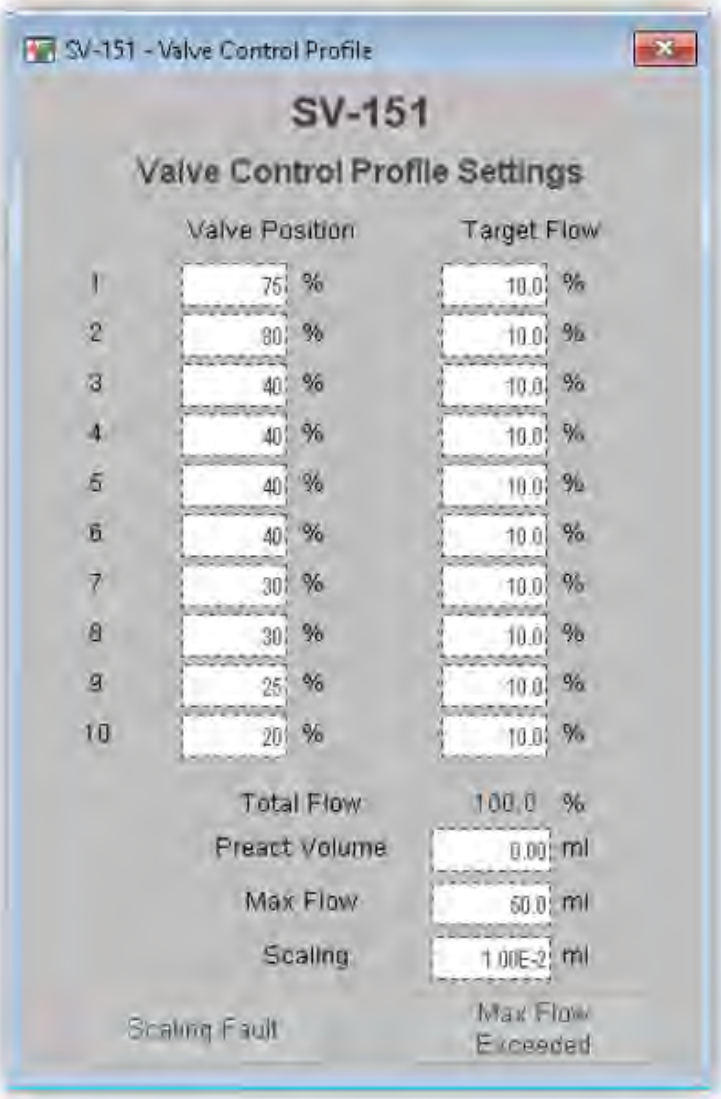
Valve Control Settings



The Valve Control Settings Screen is an interface to select any valve one wants to view or modify the current valve profile. Pushing a valve button will open a Valve Control Profile Popup for said valve.

The figure presents the "Valve Control Settings" screen from an HMI (Human-Machine Interface) system. It provides a user interface for selecting and adjusting valve settings across multiple fill stations, specifically Fill Stations 3, 4, and 5. Each fill station has buttons corresponding to different valves, labeled with SV (Solenoid Valve) identifiers. By pressing any of these buttons, the user can access a Valve Control Profile Popup, where they can view or change the current settings of the selected valve.

