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			Revision: 00
Client: City of Winnipeg	Project: Montcalm Wastewater Pumping Station	Package / Area:	

PREPARATION		Professional Seal Original Sealed By: C. J. Reimer SNC-Lavalin Inc. Member #21968 2012/02/24 Rev. 00
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00	Issued for Tender	2012-02-24	B. Cleven C. Reimer	C. Reimer	C. Reimer



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1.0 OVERVIEW

This document is intended to provide a description of the PLC functionality for the Marion Wastewater Pumping Station. It is written from a technical perspective, and is intended to be read along with the associated Process & Instrument Diagram (P&ID) drawings.


1.1 Associated Documents

The associated Process and Instrument Diagrams and Loop Diagrams are listed below.

Drawing Number	Rev	Description
1-0164L-P0001	00	P&ID, Wet Well
1-0164L-P0002	00	P&ID, Pumps P-L1 and P-L2
1-0164L-P0003	00	P&ID, Pumps P-L3 and P-L4
1-0164L-P0004	00	P&ID, Forcemains
1-0164L-P0005	00	P&ID, Ventilation – AHU-L1
1-0164L-P0006	00	P&ID, Ventilation – Electrical Room
1-0164L-P0007	00	P&ID, Miscellaneous

1.2 Definitions

PLC	Programmable Logic Controller
	For the purposes of this document, the SCADAPack RTU is considered to be a PLC.
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition

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2.0 OVERVIEW

The Montcalm Pumping Station pumps are configured as follows:

Pump	HP	Starter	Notes
P-L1	100	Soft Starter	Existing Pump and Motor
P-L2	100	VFD	New Pump and Motor
P-L3	100	VFD	New Pump and Motor
P-L4	100	Soft Starter	Existing Pump and Motor

The pump control will be based upon the wet well level. During normal, speed control operation, the control will be as follows. Assume that the system starts with all pumps off. Note that the VFD driven pumps will alternate and the soft start pumps will alternate, but that the VFD driven pumps will start prior to the soft start driven pumps.

2.1.1 One Pump Operation

When the wet well level exceeds the Duty 1 Start Setpoint, a VFD driven pump (P-L2 or P-L3) will start and ramp up to 40% speed, which approximately translates to 40% flow. If the level does not decrease, the pump speed will ramp up to try to bring the wet well level to the level control setpoint. If the level drops below the setpoint, the pump speed will drop to 40% speed. If the wet well level decreases below the Duty 1 Stop Setpoint, the pump will stop. It is expected that during night time dry weather flow that pump cycling, as described above, will occur.

Note: The 40% minimum speed is set to achieve a minimum forcemain velocity of 0.6 m/s (114 l/s).

2.1.2 Two Pump Operation


With the first pump in operation, the first pump will ramp up to meet the flow. If the first pump speed is equal to or exceeds 98% and the level is greater than the Duty 2 Start Setpoint, then the second pump will start. Typically the second pump will be the other VFD driven pump (P-L2 or P-L3). Both pumps will drop in speed to an initial 2-pump speed setpoint, and then ramp up as flows require. The controller will attempt to keep the wet well level at the level setpoint. If the level drops below the Duty 2 Stop setpoint or the pumps have been running below a set speed where it will be more efficient to pump with one pump, one of the two pumps in operation will stop.

2.1.3 Three Pump Operation

With two pumps in operation, the two pumps will ramp up to meet the required flow. If the pump speeds are equal to or exceed 98% and the level is greater than the Duty 3 Start Setpoint, then the third pump will start. Typically the third pump will be a soft start driven pump (P-L1 or P-L4). The VFD driven pump that pumps into the same forcemain as the soft start pump must be run at full speed to avoid "conflict" between the pumps. The VFD driven pump on the other forcemain will be varied in speed based upon the level. If the level drops below the Duty 3 stop setpoint, the 3rd duty pump (Typically the Soft Start Pump) will stop, allowing both VFD driven pumps to continue in a two pump operation mode.

2.1.4 Four Pump Operation

With three pumps in operation, the VFD driven pump on the forcemain without a second pump in operation will ramp up to meet the required flow. If the pump speeds are equal or exceed 98% and the level is greater than the Duty 4 Start Setpoint, then the fourth pump will start. Typically the fourth pump will be a soft start driven pump (P-L1 or P-L4). All pumps will be put into constant speed mode and run at 100%. If the level drops below the Duty 4

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stop setpoint, the non VFD-driven pump that has been running the longest will stop, allowing both VFD driven pumps and a soft starter pump to continue in a three pump operation mode.

2.1.5 Common Forcemain Operation

The operator will be allowed to select a mode of operation where the pumps pump into a common forcemain. In this mode of operation, if any pump is running in a constant speed mode, all pumps will run constant speed.

2.1.6 Backup Operation

Montcalm Pumping Station is equipped with a backup level control system to control pumps, in the event that the RTU is out of service. A Backup / RTU switch is located on the door of control panel CP-L1, to allow the operator to select the point of control. While in Backup Mode, a Precision Digital Meter will provide four outputs to turn on the pumps. The pump start sequence will be hardwired. In addition, in backup mode, a signal will be sent to the VFD driven pumps to run in a constant speed mode. The VFDs will still ramp up and down during start and stop sequences, but will run at 100% speed when running.

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3.0 GENERAL REQUIREMENTS

3.1 Human Machine Interface

3.1.1 Screen Layout

The typical screen layout for the HMI graphic terminal shall be as shown in Figure 1. Navigation buttons shall reside across the bottom, a single-line alarm banner across the top, and the remainder of the screen allocated for the graphic display area. The graphic display area will be utilized for mimic displays, configuration screens, trends, and an alarm summary.

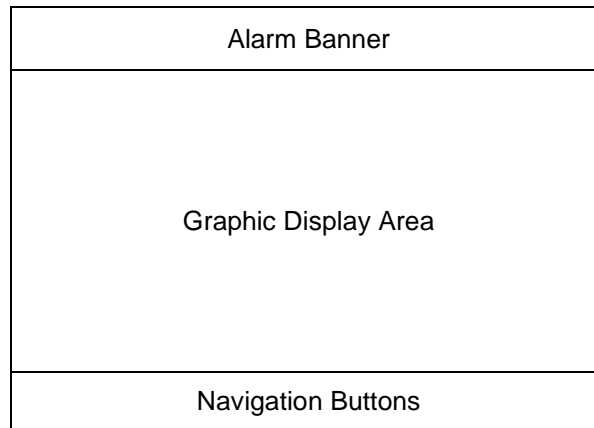






Figure 1: Screen Layout


3.1.2 Graphic Displays

A graphic (process mimic) display is a graphical representation of the process, showing pumps, instruments, and associated piping. Show sufficient detail from the P&IDs to allow operators a full understanding of the process. Metric units are to be used.

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3.2 HMI Animation Plan

Item	Condition	Color	Background	Display Notes
Background	-	Lt Gray	-	
Control Mode (PLC)	Auto	-	-	Invisible
	Manual	Yellow	-	"M" visible
Equipment Graphic	Stopped	Green	-	
	Running	Red	-	
	Alarm	Magenta	-	
Valve / Gate Position	Closed	Green	-	
	Open	Red	-	
Equipment Man / Off / Auto Switch	Manual	Yellow	Gray	
	Off	Yellow	Gray	
	Auto	White	Gray	
VFD / Bypass Mode	VFD	Black	Gray	Display "VFD Active"
	Bypass	Black	Yellow	Display "VFD Bypassed"
Starter Ready	Not Ready	Black	Yellow	Display "Starter Not Ready"
	Ready	Black	Gray	Display "Starter Ready"
Analog Measurement Values	-	Black	Gray	Text in a border, with units. Display adjacent to the location on the process display where the measurement is made.
Heater Auto/Manual Mode	Manual	Black	-	"Starter in Manual" visible
	Auto	Black	-	"Starter in Manual" invisible
Equipment ID Tag	-	Black	-	Bold Text, adjacent to equipment
Piping – Path Lines	-	Dk Gray	-	
Faceplates	-	-	Pale Blue	
Trend Background	-	White	-	
Trend Pen Lines	-	Separate Contrasting Color for Each Pen	-	
Pushbuttons	Enabled	Black Text	Lt Gray	Pushbuttons are to appear bevelled.
	Disabled	Dk Gray Text	Lt Gray	Utilize pushbuttons for a single purpose only. Do not change the text on a pushbutton.

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Note: For instruments / sensors mounted on equipment, display actual field inputs (after moving to internal PLC variables) on the HMI equipment graphic. Do not show alarms that come after a delay on the equipment graphic. The operator can look at the process graphic to see if the initiating cause of the alarm is still present or not.

3.2.1 RGB Colour Reference

Colour	RGB Ref
Lt Gray	192,192,192
Dk Gray	128,128,128
Gray	176,176,176
Magenta	255,0,255
Red	255,0,0
Yellow	255,255,0
Cyan	128,255,255
Pale Blue	192,224,255

3.2.2 Faceplates (Popup Windows)

Create popup faceplates for each major piece of equipment that has control capability. Display equipment faceplates upon a click of the associated equipment on the graphic display. Display the equipment identifier at the top of the faceplate. Display status information and provide for control as specified.

Where a piece of equipment has an alarm that requires a manual reset, include an alarm reset pushbutton at the bottom of the faceplate.

Provide a close button for the faceplate in the top right corner, with an "X" as the caption.


3.2.3 Trends

Incorporate pre-configured trend displays. Make trend displays accessible via a button(s) in the bottom right corner of the graphic display. Display a legend which relates the tag name and description to the pen colours.

Group trend screens by system.

3.2.4 Configuration Screen

A configuration screen shall be provided that allows operators to adjust process and alarm setpoints. The configuration screen shall be accessible from a button in the navigation button area and shall utilize a light grey background colour with black text.

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3.2.5 Alarms

New alarms are to be displayed in an alarm banner that resides across the top of the screen.

Create an Alarm Summary screen so that operators are able to view historical alarms. The Alarm Summary object is to have the *Alarm List* property set to *History*. The alarm banner need not be shown when the alarm summary is displayed provided that the alarm summary also displays current (active) alarms.

Use the scheme in Table 3-1 display of alarms as a function of their state:

State	Visible	Colour
Active	Yes	Red
ACK	Yes	Orange
RTN	No	N/A

Table 3-1: Alarm Summary Colours

3.2.6 PLC Control from HMI

Configure HMI commands to utilize a SET operation rather than the Momentary On operation. The PLC shall reset the bit. This prevents discrete PLC tags from being stuck on in the event of communication failures, timing issue, or control from multiple HMI nodes.

Enable and disable pushbuttons appropriately.

