THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

Engineer's Seal

METCALFE LIFT PUMPING STATION
2023 UPGRADES
CONTROL NARRATIVE
PLC-L81 & HVAC CONTROLS

City Document Number: 5-0162L-A0002

KGS Project Number: 22-0107-004

Rev.	Description	Date	Created By	Checked By	Approved By
0	Issued for Construction	2023/02/27	JO/AN/CSR		

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1.0 STATEMENT OF LIMITATIONS

This report has been prepared for the City of Winnipeg in accordance with the agreement between KGS Group and the City of Winnipeg (the "Agreement"). This report represents KGS Group's professional judgment and exercising due care consistent with the preparation of similar reports. The information, data, recommendations and conclusions in this report are subject to the constraints and limitations in the Agreement and the qualifications in this report. This report must be read as a whole, and sections or parts should not be read out of context.

2.0 PART 1 - INTRODUCTION

2.1 Overview

This controls narrative describes the process for controlling the pumps, HVAC systems, alarm sensors and miscellaneous systems for the Metcalfe Lift Station. The intent is for the PLC programmer to utilize this document for the preparation of the PLC program for the station. The controls narrative provides a description of the intended PLC functionality at a high level. The programming language used to implement the control logic shall be function block diagram (FBD) programming. Permission must be given by the contract administrator before using any alternate language. All IO as it is mapped into the PLC will be converted to positive logic such that a Boolean value of 1 signifies an alarm condition and a Boolean value of 0 signifies the okay state.

Timer settings and initial setpoints are intended to be used as a starting point for commissioning. Timer settings and initial setpoints shall be adjusted during commissioning as required. Notify Engineering Consultant of any and all timer and setpoint changes for Engineering Consultant review. As-built documentation for any and all setpoint or timer changes.

2.2 Reference Drawings

When reviewing this controls narrative refer to the drawings as identified in the table below for supplementary information as well as the process piping connections.

Drawing No.	Title
1-0162L-P0001-001	Process – Wastewater Pumping – Process and Instrumentation Diagram
1-0162L-P0001-002	Process – Wastewater Pumping – Process and Instrumentation Diagram
1-0162L-P0001-003	Process – Wastewater Pumping – Process and Instrumentation Diagram
1-0162L-P0002-001	Process – HVAC and Plumbing System – Process and Instrumentation Diagram
1-0162L-A0007-001	PLC IO Wiring Diagram – Control Panel CP-L81 – Discrete Input Rack 0, Module 4
1-0162L-A0008-001	PLC IO Wiring Diagram – Control Panel CP-L81 – Discrete Input Rack 0, Module 5

Drawing No.	Title
1-0162L-A0009-001	PLC IO Wiring Diagram – Control Panel CP-L81 – Discrete Input Rack 0, Module 6
1-0162L-A0010-001	PLC IO Wiring Diagram – Control Panel CP-L81 – Discrete Output Rack 0, Module 7
1-0162L-A0011-001	PLC IO Wiring Diagram – Control Panel CP-L81 – Analog Input Rack 0, Module 8
1-0162L-A0012-001	PLC IO Wiring Diagram – Control Panel CP-L81 – Analog Input Rack 0, Module 9
1-0162L-A0013-001	PLC IO Wiring Diagram – Control Panel CP-L81 – Analog Input Rack 0, Module 10
1-0162L-A0014-001	PLC IO Wiring Diagram – Control Panel CP-L81 – Analog Input Rack 0, Module 11
1-0162L-A0015-001	PLC IO Wiring Diagram – Control Panel CP-L81 – Analog Input Rack 0, Module 0
1-0162L-A0016-001	PLC IO Wiring Diagram – Control Panel CP-L81 – Analog Input Rack 0, Module 1
1-0162L-A0017-001	Control Schematic - Control Panel CP-L81 - Pump Control PLC Mode

2.3 Key Operating Parameters

The station is always activated with the controls are set to automatically start and stop the pumps. Key elevations for the Metcalfe Lift Pumping Station are shown below:

Description		Geodetic Elevation (meters above sea level)	Reference Elevation Above Transmitter Zero (meters)
Wet Well Top Elevation		223.601	1.981
High High Wet Well Alarm Level		223.301	1.681
High Wet Well Alarm Level		222.78	1.16
Wet Well Duty 1	- **Start**	222.33	0.710
	- **Stop**	222.07	0.450
	- **Differential**	0.260	0.260
Wet Well Duty 2	- **Start**	222.48	0.860
	- **Stop**	222.22	0.600
	- **Differential**	0.260	0.260

Wet Well Duty 3	- **Start**	222.63	1.010
	- **Stop**	222.37	0.750
	- **Differential**	0.260	0.260
Wet Well Zero Elevation		221.62	0.000