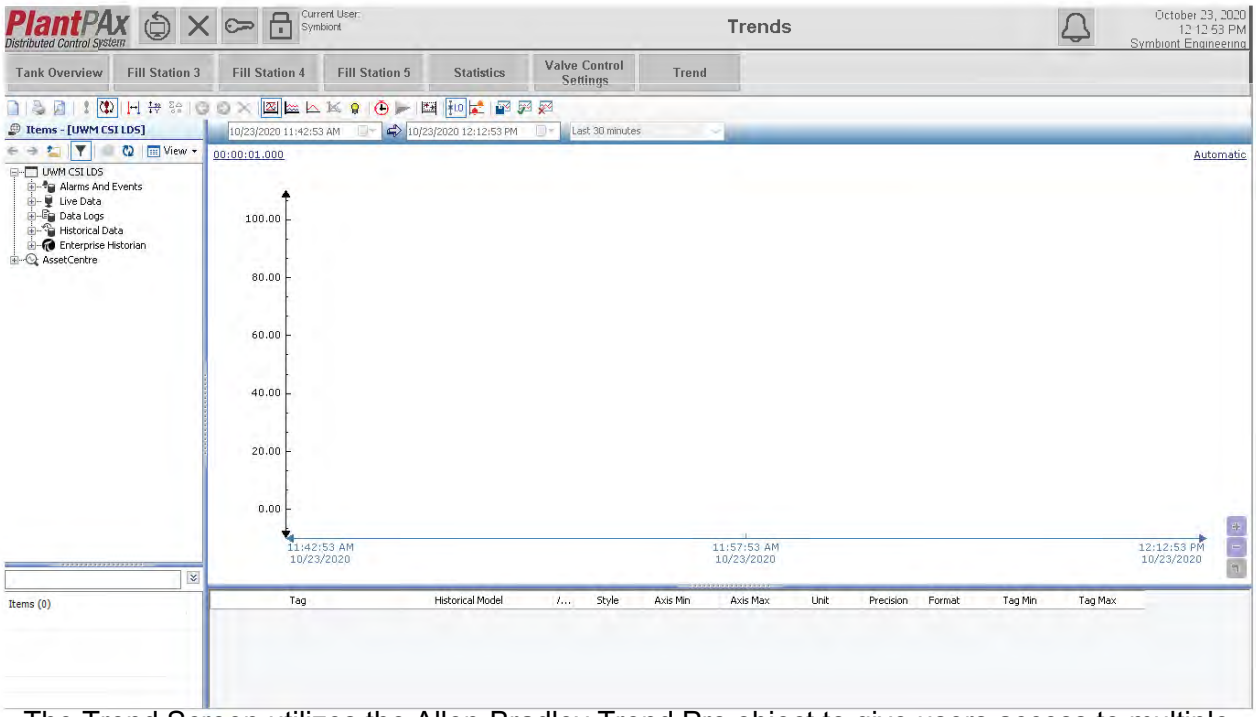
Valve Control Profile



The Valve Control Profile Popup allows users to modify the valve control settings. Each valve is setup to dose a target % of total flow volume for 10 different programmable positions. There is also an Preact field that can be entered. The preact will cause the valve to targe the target volume minus the preact volume. This value is entered in an attempt to adjust for the delay in valve reaction. Users can also enter the Scaling parameter, which is the amount of volume per pulse as setup in the flow meters. By default this value is 0.01ml/pulse.

The figure is a Valve Control Profile for SV-151. It shows a user interface for setting valve positions and target flow rates for ten programmable positions. The interface allows for the configuration of each valve to dose a percentage of the total flow volume and provides fields to adjust 'Preset Volume' and 'Max Flow.' It also includes a 'Scaling' parameter to set the volume per pulse, with a default of 0.01 ml/pulse, allowing for fine-tuning of the valve based on the flow meter's feedback, which is critical for precise fluid control in automated processes.