3.2.7 Security

Implement a logon / logoff security system. Allow for four levels of security: High (H), Medium (M), Low (L) and None (N)

When logged off, the security level will be None (N), however basic viewing of the HMI system will still be allowed.

Automatically logoff after 20 minutes of inactivity.

3.3 Equipment and System General Requirements


3.3.1 HMI Interface Points

Not all points between the HMI and PLC are necessarily specified or listed under the HMI-PLC interface lists. Note that in many cases the points listed as PLC I/O might also be part of the HMI-PLC interface. The requirement is based upon the HMI logging or display requirements.

3.3.2 HMI Interface Type Codes

R HMI Read
 RA HMI Read, Alarmed
 RW HMI Read/Write
 W HMI Write
 W1 HMI Write, PLC will immediately reset to 0

Multiple W1 variables may be assigned within a given word, as these bits will be immediately zeroed by the PLC, and thus should never experience issues with overwriting bits.

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3.3.3 HMI Display Type


HMI Display Type	Description
-	Do not show on the HMI
A	Alarm Banner
EF-G	Show as graphic on the faceplate, which will popup when the operator clicks on the specific piece of equipment
EF-L	Show as an indicator light on the equipment faceplate.
EF-T	Show as a text display on the faceplate
EF-TE	Show as a text entry on the faceplate
EF2-*	Show as a 2 nd tab on the faceplate.
EF3-*	Show as a 3 rd tab on the faceplate.
GD-A	Show as an animation on the graphic display.
GD-G	Show as a graphic on the graphic display.
GD-L	Show as an indicator light on the graphic display.
GD-T	Show as text on the graphic display.
SW-T	Show as text on a settings window.
T	Trend

Note:

1. For Vijeo Designer, implementation of a second/third tab on the equipment faceplate will require creation of a second popup window.

Example:

Tag	Type	Description	HMI Display Type		
			0 State	1 State	Display
L501-EL	DI	Starter Ready	Not Ready	Ready	GD-T
L501-HS-4	DI	Starter in Remote Mode	Local	Remote	GD-T
L501-YS	DI	Bypass Mode	VFD	Bypass	GD-T

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3.3.4 HMI Control Type

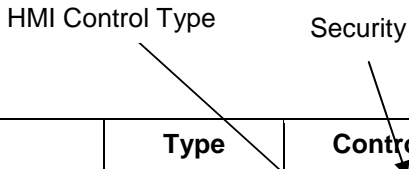
HMI Control Type	Description
-	Not Applicable
EF-PB	Show as a button on the equipment faceplate
EF-TE	Show as a text entry on the equipment faceplate
SW-CB	Show as a checkbox on the equipment settings window.
SW-TE	Show as a text entry on the equipment settings window.

3.3.5 Security

Security Type	Description
N	None
L	Low (Accessible to operator security level)
M	Medium (Accessible to senior operators only)
H	High (Accessible to maintenance only)


Example:

Tagname	Description	Type	Control
L501_CtrlManCmd	Set to Manual Control Mode	W1	EF-PB (L)
L501_CtrlAutoCmd	Set to Auto Control Mode	W1	EF-PB (L)

HMI Control Type Security


3.3.6 Alarm Priority

Pri	Description
1	High Priority
2	Medium Priority
3	Low Priority

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4.0 IMPLEMENTATION

4.1 Graphic Displays

Create a process graphic (process mimic) display containing a representation of the process shown on the process and instrumentation diagrams. Below are the anticipated grouping of process displays. The equipment grouping on the displays may potentially be reorganized if required, upon approval of the Contract Administrator.

4.1.1 Station Overview

Specific requirements include, but are not limited to:

- Display the wet well, all four pumps, and the two flowmeters. The pump details will not be as comprehensive as on the pump graphics.
- Animate the wet well level using vertical fill animation. Also display the level value in the center of wet well in relative and absolute (geodetic) units. Display the wet well level setpoint as an animated slider on the side of the wet well.
- In addition to equipment faceplates, provide access to the following controller faceplates:
 - Wet Well Level – L500
 - Pump Duty Level Controller – L5001-LC
 - Pump Selector – L5002-YC
 - Variable Speed Level Controller – L5003-LC
 - Variable Speed Minimum Flow Controller – L5004-FC
- Provide access to the Maintenance Screen.

4.1.2 Pump Graphic

Specific requirements include, but are not limited to:

- Display all four pumps with comprehensive pump details.
- In addition to equipment faceplates, provide access to the following controller faceplates:
 - Wet Well Level – L500
 - Pump Duty Level Controller – L5001-LC
 - Pump Selector – L5002-YC
 - Variable Speed Level Controller – L5003-LC
 - Variable Speed Minimum Flow Controller – L5004-FC


4.1.3 Forcemain Graphic

Specific requirements include, but are not limited to:

- Display all the four pump discharges into the forcemains.
- Display all manual valves on the forcemains.
- Display the flowmeters.

4.1.4 Ventilation

Create a graphic (process mimic) display containing a representation of the process shown on P&IDs 1-0164L-P0005 and 1-0164L-P0006. Specific requirements include, but are not limited to:

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- Occupancy Status
- Electrical Room Temperature
- Main Floor (Mechanical Room) Temperature
- AHU-L1
- Supply Air Temperature
- Recirculation Air Dampers
- Provide access to the following controller faceplates:
 - Mixed Air Dampers – L621-FV-1, L621-FV-2, L621-FV-3
 - Supply Air Temperature Controller L602-TT
 - AHU-L1 Air Handling Unit – L603
 - Mechanical Room Temperature Control L604-TC
 - SF-L2 Ventilation Fan – L605

4.1.5 Miscellaneous

Create a Graphic Display with the following:

- SP-L14 Discharge Chamber Sump Pump – L570
- Items from Section 5.22.

4.1.6 Control System Status


Create a Graphic Display with relevant items such as RTU health, connection to SCADA Status, I/O faults, RTU battery status, etc.

4.2 Trend Displays

4.2.1 Trends

Create, at minimum, the following trend displays, with the indicated pens.

- Wet Well Level Trend:
 - Pens:
 - L500-LI_Perc, Wet Well Level
 - L501-MM, Pump 1 Running Status
 - L502-ST, Pump 2 Speed Feedback
 - L503-ST, Pump 3 Speed Feedback
 - L504-MM, Pump 4 Running Status
 - Sample Rate: 10 seconds
 - Vertical Scale: 221 – 231 m on left / 0 – 100% on right
 - Horizontal Scale: 60 minutes

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- Discharge Flow Trend

Pens:
L501-MM, Pump 1 Running Status
L502-ST, Pump 2 Speed Feedback
L503-ST, Pump 3 Speed Feedback
L504-MM, Pump 4 Running Status
L552-FT, North Forcemain Flow Rate
L557-FT, South Forcemain Flow Rate
Sample Rate: 10 seconds
Vertical Scale: 0 – 1000 l/s
Horizontal Scale: 1 hour

- Pump Discharge Flow Trend - Day

Pens:
L552-FT, North Forcemain Flow Rate
L557-FT, South Forcemain Flow Rate
Sample Rate: 2 minutes
Vertical Scale: 0 – 1000 l/s
Horizontal Scale: 24 hours

- Ventilation Trend


Pens:
L601-FC, Damper Position Output
L602-TT, Supply Air Temperature
L603-TC, Discharge Temperature Setpoint
L606-TT, Mechanical Room Temperature
Sample Rate: 1 minute
Vertical Scale: 0 – 100
Horizontal Scale: 10 hours

- Building Temperature

Pens:
L604-TT, Mechanical Room Temperature
L613-TT, Electrical Room Temperature
Sample Rate: 2 minutes
Vertical Scale: 0 – 50
Horizontal Scale: 24 hours

- Damper Trend

Pens:
L621-FC, Damper Position Output
L621-FV-1, Outdoor Air Damper Position
L621-FV-2, Return Air Damper Position
L621-FV-3, Exhaust Air Damper Position
Sample Rate: 2 minutes
Vertical Scale: 0 – 100
Horizontal Scale: 24 hours

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4.2.2 Logging Settings

The following is applicable to Vijeo Touchscreen HMIs.

Create a new logfile each day, and keep logfiles for 14 days.


4.2.3 Equipment Control Faceplates

Create equipment control faceplates for all controllable pieces of equipment and controllers. Note that a sample faceplate for P-L1 is provided in Section 5.6.6. Base other faceplates on the example provided.

Each piece of equipment with manual control capability shall have a *Manual* and *Auto* pushbutton. A text display above the buttons will indicate the appropriate Manual or Auto mode that the equipment is currently in.

Disable all buttons that are not currently active or available. Examples:

- Disable the *Auto* button when in Auto mode.
- Disable the *Start* and *Stop* buttons when in Auto mode.
- Disable the *Manual Speed Entry* when in Auto mode.

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5.0 EQUIPMENT AND SYSTEM REQUIREMENTS

5.1 Wet Well Level – L500

Wet Well Level Indicator L500-LI provides a means for the user to manually simulate a specific level in the wet well. This feature is useful for testing, and could be utilized in some maintenance modes. While, in manual mode, an alarm will be set to ensure that the operators are aware of the situation. In addition, L500-LI provides level alarming.

L500-LSH is a future high level switch based upon a Flygt ball. All wiring and control for this switch will be implemented.