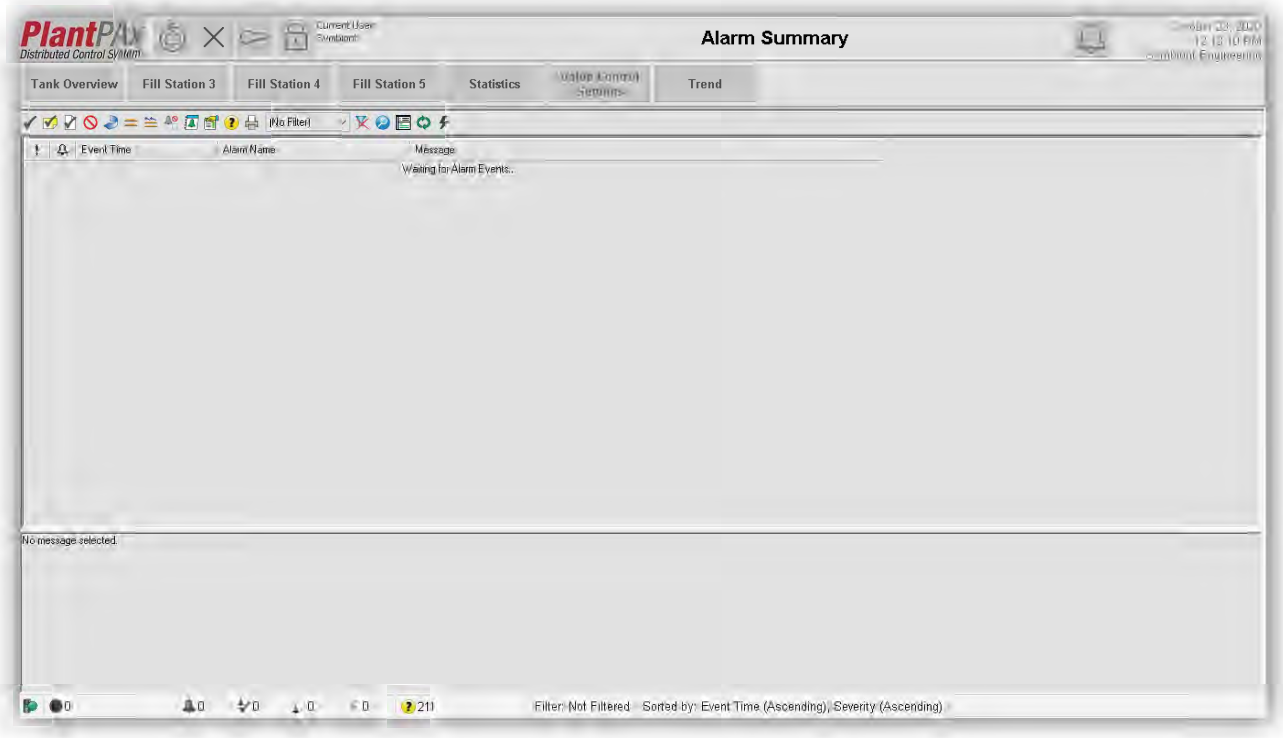
Trend



The Trend Screen utilizes the Allen-Bradley Trend Pro object to give users access to multiple data sources for trending. Trends can then be manipulated to the desired scaling and style. Trend templates can even be saved to be recalled at a later time.

The figure displays the "Trend" screen from a PlantPAx system, which is used to visualize data over time. This screen features the Allen-Bradley Trend Pro object, allowing users to access and display multiple data sources for trending purposes. Users can adjust the trends for scaling and style to better analyze the data. There's also functionality to save trend templates, which can be recalled later, aiding in consistent data analysis and monitoring.

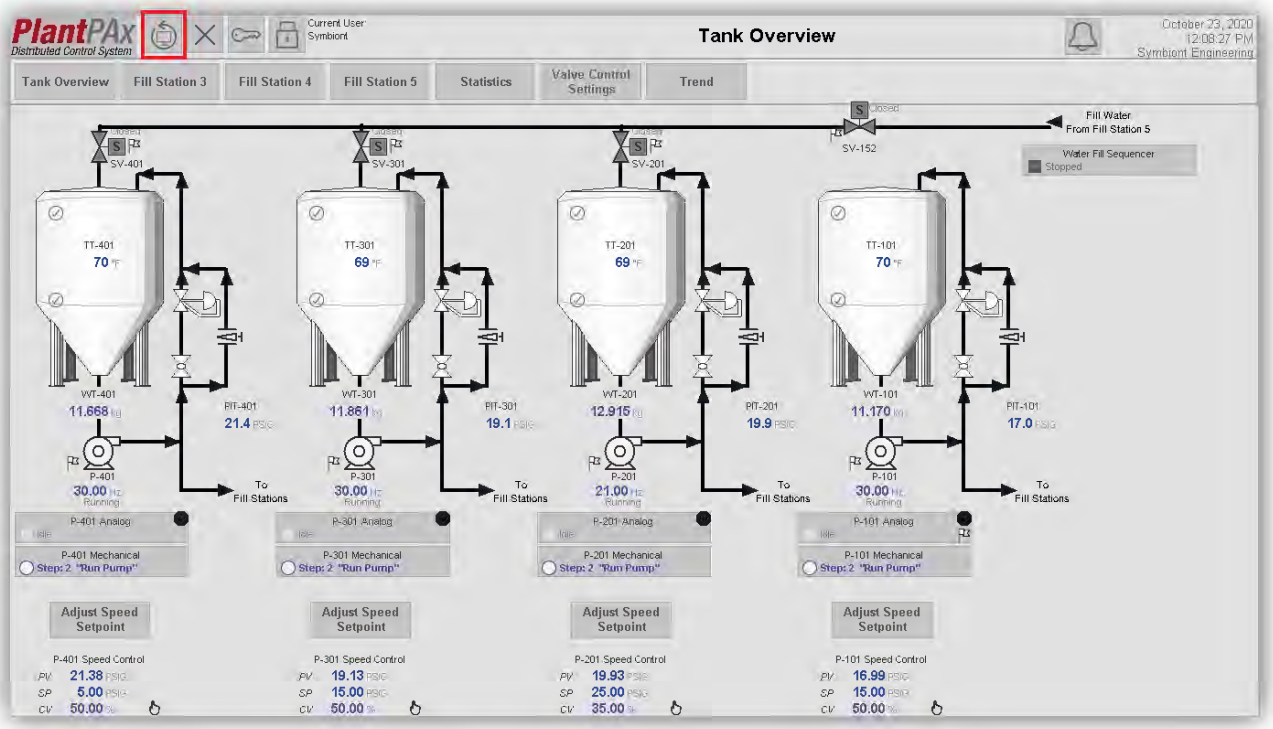
Alarm Summary



The Alarm Summary Screen will display the list of current alarms. Using the PlantPAx features, when devices are in an alarm state the associated navigation button and device symbol will also be highlighted to indicate a problem. Depending on the severity of the alarm these indicators will change color (yellow = warning, orange = alarm, red = severe alarm).

The figure previews the "Alarm Summary" screen from a PlantPAx HMI system. This interface is designed to display the current alarms from various devices within the system. It utilizes the PlantPAx features to not only list the alarms but also visually indicate the alarm state and severity by changing the color of navigation buttons and device symbols—yellow for warnings, orange for alarms, and red for severe alarms—allowing operators to quickly assess and respond to issues.