5.1.1 PLC I/O

Discrete:

Tag	Type	Description	0 State	1 State	Display
L500-LSH	DI	Wet Well High Level Switch	High Level	-	-

Analog:

Tag	Type	Description	Range	Display
L500-LT-A	AI	Wet Well Level A (Submersible)	0 – 6.00 m	EF-T
L500-LT-B	AI	Wet Well Level B (Bubbler)	0 – 6.00 m	EF-T


5.1.2 HMI-PLC Interface

Discrete Status Bits:

Tagname	Description	Type	Control
L500_CtrlMan	Control Mode in Manual	DR	EF-T

Discrete Control Bits:

Tagname	Description	Type	Control
L500_CtrlManCmd	Set to Manual Control Mode	W1	EF-PB (H)
L500_CtrlAutoCmd	Set to Auto Control Mode	W1	EF-PB (H)

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Analog Values:


Tagname	Description	Values	Type	Display
L500_LI	Wet Well Level (Utilized for Control)	221.000 – 227.000 m	R	GD-T
L500_LI_Perc	Wet Well Level (For Trending) (Same PLC value as L500_LI, just scaled to percent for the HMI)	0 – 100%	R	T
L500_LI_A	Wet Well Level A (Geodetic)	221.000 – 227.000 m	R	EF-T
L500_LI_B	Wet Well Level B (Geodetic)	221.000 – 227.000 m	R	EF-T

Analog Set Points:

Tagname	Description	Values	Type	Control
L500_AutoMode	Control Mode: 0 = Average, 1 = L500-LT-A, 2 = L500-LT-B	0 - 2	RW	EF-T EF-PB (M)
L500_LI_Man	Manual Level	221.000 – 227.000 m	RW	EF-TE (H)
L500_LAHH_SP	Level High-High Alarm Setpoint	221.000 – 227.000 m	RW	EF2-TE (M)
L500_LAH_SP	Level High Alarm Setpoint	221.000 – 227.000 m	RW	EF2-TE (M)
L500_LAL_SP	Level Low Alarm Setpoint	221.000 – 227.000 m	RW	EF2-TE (M)

5.1.3 Alarms

Tagname	Description	Logic	Pri	Reset
L500_CtrlMode	Wet Well Level Manual Control Mode	L500_CtrlMan	2	Auto
L500_Calibration	Wet Well Level Calibration Warning	L500_AutoMode == 0 AND ABS(L500_LT_A - L500_LT_B) > 0.2 m for > 15 sec	3	Auto
L500_ABError	Wet Well Level Transmitter Mismatch	L500_AutoMode == 0 AND ABS(L500_LT_A - L500_LT_B) > 0.4 m for > 15 sec	2	Auto
L500_LAF-A	L500-LT-A Wet Well Level Transmitter Failure - Submersible	L500-LIT-A < 4mA or > 20mA	2	Auto

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Tagname	Description	Logic	Pri	Reset
L500_LAF-B	L500-LT-B Wet Well Level Transmitter Failure – Bubbler	L500-LT-B < 4mA or > 20mA	2	Auto
L500_LAH	Wet Well Level High	L500_LI >= L500_LAH_SP for > 5 sec	2	Auto
L500_LAHH	Wet Well Level High-High	L500_LI >= L500_LAHH_SP OR NOT L500_LSH for > 5 sec	1	Auto
L500_LAL	Wet Well Level Low	L500_LI <= L500_LAL_SP for > 1 sec Reset when L500_LI > L500_LAL_SP for 10 sec	2	Auto

5.1.4 Control Narrative

When L500_CtrlManCmd is set, set L500_CtrlMan to 1 and utilize the value in L500_LI_Man as the current level and set the L500_CtrlMode alarm.


When L500_CtrlMan is not set, set L500_LI_Man = L500_LI to allow bump-less transfer when switching to Manual mode.

When L500_AutoMode is set to 0, move the average of L500_LI_A and L500_LI_B into L500_LI. When L500_AutoMode is set to 1, move L500_LI_A into L500_LI. When L500_AutoMode is set to 2, move L500_LI_B into L500_LI.

Upon L500_LAF_A and NOT L500_LAF_B set L500_AutoMode = 2 (L500-LT-B)

Upon (L500_LAF_B OR L524_PAL) and NOT L500_LAF_A set L500_AutoMode = 1 (L500-LT-A)

Do not automatically transition L500_AutoMode to 0 (Average) without operator intervention.

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5.2 Pump Duty Level Controller – L5001-LC

The pump duty level controller L5001-LC controls how many pumps are required to run, based upon wet well and the pump duty level start and stop setpoints.

5.2.1 HMI-PLC Interface

Discrete Status Bits:

Tagname	Description	Type	Display
L5001_D1_Run	Duty 1 Pump Called to Run	R	EF-L
L5001_D2_Run	Duty 2 Pump Called to Run	R	EF-L
L5001_D3_Run	Duty 3 Pump Called to Run	R	EF-L
L5001_D4_Run	Duty 4 Pump Called to Run	R	EF-L


Analog Set Points:

Tagname	Description	Values	Type	Control
L5001_Duty1_N_SP	Duty 1 Level Start Setpoint	221.000 – 227.000 m	RW	EF-TE (M)
L5001_Duty1_O_SP	Duty 1 Level Stop Setpoint		RW	EF-TE (M)
L5001_Duty2_N_SP	Duty 2 Level Start Setpoint		RW	EF-TE (M)
L5001_Duty2_O_SP	Duty 2 Level Stop Setpoint		RW	EF-TE (M)
L5001_Duty3_N_SP	Duty 3 Level Start Setpoint		RW	EF-TE (M)
L5001_Duty3_O_SP	Duty 3 Level Stop Setpoint		RW	EF-TE (M)
L5001_Duty4_N_SP	Duty 4 Level Start Setpoint		RW	EF-TE (M)
L5001_Duty4_O_SP	Duty 4 Level Stop Setpoint		RW	EF-TE (M)
L5001_StartIntDelay	Time Interval Between Successive Pump Starts	0 – 32767 sec	RW	EF-TE (M)

5.2.2 Control Narrative

Command the first, second, third, and 4th duty pump to start and stop based on the level setpoints. Ensure that the value is \geq or \leq the setpoint for 1 second before starting or stopping the corresponding pump.

Ensure that there is a minimum of L5001_StartIntDelay between two different pumps starting.

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5.3 Pump Selector – L5002-YC

The pump selector will determine which pumps, as the various pump duties are called to run by the Pump Duty Level Controller L5001-LC.

5.3.1 PLC I/O

None

5.3.2 HMI-PLC Interface

Discrete Status Bits:

Tagname	Description	Type	Display
L5002_Alternate	In Alternate Mode	R	EF-L
L5002_P1_Run	Pump 1 Called to Run	R	EF-L
L5002_P2_Run	Pump 2 Called to Run	R	EF-L
L5002_P3_Run	Pump 3 Called to Run	R	EF-L
L5002_P4_Run	Pump 4 Called to Run	R	EF-L

Discrete Control Bits:

Tagname	Description	Type	Control
L5002_AlternateOnCmd	Turn on Alternate Mode	W1	EF-PB (M)
L5002_AlternateOffCmd	Turn off Alternate Mode	W1	EF-PB (M)

Analog Setpoints:

Tagname	Description	Values	Type	Display
L5002_D1_Pump	Duty 1 Pump Number	0, 1, 2, 3, 4	RW	EF-TE (M)
L5002_D2_Pump	Duty 2 Pump Number	0, 1, 2, 3, 4	RW	EF-TE (M)
L5002_D3_Pump	Duty 3 Pump Number	0, 1, 2, 3, 4	RW	EF-TE (M)
L5002_D4_Pump	Duty 4 Pump Number	0, 1, 2, 3, 4	RW	EF-TE (M)


5.3.3 Alarms

None

5.3.4 Control Narrative

When L5002_Alternate is set, alternate the pumps as follows:

- The first and second pumps to start should be VFD driven pumps (P-L2 or P-L3).
- The third and fourth pumps to start should be soft-starter driven pumps (P-L1 or P-L4).

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- If two pumps are running (both VFD driven pumps) and one pump is called to stop then stop the pump that has been running the longest.
- If three pumps are running (two VFD driven pumps and one soft-starter driven pump) and a pump is called to stop then stop the soft-starter driven pump that has been running the longest.
- If four pumps are running and a pump is called to stop then stop the soft-starter driven pump that has been running the longest.
- Do not modify the pump duty assignments when pumps are started or stopped.
- If a pump is out of service, then start the next pump


When L5004_Alternate is not set, start the pumps by the Duty Pump assignments:

- When one pump is called to run, start the pump that is assigned Duty 1. If the Duty 1 pump is faulted, start the next available pump (e.g. Duty 2).
- When one pump is running and a second pump is called to run, start the pump that is assigned Duty 2. If the Duty 2 pump is out of service, start the next available pump (e.g. Duty 3)
- When two pumps are running and a third pump is called to run, start the pump that is assigned Duty 3. If the Duty 3 pump is out of service, start the next available pump (e.g. Duty 4).
- When three pumps are running and a fourth pump is called to run, start the pump that is assigned Duty 4.

Duty number assignments should never change without operator intervention. Do not change duty number assignments in the event of a pump fault.

Perform input checking on the duty number assignments to ensure that:

- No two duty number assignments are assigned the same pump.
- All four duty numbers are assigned a value between 0 and 4, inclusive.

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5.4 Variable Speed Level Controller – L5003-LC

The Variable Speed Level Controller L5003-LC utilizes a PID control loop to control the speed of the pumps that are powered from VFDs. Controlling the speed of the pumps facilitates control of the wet well level. The speed controller will utilize two different PID loops, tuned differently, depending on how many VFD driven pumps are operating.

5.4.1 PLC I/O

None

5.4.2 HMI-PLC Interface

Discrete Status Bits:

Tagname	Description	Type	Display
L5003_Cleanout	Wet Well in Cleanout State	R	EF-T
L5004_CtrlMan	Manual Control Mode	R	GD-T, EF-T
L5003_MinSpdMode	Running in Minimum Speed Mode	R	EF-T

Discrete Control Bits:


Tagname	Description	Type	Control
L5004_CtrlManCmd	Set to Manual Control Mode	W1	EF-PB (M)
L5004_CtrlAutoCmd	Set to Auto Control Mode	W1	EF-PB (M)

Analog Values:

Tagname	Description	Values	Type	Display
L5003_P2_CV	P-L2 Speed Output Signal	0 – 100%	R	EF-T
L5003_P3_CV	P-L3 Speed Output Signal	0 – 100%	R	EF-T

Analog Set Points:

Tagname	Description	Values	Type	Control
L5003_CO_Enbl	Daily Cleanout Enabled	0 (Off), 1 (On)	RW	EF-CB (M)
L5003_CO_Time	Daily Cleanout Time (Hour)	0 – 24	RW	EF-TE (M)
L5003_LC_SP	Level Control Setpoint	221.000 – 227.000 m	RW	EF2-TE (M)
L5003_CO_SP	Wet Well Cleanout Level Setpoint	221.000 – 227.000 m	RW	EF2-TE (M)
L5003_SC_2P_Init	Initial Speed for Transition to Two Pumps	0 – 100%	RW	EF2-TE (M)

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Tagname	Description	Values	Type	Control
L5003_SC_3P_Init	Initial Speed for Transition to Three Pumps	0 – 100%	RW	EF2-TE (M)
L5003_SC_2P_SP_L	Speed for Transition from Two Pumps to One Pump	0 – 100%	RW	EF2-TE (M)

5.4.3 Alarms

None

5.4.4 Control Narrative

The pump speed control shall be PID controlled based upon the level in the wet well. The PID tuning parameters will only be adjustable via modifications in the PLC program. Two PID control loops will be utilized, with separate tuning parameters. The first PID control loop will be utilized with one VFD driven pump active. The second PID control loop will be utilized with two VFD driven pumps active.

The first through fourth duty pumps will be started by the Pump Duty Level Controller L5001-LC.

The duty pumps will also be typically stopped by the Pump Duty Level Controller L5001-LC, however in the event that pumps P-L2 and P-L3 are both operating in variable speed mode, and the speed output is less than L5003_SC_2P_SP_L for five (5) minutes, a signal will be sent to Pump Duty Level Controller L5001-LC to stop the second duty pump. This will allow for a higher efficiency with only one instead of two pumps operating.