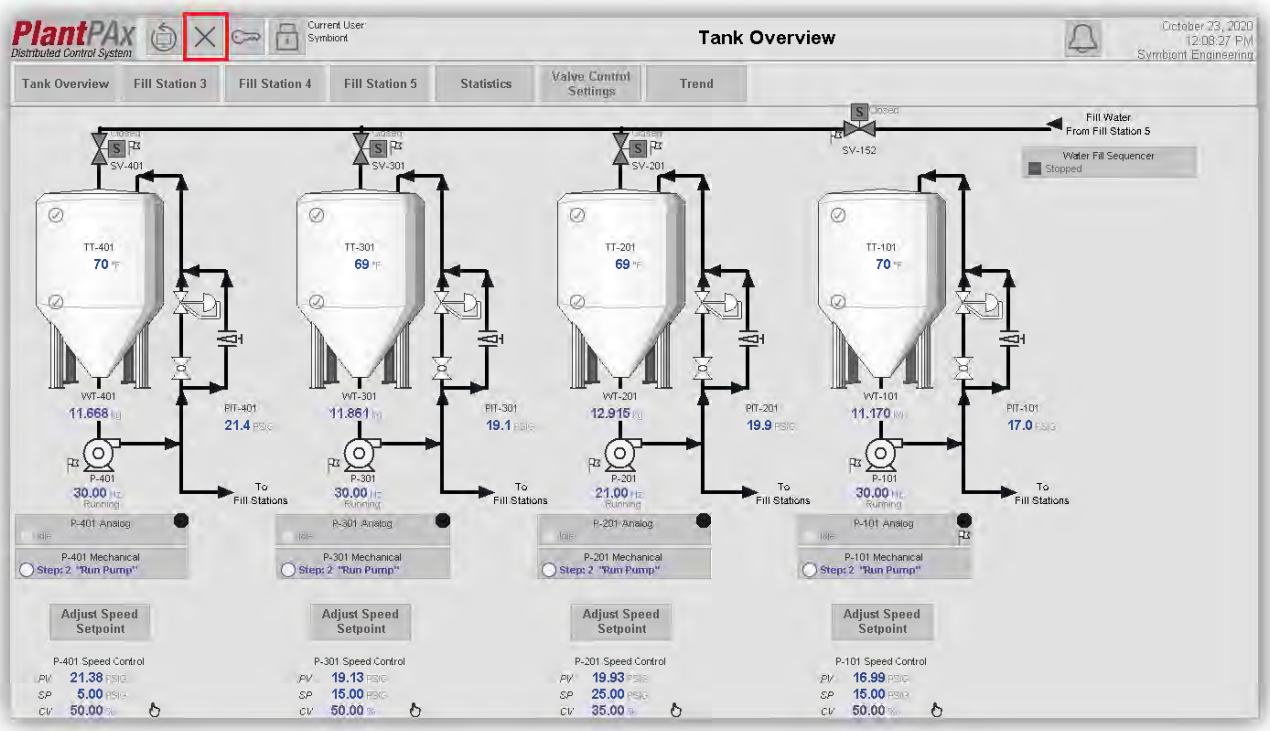
Refresh



The Repaint button will clear all open screen and reload the HMI to the Tank Overview Screen. This can be useful when making updates to the HMI. Instead of rebooting the HMI after an update, a simple repaint command will update the screens.

The figure shows a "Tank Overview" screen from the PlantPAx HMI system focusing on the "Refresh" feature. It highlights the Repaint button function, which clears all open screens and reloads the HMI to the Tank Overview Screen without needing a full system reboot. This feature is particularly useful for applying updates to the HMI system efficiently, as it allows for a simple screen refresh, updating the interface with any new changes or data with just a repaint command.

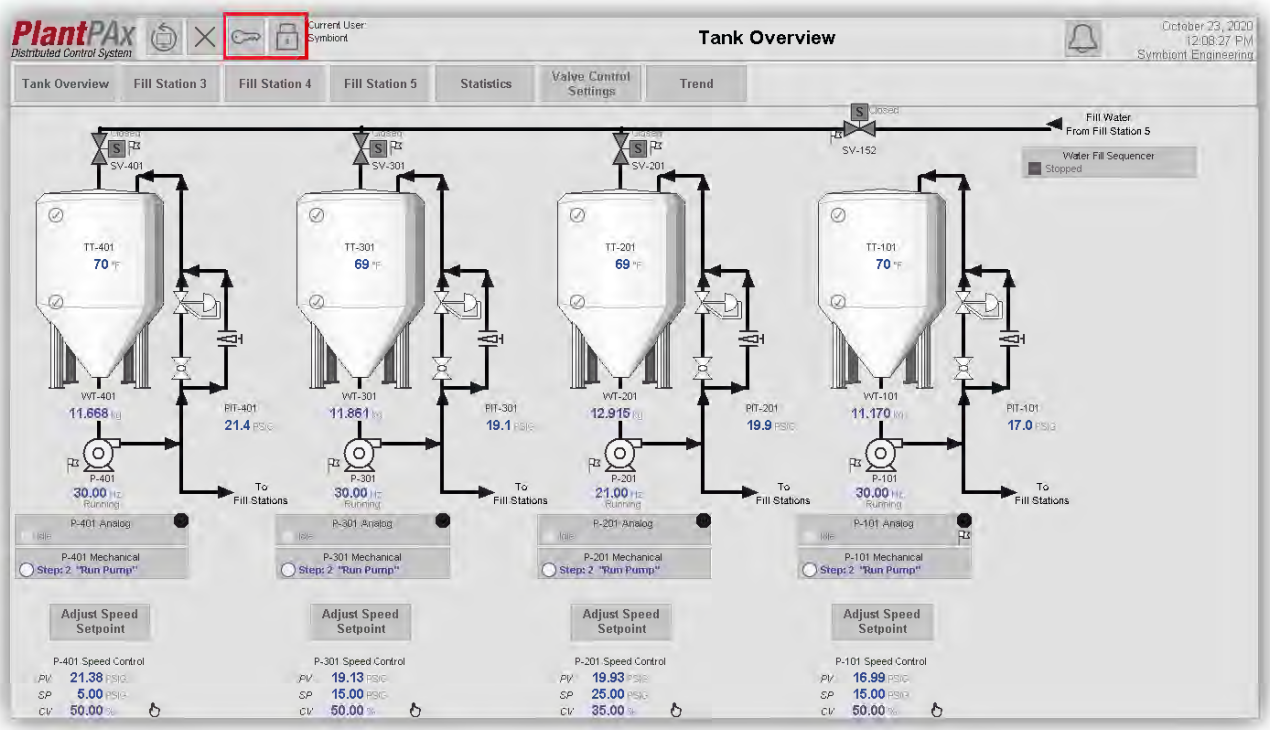
Close



The Close Button will shut down the HMI Client

The figure depicts the "Tank Overview" screen from a PlantPAx HMI system and highlights the "Close" button feature. The Close Button, indicated by a red 'X' at the top right of the screen, is designed to shut down the HMI Client when activated. This function is typically used to exit the application safely.

Login/Logout



The login/logout buttons allow users to change who is currently logged into the HMI. While logins can be setup to utilize the domain server, there can also be local logins.

The figure is a screenshot of the "Tank Overview" screen from a PlantPAx HMI system featuring login/logout functionality. This feature enables users to log in or out of the HMI, allowing for user access management. The system can be configured to authenticate users against a domain server or allow local logins, ensuring secure access to the HMI functions and maintaining user-specific settings and permissions.

Section 5.0
SAFETY

5.1 INTRODUCTION

Safety is accomplished by individual effort and group cooperation. Only informed people who respect themselves and have a high regard for the welfare of others can achieve a safe work environment.

A. Safety is Your Responsibility

It is your responsibility and obligation as the owner/user of this pH adjustment equipment to ensure that all persons who may come in contact with the equipment and chemicals are thoroughly trained and familiar with its operation, maintenance, and safety requirements. Only qualified persons should be allowed to come in contact with this equipment. Qualified persons are those knowledgeable in the operation, maintenance, and safety aspects of the equipment and chemicals used for this system.

B. Safety Precautions

All safety begins and ends with prudent, responsible personnel whose welfare is the primary concern. There is no greater safety practice than the care and common sense exercised by you.

The SAFETY section discusses the major safety aspects of the chemicals and equipment used in the system. This guide advises personnel of the major safety precautions required for safe start-up, operation, and maintenance of this system. However, no manual can cover every possible hazard. The ultimate responsibility for safety rests with you! Remember:

No work is so urgent or so important that you cannot take the time to do the job safely.

Think about what you are doing!

Safety is no joke! Be serious about safety!

This system may be potentially dangerous for those not familiar with the specific hazards involved in installing, operating and servicing this system.

Only qualified, knowledgeable people should be allowed to contact this system.

If you are going to work on or near this equipment, it is YOUR PERSONAL RESPONSIBILITY to learn as much as possible beforehand about the system and the dangers it may present. This is important for your safety and the safety of others working with you.

5.2 MAINTENANCE SAFETY

The following procedures should be followed whenever maintenance of any pump is required:

A. The HAND/OFF/AUTOMATIC (HOA) switch on the control panel servicing the device to be maintained should be turned to the **OFF** position.

B. The local disconnect for the equipment to be serviced should be shut off.

C. All pumps have been installed with isolating valves and/or unions to assist in their removal and maintenance. These valves should be closed before attempting to service a pump, and the material drained from the pump.

D. After all necessary maintenance has been performed, open all isolating valves. Place the pump back in service by turning the disconnect "ON" and the HOA switch on the control panel to the “AUTO” position.

5.3 PERSONAL PROTECTIVE EQUIPMENT

A. Whole body to protect, inside and outside

B. Equipment worn should vary with the exposure potential

1. Safety glasses and gloves

2. Safety glasses, goggles, gloves, rain gear, or impervious apron, boots

3. Respirator (air purifying or air supplied)

    a. Dust and mist (include asbestos and lead) instructions right on the box, check headbands, cup under chin, bottom band behind head and below ears, top band behind head above ears, adjust nosepiece, check fit for leaks around edges, readjust bands or nosepiece as required – no fit no entry – warnings on respirator limitations not for gases, fumes, vapors.
    b. Canister type of air purifying – organic vapors, spray painting, dusts, and mists. Instructions on fitting and limitations to be studied; check exhalation valve, canister seating, straps okay and properly adjusted. Test fit covering and properly adjusted. Test fit covering exhalation valve and blowing into unit, slight positive pressure inside with no leaks around edges – no fit no entry.

    c. A variety of canisters are available for different chemical exposures. Uses are listed on the side and they are color coded for easy identification.