Upon starting of the first duty pump, set a speed equal to `_MinSpd` (See Logic below) and set the L5003_MinSpdMode status bit. Do not activate the PID controller while L5003_MinSpdMode is set. Deactivate L5003_MinSpdMode upon any of the following:

- The first duty pump stops
- The second duty pump is started
- The wet well level exceeds the L5001_Duty1_N_SP for 30 seconds.

Note: The purpose of the MinSpdMode is to minimize the number of pump cycles when in a low inflow condition, such as dry weather night-time flow. The VFD is kept at minimum speed, provided it is sufficient to draw down the wet well level.


Upon switching to two VFD driven pumps being active, utilize the second PID controller, which shall be forced to an initial output value of L5003_SC_2P_Init %. The output from the second PID will be used as the speed reference for both pumps in order to have them operate at the same speed.

In the event that two VFD driven pumps are active, and a third pump is brought online, it will be required to have at least one of the VFD driven pump that is on the common forcemain with the constant speed pump, to be run at 100% speed. In the event that the forcemain tie valve is open, all pumps would need to operate at 100% speed. If a pump can remain in a variable speed mode, the pump would be forced to an initial value of its minimum speed, and then activate PID control.

When decreasing the number of pumps, set the PID output controller to an initial output value of 100 %. Confirm and adjust this value during commissioning.

Do not allow the speed output to drop below `_MinSpd` (See Logic below).

The VFD shall be programmed with a maximum slew rate of 12 Hz / second, which translates into 20% / second. The PID maximum slew rate shall be less than this value.

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- Limit the controller minimum output to the pump minimum speed, until the pump startup sequence is complete.
- An cleanout function is incorporated to automatically clean out the wet well at periodic intervals, defined by L5003_CO_Time. When the current hour equals L5003_CO_Time, set L5003_Cleanout. When L5003_Cleanout is set, the PID is to use L5003_CO_SP as the setpoint variable. Once the level in the wet well is less than or equal to L5003_CO_SP then reset L5003_Cleanout. The process repeats again once the current hour reached L5003_CO_Time on the next day.

In the event that it is desired to not utilize variable speed control, this can be accomplished by simply putting the controller in Manual Mode, and setting the speed output to 100%.


Determine the minimum speed via logic similar to below.

_MinSpd // Minimum Speed - Set the minimum speed for the variable speed control

```

// P-L2 Running Case
IF L5002_P2_Run AND (NOT L5002_P3_Run OR NOT L503_SC_En) THEN
  IF L502_SC_En THEN
    _MinSpd = L5004_P2_Min
  ELSE
    _MinSpd = 100
// P-L2 and P-L3 Running Case
IF L5002_P2_Run AND L5002_P3_Run THEN
  IF L502_SC_En THEN
    IF L503_SC_En THEN
      MinSpd = MAX(L5004_P2_Min, L5004_P3_Min)
    ELSE
      _MinSpd = L5004_P2_Min
  ELSE
    _MinSpd = 100
// P-L3 Running Case
IF L5002_P3_Run AND (NOT L5002_P2_Run OR NOT L502_SC_En) THEN
  IF L503_SC_En THEN
    _MinSpd = L5004_P3_Min
  ELSE
    _MinSpd = 100

```


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5.5 Variable Speed Minimum Flow Controller – L5004-FC

The Variable Speed Minimum Flow Controller L5004-FC sets the minimum speed for the variable speed pumps, when in an automatic mode of operation. The primary motivation for utilization of this controller is to ensure that the forcemain velocity does not fall below the a minimum flowrate while pumping for a significant amount of time, as this could lead to forcemain plugging.

5.5.1 PLC I/O

None

5.5.2 HMI-PLC Interface

Discrete Status Bits:

Tagname	Description	Type	Display
L5004_CtrlMan	Manual Control Mode	R	GD-T, EF-T

Discrete Control Bits:

Tagname	Description	Type	Control
L5004_CtrlManCmd	Set to Manual Control Mode	W1	EF-PB (M)
L5004_CtrlAutoCmd	Set to Auto Control Mode	W1	EF-PB (M)

Analog Values:


Tagname	Description	Values	Type	Display
L5004_P2_S_Min	P-L2 Minimum Speed	0 – 100%	R	EF-T
L5004_P3_S_Min	P-L3 Minimum Speed	0 – 100%	R	EF-T

Analog Set Points:

Tagname	Description	Values	Type	Control
L5004_P2_AbsMin	P-L2 Absolute Minimum Speed	0 – 100%	RW	EF2-TE (H)
L5004_P3_AbsMin	P-L3 Absolute Minimum Speed	0 – 100%	RW	EF2-TE (H)
L5004_P2_ManMin	P-L2 Manual Minimum Speed	0 – 100%	RW	EF-TE (H)
L5004_P3_ManMin	P-L3 Manual Minimum Speed	0 – 100%	RW	EF-TE (H)


5.5.3 Alarms

None

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5.5.4 Control Narrative

- Perform range checking for each pump (i.e.)
 - IF L5004_P2_S_Min < L5004_P2_AbsMin L5004_P2_S_Min = L5004_P2_AbsMin
 - IF L5004_P2_S_Min > 100 L5004_P2_S_Min = 100
- Ensure transfer to and from Manual Control is bump-less
- If the pump is running at minimum speed, and the flow is less than the minimum flow rate, for 5 minutes, then increase the minimum speed by 1% and reset the timer.
- If the pump is running at minimum speed, and the flow rate is greater than the minimum flow rate by 5%, and the wet well level is less or equal to the 2nd Duty Pump Stop Setpoint for 5 minutes, then decrease the minimum speed by 1%. Note that the level check is included as the pumping efficiency will increase as the wet well level increases. It is not desired to decrease the minimum speed based upon a temporary high wet well level.
- Refer to the correct flowmeter based upon the forcemain valve configuration.

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5.6 P-L1 Wastewater Lift Pump – L501

P-L1 is a wastewater lift pump that is started using a soft starter or bypass starter.

5.6.1 PLC I/O

Discrete:

Tag	Type	Description	0 State	1 State	Display
L501-HS-4A	DI	Starter in Auto Mode	Not Auto	Auto	GD-A
L501-HS-4M	DI	Starter in Manual Mode	Not Manual	Manual	GD-A
L501-UL	DI	Starter Ready	Not Ready	Ready	GD-T
L501-HS-5	DI	Bypass Mode	Soft Start Mode	Bypass Mode	GD-T
L501-MM	DI	Pump Running	Off	Running	GD-G
L501-UA	DI	Soft Starter Fault	OK	Alarm	A
L501-IA	DI	Bypass Overload Alarm	OK	Alarm	A
L501-MN	DO	Run Command	Stop	Run	-

Analog:


Tag	Type	Description	Range	Display
L501-IT	AI	Current Feedback	0 – 150 A	EF-T

5.6.2 HMI - PLC Interface

The full HMI – PLC interface will include PLC I/O designated above.

Discrete Status Bits:

Tagname	Description	Type	Display
L501_Alarm	Alarm Present	R	GD-A
L501_CtrlMan	Manual Control Mode	R	GD-T, EF-T
L501_IntL_LL	Low Level Interlock (1 = Active)	R	EF2-T
L501_IntL_DischC	Forcemain Valve Interlock	R	EF2-T

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Discrete Control Bits:

Tagname	Description	Type	Control
L501_CtrlManCmd	Set to Manual Control Mode	W1	EF-PB (L)
L501_CtrlAutoCmd	Set to Auto Control Mode	W1	EF-PB (L)
L501_Reset	Reset	W1	EF-PB (L)
L501_ManualStart	Manual Start command	W1	EF-PB (L)
L501_ManualStop	Manual Stop command	W1	EF-PB (L)

Analog Values:


Tagname	Description	Range	Type	Display
L501_II	Motor Current (% Full Load Amps)	0 – 160 %FLA	R	GD-T EF2-T
		0 – 150 A	R	EF2-T
L501_KI	Pump Runtime <i>(Note 1)</i>	0 – (2 ³¹ - 1) min	R	EF2-T

Notes:

(1) *Display in units of "0.0" hours*

Analog Set Points:

Tagname	Description	Range	Type	Control
L501_FAL_SP	Flow Alarm Low Setpoint	0 – 32767 l/s	RW	EF3-TE (M)
L501_II_FLA	Motor Current Full Load Amps	0 – 3276.7 A	RW	EF3-TE (M)
L501_LL_SP	Low Level Stop Setpoint	0 – 327.67 m	RW	EF3-TE (H)
L501_SC_Man	Manual Speed Control Output	0 – 100%	RW	EF-TE (L)
L501_SC_Min	Minimum Speed Control Output	0 – 100%	RW	EF3-TE (H)

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5.6.3 PLC Generated Alarms

Tagname	Description	Logic	Pri	Reset
L501_IA	P-L1 Bypass Overload Alarm	L501-IA	1	HMI
L501_RunFault	P-L1 Run Fault	L527_EA AND L501-HS-4A AND ((L501-MN AND NOT L501-MM) for 2 seconds OR (NOT L501-MN AND L501-MM) for 8 sec)	1	HMI Or NOT L527_EA
L501_FAL	P-L1 Low Flow Alarm	L501_MM AND L521_FT < L501_FAL_SP AND NOT L521_FAF for > 60 sec	1	Auto
L501_UA	P-L1 Soft Start Fault	L501-UA	1	HMI

5.6.4 Interlocks

Initiating Event	Action	Control Mode		Description
		Auto	Manual	
NOT L501_UL	Stop	Y	Y	Starter Not Ready
L501_UA AND NOT L501-HS-5	Stop	Y	Y	Soft Start Fault
L501_IA	Stop	Y	Y	Bypass Overload Fault
L501_IntL_LL	Stop	Y	Y	Low Level Interlock
L501_IntL_DischC	Stop	Y	N	Forcemain Valve Interlock

5.6.5 Control Narrative

// Setup Interlocks

Set L501_IntL_LL = L500_LI <= L501_LL_SP

Set L501_IntL_DischC = NOT LN501_Open

.1 Starter Not in Auto (NOT L501-HS-4A) OR Backup Control (NOT L509-YL)

The PLC does not have control of the pump, so turn off the run output:

Set L501-MN = 0


All HMI control is disabled. The HMI continues to monitor the status and display alarms.

.2 Starter in Auto (L501-HS-4A) AND Manual Control Mode (L501_CtrlMan)

Utilize the Manual Start (L501_ManualStart) and Stop (L501_ManualStop) signals to start and stop the pump.

.3 Starter in Auto (L501-HS-4A) AND Auto Control Mode (L501_CtrlMan)

Utilize the signals from L5002-YC Pump Selector to start and stop the pump.

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5.6.6 Faceplate

An example faceplate is shown in Figure 2.

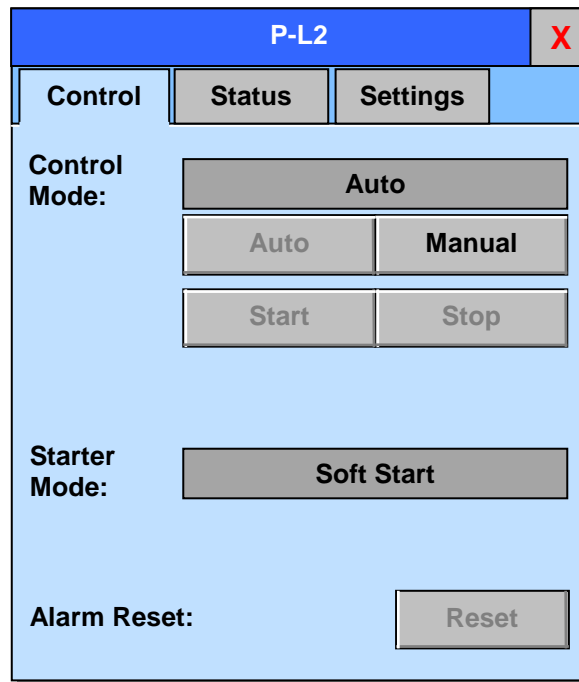



Figure 2: P-L1 Equipment Faceplate 1/3

Notes:

1. Clicking on the Pump on the Process Graphic will bring up the Equipment Faceplate 1/2.
2. Press the Status button to bring up the P-L1 Equipment Faceplate 2/3 (Not Shown).
3. Press the Settings button to bring up the P-L1 Equipment Faceplate 3/3 (Not Shown).

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5.7 P-L2 Wastewater Lift Pump – L502

P-L2 is a wastewater lift pump that is speed controlled from a VFD. A bypass starter is also provided to allow starting in the event of a VFD failure.

5.7.1 PLC I/O

Discrete:

Tag	Type	Description	0 State	1 State	Display
L502-HS-4A	DI	Starter in Auto Mode	Not Auto	Auto	GD-A
L502-HS-4M	DI	Starter in Manual Mode	Not Manual	Manual	GD-A
L502-UL	DI	Starter Ready	Not Ready	Ready	GD-T
L502-HS-5	DI	VFD Bypass Mode	VFD	Bypass	GD-T
L502-MM	DI	Pump Running	Off	Running	GD-A
L502-UA	DI	VFD Fault	OK	Alarm	A
L502-IA	DI	Bypass Overload Alarm	OK	Alarm	A
L502-MN	DO	Run Command	Stop	Run	-

Analog:


Tag	Type	Description	Range	Display
L502-SC	AO	Speed Command	0 – 100 %	
L502-ST	AI	Speed Feedback	0 – 100 %	
L502-IT	AI	Current Feedback	0 – 150 A	

5.7.2 HMI - PLC Interface

The full HMI – PLC interface will include PLC I/O designated above.

Discrete Status Bits:

Tagname	Description	Type	Display
L502_Alarm	Alarm Present	R	GD-A
L502_CtrlMan	Manual Control Mode	R	GD-T, EF-T
L502_IntL_LL	Low Level Interlock (1 = Active)	R	EF2-T
L502_IntL_DischC	Forcemain Valve Interlock	R	EF2-T

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Tagname	Description	Type	Display
L502_SC_En	Auto Speed Control Enabled	R	EF2-T

Discrete Control Bits:

Tagname	Description	Type	Control
L502_CtrlManCmd	Set to Manual Control Mode	W1	EF-PB (L)
L502_CtrlAutoCmd	Set to Auto Control Mode	W1	EF-PB (L)
L502_Reset	Reset	W1	EF-PB (L)
L502_ManualStart	Manual Start command	W1	EF-PB (L)
L502_ManualStop	Manual Stop command	W1	EF-PB (L)

Analog Values:


Tagname	Description	Range	Type	Display
L502_II	Motor Current (% Full Load Amps)	0 – 150 %FLA	R	GD-T EF2-T
		0 – 150 A		EF2-T
L502_KI	Pump Runtime <i>(Note 1)</i>	0 – (2 ³¹ - 1) min	R	EF2-T
L502_SI	Pump Speed <i>(Note 2)</i>	0 – 100%	R	GD-T, EF2-T, T

Notes:

- (1) *Display in units of “0.0” hours*
- (2) *Set L502_SI = L502_ST when in VFD mode and L502_SI = 0 or 100%, based upon pump run signal, when in Bypass mode.*

Analog Set Points:

Tagname	Description	Range	Type	Control
L502_FAL_SP	Flow Alarm Low Setpoint	0 – 32767 l/s	RW	EF3-TE (M)
L502_II_FLA	Motor Current Full Load Amps	0 – 3276.7 A	RW	EF3-TE (M)
L502_LL_SP	Low Level Stop Setpoint	221.000 – 227.000 m	RW	EF3-TE (H)
L502_SC_Man	Manual Speed Control Output	0 – 100%	RW	EF-TE (L)
L502_SC_Min	Minimum Speed Control Output (Default: 25%)	0 – 100%	RW	EF3-TE (H)

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5.7.3 PLC Generated Alarms

Tagname	Description	Logic	Mask	Pri	Reset
L502_IA	P-L1 Bypass Overload Alarm	L501-IA	N/A	1	HMI
L502_RunFault	P-L1 Run Fault	L527_EA AND L501-HS-4A AND ((L501-MN AND NOT L501-MM) for 2 seconds OR (NOT L501-MN AND L501-MM) for 8 sec)	N/A	1	HMI Or NOT L527_EA
L502_FAL	P-L1 Low Flow Alarm	L501_MM AND L521_FT < L501_FAL_SP AND NOT L521_FAF for > 60 sec	N/A	1	Auto
L502_UA	P-L1 VFD Fault	L501-UA	N/A	1	HMI

5.7.4 Interlocks

Initiating Event	Action	Control Mode		Description
		Auto	Manual	
NOT L502_UL	Stop	Y	Y	Starter Not Ready
L502_UA AND NOT L502-HS-5	Stop	Y	Y	VFD Fault
L502_IA AND L502-HS-5	Stop	Y	Y	Bypass Overload Fault
L502_IntL_LL	Stop	Y	Y	Low Level Interlock
L502_IntL_DischC	Stop	Y	N	Forcemain Valve Interlock

5.7.5 Control Narrative

If L502_SC_Man < L502_SC_Min THEN SET L502_SC_Man = L502_SC_Min

Set L502_IntL_LL = L500_LI <= L502_LL_SP

Set L502_IntL_DischC = NOT LN501_Open


.1 Starter in Manual (NOT L502-HS-4) OR Backup Control (NOT L509-YL)

The PLC does not have control of the pump, so turn off the run and speed outputs:

Set L502-SC = 0

Set L502-MN = 0

All HMI control is disabled. The HMI continues to monitor the status and display alarms.

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.2 Starter in Auto (L502-HS-4) AND Manual Control Mode (L502_CtrlMan)

Utilize the Manual Start (L502_ManualStart) and Stop (L502_ManualStop) signals to start and stop the pump.

```

IF VFD Mode (NOT L502-HS-5)
Set L502-SC = L502_SC_Man when the pump is commanded to start;
ELSE // Bypass Mode
Set L502-SC = 0;

```

Ensure that the manual speed setpoint (L502_SC_Man) is set to the actual speed when in Auto, so that upon the transition to manual control, the transition is bump-less.

.3 Starter in Auto (L501-HS-4) AND Auto Control Mode (L501_CtrlMan)

Utilize the signals from L5002-YC Pump Selector Variable Speed Level Controller – L5003-LC to start and stop the pump and set the pump speed.

```

Set L502-SC = L5003_CV (After start-up sequence)
Set L502-MN = L5002_P1_Run

```

Upon startup, the PLC will set the speed to L502_SC_Min for 1.5 seconds. During this time, the VFD will ramp up the pump at the VFD programmed maximum slew rate of 20% / second. After the 3 seconds ramp up the speed to L502_SC_Min at a rate of 0.9 Hz / sec (1.5 % / sec). After the speed is at the minimum speed, set a flag to allow control from the L5003_CV controller.

Upon shutdown, ramp down the pump speed to L502_SC_Min at a rate of 10% / second. After this, set the speed output to 0 and turn off the run command.


.4 Set L502_SC_En

Set L502_SC_En to determine in Auto mode if the pump can be operated in a variable speed mode.

```

IF L501_MM THEN // P-L1 is running
L502_SC_En = FALSE
ELSE
IF LN550_ZLC THEN // Tie Valve Closed - Normal Forcemain Configuration
IF L502-HS-5 THEN // Bypass Mode
L502_SC_En = FALSE
ELSE
L502_SC_En = TRUE
ELSE // Tie Valve OPEN
IF L504_MM THEN // P-L4 is running
L502_SC_En = FALSE
ELSE
IF L503_MM THEN // P-L3 is running
IF L503-HS-5 THEN // Bypass Mode
L502_SC_En = FALSE
ELSE
L502_SC_En = TRUE
ELSE
L50 L502_SC_En = TRUE

```

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5.7.6 Faceplates

An example control faceplate is shown in Figure 3.

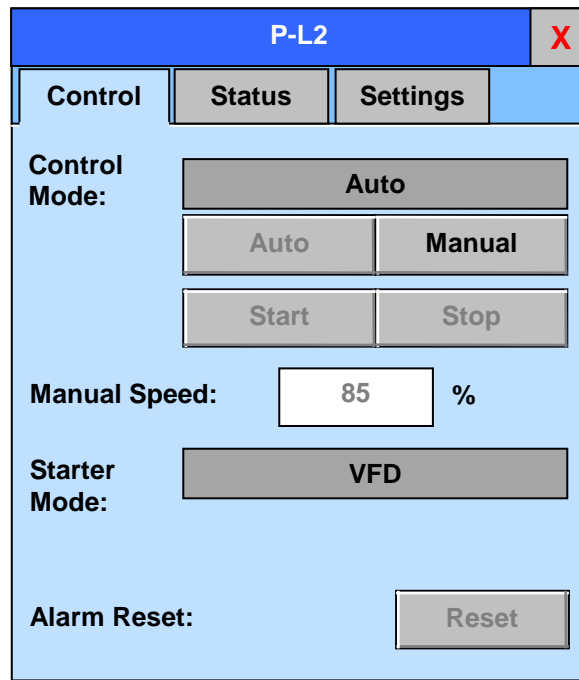



Figure 3: P-L2 Equipment Faceplate 1/3

Notes:

1. Clicking on the Pump on the Process Graphic will bring up the Equipment Faceplate 1/2.
2. Press the Status button to bring up the P-L2 Equipment Faceplate 2/3.
3. Press the Settings button to bring up the P-L2 Equipment Faceplate 3/3.

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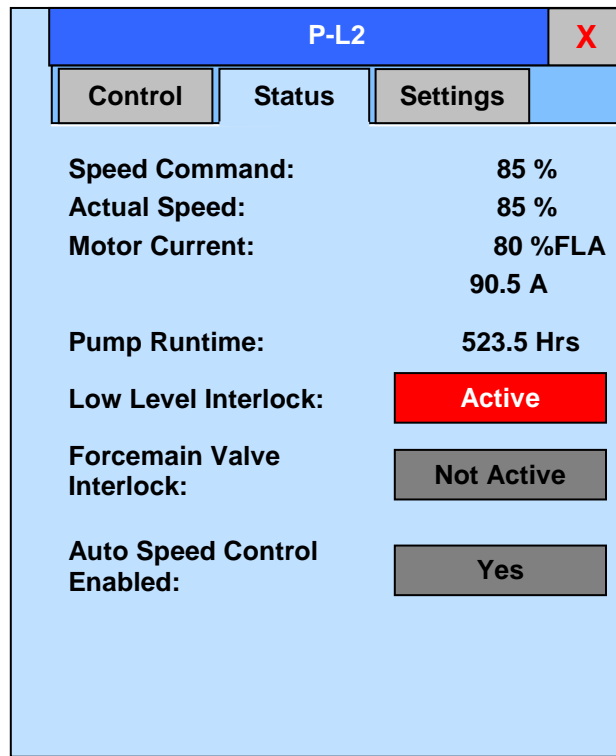


Figure 4: P-L2 Equipment Faceplate 2/3

Notes:


1. Press the Control button to bring up the P-L2 Equipment Faceplate 1/3.
2. Press the Settings button to bring up the P-L2 Equipment Faceplate 3/3.
3. The Low Level Interlock indicator will be Gray with black text when in the "Not Active" state.

5.8 P-L3 Wastewater Lift Pump – L503

Pump P-L3 is identical to P-L2. Utilize the P-L2 requirements as the basis for P-L3.

5.9 P-L4 Wastewater Lift Pump – L504

Pump P-L4 is identical to P-L1. Utilize the P-L1 requirements as the basis for P-L4.

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5.10 Backup Level Control – L509-LC

The City of Winnipeg has requested that backup level control be provided in the event the RTU is not in service. This backup control will be based upon a Precision Digital Process Meter, with four relay outputs based upon level setpoints. The selection for whether the RTU or Backup Level Controller has control of the pumps will be based upon the following:

- In the event of a RTU failure, the control will automatically transition from RTU to Backup Control. The control will not transition back to RTU automatically, but rather will require operator intervention.
- The operator may switch from RTU to Backup control by pressing a local *Backup Control* button.
- The operator may switch from Backup to RTU control by pressing a local *RTU Control* button.

5.10.1 PLC I/O

Discrete:

Tag	Type	Description	0 State	1 State	Display
L509-YL	DI	RTU Control Mode	Backup Control Mode	RTU Control Mode	GD-T
L509-YN	DO	RTU Status OK	Fail	OK	-

Analog:

None

5.10.2 HMI - PLC Interface

The full HMI – PLC interface will include PLC I/O designated above.

5.10.3 PLC Generated Alarms


None

5.10.4 Interlocks

None

5.10.5 Control Narrative

Set L509-YC to 1 whenever the RTU is running and in normal health. Set to 0 if the RTU fails.

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5.11 Forcemain Manual Valves

The full size valves on the forcemain are manual, and do not have any position indication. However, the position of these valves must be known, to allow the variable speed pump control logic to operate correctly. Thus, the position of these valves will be simulated, based upon operator entry.

5.11.1 PLC I/O

None

5.11.2 HMI - PLC Interface

Discrete Status Bits:

Tagname	Description	Type	Display
L550_ZLC	MV-L50 Forcemain Tie Valve Closed	R	GD-G
L551_ZLC	MV-L51 North Forcemain Pump Room Valve Closed	R	GD-G
L553_ZLC	MV-L53 North Forcemain Flowmeter Chamber Valve Closed	R	GD-G
L556_ZLC	MV-L56 South Forcemain Pump Room Valve Closed	R	GD-G
L558_ZLC	MV-L58 South Forcemain Flowmeter Chamber Valve Closed	R	GD-G

Discrete Control Bits:


Tagname	Description	Type	Control
L550_ManualOpen	Manual Open command	W1	EF-PB (L)
L550_ManualClose	Manual Close command	W1	EF-PB (L)
L551_ManualOpen	Manual Open command	W1	EF-PB (L)
L551_ManualClose	Manual Close command	W1	EF-PB (L)
L553_ManualOpen	Manual Open command	W1	EF-PB (L)
L553_ManualClose	Manual Close command	W1	EF-PB (L)
L556_ManualOpen	Manual Open command	W1	EF-PB (L)
L556_ManualClose	Manual Close command	W1	EF-PB (L)
L558_ManualOpen	Manual Open command	W1	EF-PB (L)
L558_ManualClose	Manual Close command	W1	EF-PB (L)

5.11.3 PLC Generated Alarms

None

5.11.4 Interlocks

None

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5.11.5 Control Narrative

// Check if North Forcemain is Open

LN551_Open = NOT L551_ZLC AND NOT L553_ZLC

// Check if South Forcemain is Open

LN556_Open = NOT L556_ZLC AND NOT L558_ZLC

// Check if P-L1 and P-L2 Discharge Header is Open

LN501_Open = LN551_Open OR (NOT L550_ZLC AND LN556_Open)

// Check if P-L3 and P-L4 Discharge Header is Open

LN503_Open = LN556_Open OR (NOT L550_ZLC AND LN551_Open)

5.11.6 Faceplate

Provide a separate faceplate for each valve. An example faceplate is shown in Figure 3.

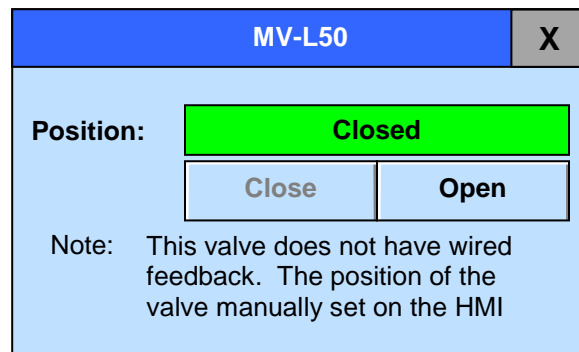



Figure 5: Manual Valve Equipment Faceplate

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5.12 Flow Meter – L552-FT

Flow meter L552-FT measures the north forcemain flow, which usually received flow from pumps P-L1 and P-L2.

5.12.1 PLC I/O

Discrete:

Tag	Type	Description	0 State	1 State	Display
L552-FQ	DI	Flow Meter Pulse Input	-	Pulse 1000 I	

Analog:

Tag	Type	Description	Range	Display
L552-FT	AI	Pump Discharge Flow Meter	0 – 1000 l/s	GD-T, T

5.12.2 HMI-PLC Interface


Discrete Control Bits:

Tagname	Description	Type	Control
L552_Reset	Reset Totalizer	W1	EF-PB (L)

Analog Values:

Tagname	Description	Range	Type	Display
L552_FQ	Total Flow	0 – (2 ³¹ - 1) m ³	R	EF-T
L552_FQ_HourC	Total Flow – Current Hour	0 – (2 ³¹ - 1) m ³	R	EF-T
L552_FQ_HourP	Total Flow – Previous Hour	0 – (2 ³¹ - 1) m ³	R	EF-T
L552_FQ_DayC	Total Flow – Current Day	0 – (2 ³¹ - 1) m ³	R	EF-T
L552_FQ_DayP	Total Flow – Previous Day	0 – (2 ³¹ - 1) m ³	R	EF-T
L552_FT_Min	Minimum Design Flow	Constant 114 l/s	R	EF-T

Note: 114 l/s corresponds to 0.6 m/s minimum velocity in the forcemain.

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5.12.3 Alarms

Tagname	Description	Logic	Pri	Reset
L552_FAF	North Forcemain Flow Meter Failure	L544_ESL AND L552-FIT < 4mA or > 20mA for 5 seconds	2	Auto
L552-FAL	North Forcemain Low Flow	NOT L552_FAF AND L552-FIT < L552_FT_Min AND LN551_Open AND (L501_MM OR L502_MM OR NOT L550_ZLC AND (L503_MM OR L504_MM) For 60 sec	3	Auto

5.12.4 Control Narrative

Compute three flow totals from the pulse input:

- 1) Total Flow
- 2) Current hour flow total
- 3) Current day flow total


Move the Current Hour and Current Day values to the Previous Hour and Previous Day values at the end of each hour and day respectively.

Reset the Total Flow (L552_FQ) upon the operator pressing the Reset Totalizer button on the equipment faceplate. Do not reset the Hourly and Daily total values.

5.13 Flow Meter – L557-FT

Flow meter L557-FT measures the south forcemain flow, which usually received flow from pumps P-L3 and P-L4.

Use the L552-FT requirements as a basis for L557-FT. Modify the L552-FAL logic as required.

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5.14 SP-L14 Discharge Chamber Sump Pump – L570

SP-L14 is the flowmeter chamber sump pump. It is controlled via a separate control panel.

5.14.1 PLC I/O

Discrete:

Tag	Type	Description	0 State	1 State	Display
L570-HS-1	DI	Starter in Auto	Not Auto	Auto	GD-A
L570-UL	DI	Starter Ready	Not Ready	Ready	GD-T
L570-MM	DI	Running	Stopped	Running	GD-A
L570-IA	DI	Starter Overload	-	Alarm	A

5.14.2 HMI - PLC Interface


The full HMI – PLC interface will include PLC I/O designated above.

Discrete Status Bits:

Tagname	Description	Type	Display
L570_Alarm	Alarm Present	R	GD-A

5.14.3 Alarms

None, other than L570-IA

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5.15 Ventilation System – Occupied State – L600

The occupied state is utilized to indicate to the ventilation controls whether the station is occupied. When occupied, the fresh air ratio is increased to 100% to meet safety requirements as per NFPA 820. The occupied state is determined from the station light switch, when the L600-YL switch on the control panel is in the *Auto* position. The L600-YL switch can also be utilized to force an *Unoccupied* or *Occupied* state.


5.15.1 PLC I/O

Discrete:

Tag	Type	Description	0 State	1 State	Display
L600-YL	DI	Occupied State	Unoccupied	Occupied	GD-T

5.15.2 PLC Generated Alarms

Tagname	Description	Logic	Mask	Pri	Reset
L600_KA	Occupied Over 8 hours	L600-YL > 8 hours	N/A	3	Auto

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5.16 Mixed Air Dampers – L621-FV-1, L621-FV-2, L621-FV-3

Dampers L621-FV-1, L621-FV-2, and L621-FV-3 are utilized to control the mixed air ratio to the air handling unit AHU-L1. The dampers allow for a fresh air ratio of between 25 – 100%, to meet temperature requirements. When the station is occupied, the fresh air ratio is increased to 100%, to meet safety requirements as per NFPA 820. When unoccupied, the dampers may modulate to provide cooling as required, with a minimum fresh air ratio of 25%. The damper position correlating to 25% fresh air flow should be tested at commissioning, and entered as a setting.

5.16.1 PLC I/O

Discrete:

None

Analog:

Tag	Type	Description	Range	Display
L601-FC	AO	Outdoor Air Ratio Control (See Note 1)	0 – 100%	EF-T, T
L601-ZT-1	AI	Intake Air Damper Position Feedback	0 – 100% Open	GD-T
L601-ZT-2	AI	Return Air Damper Position Feedback	0 – 100% Open	GD-T
L601-ZT-3	AI	Exhaust Air Position Feedback	0 – 100% Open	GD-T

Notes:

1. An output of 0% for L601-FC will close the intake and exhaust dampers, and open the return air damper.


5.16.2 HMI - PLC Interface

Discrete Status Bits:

Tagname	Description	Type	Display
L601_CtrlMan	Control Mode Manual	RW	GD-T / EF

Discrete Control Bits:

Tagname	Description	Type	Control
L601_CtrlAutoCmd	Set to Auto Control Mode	W1	EF-PB (L)
L601_CtrlManCmd	Set to Manual Control Mode	W1	EF-PB (L)

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Analog Set Points:

Tagname	Description	Range	Type	Control
L601_FC_Manual	Manual Mode Output	0 – 100 %	RW	EF-TE (L)
L601_FC_Min	Min Operating Damper Position Default: 25% (Determine value during commissioning – should correspond to 25% Fresh Air, 75% Recirc)	0 – 100 %	RW	EF2-TE (H)

5.16.3 PLC Generated Alarms


Tagname	Desc.	Logic	Pri	Reset
L601_FV_1_Alarm	AHU-L1 Intake Air Damper Position Alarm	ABS(L601_FC - L601_ZT_01) > 10% for > 150 seconds (Note 1)	3	Auto
L601_FV_2_Alarm	AHU-L1 Return Air Damper Position Alarm	ABS(L601_FC - (100% - L601_ZT_02)) > 10% for > 150 seconds (Note 1)	3	Auto
L601_FV_3_Alarm	AHU-L1 Exhaust Air Damper Position Alarm	ABS(L601_FC - L601_ZT_03) > 10% for > 150 seconds (Note 1)	3	Auto

Notes:

(1) Position command and position feedback are in units of percent (%).

5.16.4 Interlocks

Initiating Event	Action	Control Mode		Description
		Auto	Manual	
NOT L603_MM	Set L601_FC = 0 %	Y	N	Close Intake and Exhaust Dampers when AHU-L1 Supply Fan is stopped
L600_YL	Set L601_FC = 100 %	Y	N	Open fresh air damper fully (0% recirc) when the occupied switch is in the occupied position.
NOT L600_YL AND L603_BN AND L603_TC > 0	Set L601_FC = L601_FC_Min	Y	N	Ensure dampers are closed to the 25% fresh air / 75% recirc air position when the station is not occupied and the heater is operating.
L602_TAL	Set L601_FC = L601_FC_Min	Y	N	Close intake and exhaust dampers to the minimum position when there is a low supply temperature alarm.
L602_TALL OR L603_TAL	Set L601_FC = 0 %	Y	N	Close Intake and Exhaust Dampers when there is a room low-low temperature alarm to prevent freezing.

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Initiating Event	Action	Control Mode		Description
NOT L603_HS_1A	Set L601_FC = 0 %	Y	Y	Close the dampers / turn off the output when AHU-L1 is not in Auto.

5.16.5 Control Narrative


Utilize PID control to control the damper output:

PV: L602-TT
 SP: Based on L604_TC
 CV: L601-FC (Direct Acting)

CV_Limits: Low: L601_FC_Min (Note: Interlocks may override this minimum)
 High: 100%

The setpoint of the mixed air dampers' PID controller is based on the output of the room temperature controller L626-TC. As the room temperature warms up the mixed air damper PID controller will open the outdoor air dampers to provide cooling.

Ensure bump-less transfer is provided between manual and automatic modes, and occupied / unoccupied modes.

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5.17 Supply Air Temperature Controller L602-TT

A supply air temperature transmitter is installed on the discharge of Air Handling Unit AHU-L1 to provide alarming and control of the station ventilation. The temperature transmitter is utilized to control the air handler and mixed air dampers.

5.17.1 PLC I/O

Discrete:

None

Analog:

Tag	Type	Description	Range	Display
L602-TT	AI	Supply Air Temperature	-40 – 60 °C	GD-T, T

5.17.2 PLC Generated Alarms


Tagname	Description	Logic	Pri	Reset
L602_TAF	AHU-L1 Supply Air Temperature Transmitter Failure	L602_TT < 4mA or > 20mA	2	Auto
L602_TAHH	AHU-L1 Supply Air Temperature High-High	NOT L602_TAF AND L602_TT => 50°C for > 10 sec	2	Auto
L602_TALL	AHU-L1 Supply Air Temperature Low-Low	NOT L602_TAF AND L602_TT <= 0°C for > 10 sec	2	Auto

5.17.3 Interlocks

N/A

5.17.4 Control Narrative

N/A

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5.18 AHU-L1 Air Handling Unit – L603

Air Handling Unit AHU-L1 is equipped with an indirect fired natural gas burner and supply fan that will be used to provide heating and ventilation of the wastewater pumping station. The fan is controlled by a Man/Off/Auto switch in the Ventilation Control Panel CP-L2. The fan will always be commanded to run in the Man and Auto switch positions. The heater is modulated to control the discharge temperature to the desired discharge temperature. Note that the discharge temperature setpoint is controlled by the Mechanical Room Temperature Controller, L604-TC.

5.18.1 PLC I/O

Discrete:

Tag	Type	Description	0 State	1 State	Display
L603-HS-1A	DI	AHU-L1 In Auto	-	Auto	GD-A
L603-HS-1M	DI	AHU-L1 In Manual	-	Manual	GD-A
L603-PDS-1	DI	Summer Air Filter High Differential Pressure	High Pressure	Normal	GD-T
L603-PDS-2	DI	Winter Air Filter High Differential Pressure	High Pressure	Normal	GD-T
L603-MM	DI	AHU-L1 Supply Fan Running (See Note 1)	Stopped	Running	GD-T
L603-TAL	DI	AHU-L1 Low Temp Alarm	Alarm	Normal	GD-T
L603-BF	DI	AHU-L1 Burner Failure	Failure	Normal	GD-T
L603-BY	DO	AHU-L1 Burner Enable	Disable	Enable	EF-T

Notes:

- The Supply Fan Running signal is based upon a current sensor, and will detect many fan failure modes.

Analog:

Tag	Type	Description	Range	Display
L603-TC	AO	AHU-L1 Discharge Air Setpoint (See Note 1)	0 – 100 %	EF-T, T


Notes:

- The Discharge Air Setpoint is non-linear, with 0% representing approximately 10°C and 100% representing approximately 43°C.

5.18.2 HMI - PLC Interface

Discrete Status Bits:

Tagname	Description	Type	Display
L603_CtrlMan	Control Mode Manual	R	GD-T, EF

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Discrete Control Bits:

Tagname	Description	Type	Control
L603_CtrlAutoCmd	Set to Automatic Control Mode	W1	EF-PB (L)
L603_CtrlManCmd	Set to Manual Control Mode	W1	EF-PB (L)

Analog Set Points:


Tagname	Description	Range	Type	Control
L603_C_Man	Manual Mode Output Setpoint	0 – 100 %	RW	EF-TE (L)

5.18.3 PLC Generated Alarms

Tagname	Description	Logic	Pri	Reset
L603_RunFault	AHU-L1 Supply Fan Failure	L603-HS-1A AND (NOT L603-MM) for 5 seconds	2	Manual
L603_BF	AHU-L1 Burner Failure	NOT L603-BF	2	Auto
L603_PDA_1	AHU-L1 Summer Air Filter Plugged	NOT L603-PDS-1 for > 15 seconds	3	Auto
L603_PDA_2	AHU-L1 Winter Air Filter Plugged	NOT L603-PDS-2 for > 15 seconds	2	Auto
L603_TAH	AHU-L1 Supply Air Temperature High	NOT L602_TAF AND L603-HS-1A AND L603-BY AND NOT L603_CtrlMan AND (L602_TT - L604_TC) >= 5 °C for > 5 minutes	3	Auto
L603_TAL	AHU-L1 Supply Air Temperature Low	NOT L602_TAF AND L603-HS-1A AND NOT L603_CtrlMan AND (L602_TT - L604_TC) <= -5 °C for > 5 minutes	3	Auto
L603_TAL	AHU-L1 Low Temperature Alarm	NOT L603-TAL	2	Auto

5.18.4 Interlocks

Initiating Event	Action	Control Mode		Description
		Auto	Manual	
L603-HS-1A AND L602_TAF	Set L603-BY = 1 Set L603-TC = 0 %	Y	N	On discharge air temperature sensor failure, set the air handler to heat, but at 10°C discharge temp.
NOT L603_MM	Set L603-BY = 0 Set L603-TC = 0 %	Y	Y	Disable burner if air handler fan is not running.

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Initiating Event	Action	Control Mode		Description
		Auto	Manual	
L623_BF	Set L603-BY = 0 Set L603_TC = 0 %	Y	Y	Force heater command off in the event of a burner failure.
NOT L600-YL AND L601_FC > L601_FC_Min AND L602-TT >= 2°C	Set L603-BY = 0 Set L603_TC = 0 %	Y	N	Force burner off when the station is unoccupied and the outside air damper is commanded to open more than 25% and the supply air temp is >= 2°C


5.18.5 Control Narrative

Utilize PID control to control the air handler discharge air setpoint. Note that a PID controller is utilized as the air handler discharge temperature setpoint signal is non-linear.

PV: L602-TT
 SP: L604_TC
 CV: L603-TC (Reverse Acting)

The setpoint of the supply temperature PID controller is based on the output of the room temperature controller L604-TC. As the room temperature cools, the Mechanical Room Temperature Controller will call for a higher discharge temperature. The L603-TC will increase the signal to the air handler based upon the measured discharge temperature L602-TT. As the air handler has an internal discharge temperature controller, the L603-TC must be tuned to be slow enough to allow the air handler controller to act. Utilize higher proportional gain and less integral gain.

Ensure bump-less transfer is provided between manual and automatic modes.

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5.19 Mechanical Room Temperature Control L604-TC

A room temperature sensor is located in the main floor mechanical room of the building. The Mechanical Room Temperature Control L604-TC does not directly control the air handler temperature or the recirculation / mixed air dampers, but rather controls the discharge air setpoint, which in turn affects the air handler and dampers. Note that the Mechanical Room Temperature is utilized as the temperature control for the entire pumping station interior, except for the electrical room.

5.19.1 PLC I/O

Analog:

Tagname	Type	Description	Range	Display
L604-TT	AI	Room Temperature	0 - 50 °C	GD-T, T

5.19.2 HMI - PLC Interface

Discrete Status Bits:

Tagname	Description	Type	Display
L604_CtrlMan	Control Mode Manual	R	GD-T, EF

Discrete Control Bits:


Tagname	Description	Type	Control
L604_CtrlAutoCmd	Set to Automatic Control Mode	W1	EF-PB (L)
L604_CtrlManCmd	Set to Manual Control Mode	W1	EF-PB (L)

Analog Values:

Tagname	Description	Range	Type	Display
L604_TC	Discharge Temperature Setpoint (Control Value)	0 - 50°C	R	EF-T

Analog Set Points:

Tagname	Description	Range	Type	Control
L604_TC_Man	Manual Mode Setpoint	0 - 50°C	RW	EF-TE (L)
L604_T_SP_Occ	Occupied Room Temperature Setpoint Default = 17°C	0 - 50°C	RW	EF-TE (L)
L604_T_SP_UnOcc	Unoccupied Room Temperature Setpoint Default = 8°C	0 - 50°C	RW	EF-TE (L)

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5.19.3 PLC Generated Alarms


Tagname	Description	Logic	Pri	Reset
L604_TAF	Mechanical Room Temperature Transmitter Failure	L604_TT < 4mA or > 20mA	2	Auto
L604_TAHH	Mechanical Room Temperature High-High	NOT L604_TAF AND L604_TT => 40°C for > 10 sec	3	Auto
L604_TAH	Mechanical Room Temperature High	NOT L604_TAF AND L604_TT => 35°C for > 30 min	3	Auto
L604_TAL	Mechanical Room Temperature Low	NOT L604_TAF AND L603-HS-1A AND NOT L604_CtrlMan AND (L604_TT - Controller SP) <= -4 °C for > 30 minutes	3	Auto
L604_TALL	Mechanical Room Temperature Low-Low	NOT L604_TAF AND L604_TT <= 3°C for > 10 sec	2	Auto

5.19.4 Control Narrative

Utilize PID control to control the supply air temperature based upon the room temperature:

PV: L604-TT
 SP: IF L600-YL (occupied): L604_T_SP_Occ
 IF NOT L600-YL (unoccupied): L604_T_SP_UnOcc
 CV: L604_TC (Reverse Acting)
 CV Limits: Low: 10°C
 High: 43°C (limited by air handler)

Ensure bump-less transfer is provided between manual and automatic modes.

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5.20 SF-L2 Ventilation Fan – L605

SF-L2 is a secondary ventilation fan for the pumping station, utilized during warm weather to provide additional cooling ventilation for the building. SF-L2 is normally controlled by the PLC, although it can be controlled from the starter via a local H-O-A switch. Note that the start command signal does not directly start the motor, but rather opens the exhaust damper (L605-YV) first. Once the exhaust damper is open, the fan motor starts.

5.20.1 PLC I/O

Discrete:

Tag	Type	Description	0 State	1 State	Display
L605-HS-1	DI	Starter in Auto	Not Auto	Auto	GD-T
L605-MM	DI	Running	Stopped	Running	GD-A
L605-MN	DO	Run Command	Stop	Run	-

5.20.2 HMI - PLC Interface

The full HMI – PLC interface will include PLC I/O designated above.

Discrete Status Bits:

Tagname	Description	Type	Display
L605_Alarm	Alarm Present	R	GD-A
L605_CtrlMan	Manual Control Mode	R	GD-T, EF-T

Discrete Control Bits:


Tagname	Description	Type	Control
L605_CtrlManCmd	Set to Manual Control Mode	W1	EF-PB (L)
L605_CtrlAutoCmd	Set to Auto Control Mode	W1	EF-PB (L)
L605_Reset	Reset	W1	EF-PB (L)
L605_ManualStart	Manual Start command	W1	EF-PB (L)
L605_ManualStop	Manual Stop command	W1	EF-PB (L)

Notes:

(1) The above could potentially be implemented as bits in a single register.

Analog Set Points:

Tagname	Description	Range	Type	Control
L605_TC_SP	Fan Start Temperature Setpoint Default = 30°C	0 - 40°C	RW	EF2-TE (M)

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5.20.3 Alarms

Tagname	Description	Logic	Mask	Pri	Reset
L605_RunFault	SF-L2 Ventilation Fan Run Fault	L605-HS-1 AND ((L605-MN AND NOT L605-MM) for 120 seconds OR (NOT L605-MN AND L605-MM) for 20 sec)	N/A	2	Manual


Note: Time is allowed for the exhaust damper to open.

5.20.4 Interlocks

Initiating Event	Action	Control Mode		Description
		Auto	Manual	
L626_TALL	Stop	Y	N	Room low-low temperature alarm
L605_RunFault	Stop	Y	Y	Run Fault

5.20.5 Control Narrative

Turn on SF-L2 when the room temperature (L602-TT) equals or exceeds L605_TC_SP. Turn off SF-L2 when the room temperature (L602-TT) is 1 degree below L605_TC_SP.

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5.21 Electrical Room Temperature L613-TT

A room temperature sensor is located in the main floor electrical room. The temperature sensor is utilized for monitoring only.

5.21.1 PLC I/O

Analog:

Tagname	Type	Description	Range	Display
L613-TT	AI	Electrical Room Temperature	0 - 50 °C	GD -T, T


5.21.2 HMI - PLC Interface

Analog Set Points:

Tagname	Description	Range	Type	Control
L613_TAH_SP	Electrical Room High Temperature Alarm Setpoint	0 - 50°C	RW	EF-TE (M)
L613_TAL_SP	Electrical Room Low Temperature Alarm Setpoint	0 - 50°C	RW	EF-TE (M)

5.21.3 PLC Generated Alarms

Tagname	Description	Logic	Pri	Reset
L613_TAF	Electrical Room Temperature Transmitter Failure	L613_TT < 4mA or > 20mA	2	Auto
L613_TAHH	Electrical Room Temperature High-High	NOT L613_TAF AND L613_TT => 40°C for > 10 sec	3	Auto
L613_TAH	Electrical Room Temperature High	NOT L613_TAF AND L613_TT >= L613_TAH_SP for > 1 minute	3	Auto
L613_TAL	Electrical Room Temperature Low	NOT L613_TAF AND L613_TT <= L613_TAL_SP for > 1 minute	3	Auto
L613_TALL	Electrical Room Temperature Low-Low	NOT L613_TAF AND L613_TT <= 3°C for > 10 sec	2	Auto

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5.22 Miscellaneous

5.22.1 PLC I/O

Discrete:

Tag	Type	Description	0 State	1 State	Display
L524-PSL	DI	Instrument Air Pressure Switch Low	Alarm	Normal	GD-T
L527-ESL	DI	600 VAC Power Failure	Power Fail	Normal	GD-T
L530-LSH	DI	Comminutor Chamber Flood Switch	Alarm	Normal	GD-A
L533-LSH	DI	Pump Room Flood Switch	Alarm	Normal	GD-A
L538-XA	DI	TVSS Status	Alarm	Normal	GD-T
L543-JAL	DI	UPS01 Battery Low	Alarm	Normal	GD-T
L543-XA	DI	UPS01 Battery Fault	Alarm	Normal	GD-T
L544-ESL	DI	120 VAC Power Failure	Power Fail	Normal	GD-T
L546-XA-A	DI	CP-L1 24VDC Power Supply PS01-A Fail	Alarm	Normal	GD-T
L546-XA-B	DI	CP-L1 24VDC Power Supply PS01-B Fail	Alarm	Normal	GD-T
L544-EA	DI	120 VAC Power Failure	Power Fail	Normal	GD-T
L570-LSHH	DI	Flowmeter Chamber Flood Switch	Alarm	Normal	GD-A

5.22.2 HMI - PLC Interface

Analog Values:


Tagname	Description	Range	Type	Display
RTU_Heartbeat	RTU Heartbeat	0 - 32767	R	EF-T

Text Values:

Tagname	Description	Characters	Type	Display
Username	Current Logged in Username	12	R	Button panel

5.22.3 Alarms

Tagname	Description	Logic	Pri	Reset
L524_PAL	Instrument Air Low Pressure	NOT L524_PSL > 3 seconds	2	Auto
L527_EA	600 VAC Power Failure	NOT L527_ESL > 0.5 seconds	1	Auto

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Tagname	Description	Logic	Pri	Reset
L530_LAH	Comminutor Chamber Flood	NOT L530_LSH > 3 seconds	1	Auto
L533_LAH	Pump Room Flood	NOT L530_LSH > 3 seconds	1	Auto
L538_XA	TVSS Failure	NOT L538_XA > 0.5 seconds	3	Auto
L543_JAL	UPS01 Battery Low	NOT L543_JAL > 0.5 seconds	2	Auto
L543_XA	UPS01 Battery Fault	NOT L543_XA > 0.5 seconds	2	Auto
L544_EA	120 VAC Power Failure	L527-ESL AND NOT L544_ESL > 0.5 seconds	1	Auto
L546_XA_A	CP-L1 24VDC Power Supply PS01-A Fail	L544-ESL AND NOT L546-XA-A > 0.5 seconds	1	Auto
L546_XA_B	CP-L1 24VDC Power Supply PS01-B Fail	L544-ESL AND NOT L546-XA-B > 0.5 seconds	1	Auto
L570_LAHH	Flowmeter Chamber Flood	NOT L570_LSH > 3 seconds	1	Auto

5.22.4 Control Narrative

A heartbeat signal is to be implemented in the RTU so that remote devices can determine if the RTU is in Run mode (i.e. the RTU has not faulted).

Create a one second timer that increments a register, named "RTU_Heartbeat", every one second. Increment the register to a set value (preferable 32767), reset to 0, and continue incrementing. This register will be monitored by the RTU.