3.0 PART 2 - EQUIPMENT AND SYSTEM REQUIREMENTS

3.1 HMI Graphic Displays

Create a graphic (process mimic) display containing a representation of the process as shown on P&ID 1-0162L-P0001 Sheet 1, P&ID 1-0162L-P0001 Sheet 2, P&ID 1-0162L-P0001 Sheet 3, and P&ID 1-0162L-P0002 Sheet 1. All HMI Graphics shall follow City of Winnipeg HMI Animation Guide. HMI colors to be discussed between City E&I, AICG and Operations. Provide access to the Maintenance Screen. Note that all alarms on Graphics Tabs must also display on the Alarms Summary Table Tab. Specific requirements include, but are not limited to:

- Main Lift Pumping Window
    - Animate the Wet Well level using vertical fill animation. Also display the level value in the center of wet well in relative and absolute units. Display the wet well level setpoint as an animated slider on the side of the wet well.
    - Include High Wet Well along with High High Wet Well levels as Red horizontal lines on the Wet Well display.
    - Include the readings of each level transmitter. Include a popup window with HMI buttons for selection of averaging or selecting a particular level transmitter for level monitoring.
    - Pump Duty Sequencer popup window such that the duty selection of the pumps can be selected. Include all three (3) duty start and stop setpoints. Changing of duty setpoints shall be Password protected for any changes.
    - Display lift pumps P-L01, P-L02 and P-L03 status indicating if the pump is running, mode of operation (Manual / Auto Mode), along with motor current draw and flow of each pump. By clicking on each pump, a new popup window will appear.
    - Display the automatic station operation mode (PLC Mode / Local Mode).
- Main Floor HVAC Window
    - Show status of main floor ventilation dampers FV-L641, FV-L642 and FV-L651 as percentages open i.e. ‘25% OPEN’. Any damper status shall be shown as ‘CLOSED’ when percentage is ‘0’ ғ

- ‘FULLY OPENED’ when percentage is ‘100’. Refer to drawings 1-0162L-A0029 for damper status signals.
- Show status and alarms of all 600V HVAC fans, including SF-L64 and EF-L65.
- Display the current motor room temperature in degrees Celsius from TT-L671, i.e. ‘MOTOR ROOM TEMPERATURE: 23°C’.
- Display the current pump room temperature in degrees Celsius from TT-L681, i.e. ‘PUMP ROOM TEMPERATURE: 23°C’.
- Display the current pump room temperature in degrees Celsius from TT-L681, i.e. ‘MAIN ROOM TEMPERATURE: 23°C’.
- Display the current outside temperature in degrees Celsius from TT-L681, i.e. ‘OUTSIDE TEMPERATURE: 23°C’.

- Pump Trends Window
  - Display all pump running statuses, wet well level and pump flow trending displays.
  - Display all pump vibration and temperature monitoring trending details.
  - Display Wet Well Level trending display.
  - All trending displays shall utilize a Sample Rate of five (5) seconds, Vertical Scale of 221 – 225 meters on the left / 0 – 100% on the right and a Horizontal Scale of thirty (30) minutes.
- HVAC Trends Window
  - HVAC graphical display shall include building layout and P&ID flows similar to 1-0162L-P0002.
  - Display damper FV-L641, FV-L642 and FV-L651 trending displays.
  - Display temperature TT-L691 and TT-L681 trending displays.
  - All trending displays shall utilize a Sample Rate of five (5) seconds, Vertical Scale of 0 – 30 °C on the left / 0 – 100% on the right and a Horizontal Scale of thirty (30) minutes.
- Settings Window
  - Settings can be Read Only and shall be Password Protection for any changes to be made.
  - Display all system setpoints, this may include but shall not be limited to the following:
    - All pump duty start and stop setpoints.

- All pump vibration and temperature alarms.
- Display main floor and pump room low temperature and high temperature setpoints.

- Display Window
  - Provide separate display windows for lift pump P-L01, P-L02 and P-L03.
  - For each pump display window, display all pump status signals (Ready, Running, Fault, Manual Mode, Auto Mode, etc.) shown on motor control schematics. Include motor winding temperature, pump, vibration, and temperature readings of bearings along with runtime hours and off time hours for each pump.
- Instrument Calibration Window
  - Display all analog instrument signals to the PLC. Calibration setpoints shall be provided for instrument signal offsets.
  - Calibrations shall only be done from the local HMI. Calibration settings shall be password protected.
- Alarms Summary Table Window
  - Display all alarms in a table format received at the PLC. Include current date in yyyy/mm/dd (i.e. 2023/07/26) format along with time in hh:mm:ss (i.e. 14:23:51) format in the upper right side of the window.
  - Each alarm should include date in yyyy/mm/dd (i.e. 2023/07/26) format along with time in hh:mm:ss (i.e. 14:23:51) format along with description (i.e. Motor Room High Temperature).
  - All alarms shall appear display entire row as Red when alarm is generated. Once alarm has cleared, entire row shall change to Green.

3.2 General Process

The General Process control encompasses the flow and totalization sections of the control system.

3.2.1 PLC INTERFACE INPUTS AND RELATED INSTRUMENTS

INSTRUMENT TAG NUMBER	PLC INTERNAL TAG NUMBER	DESCRIPTION	LOCATION
FIT-L012	FIT_L012.In	Lift pump P-L01 discharge flow transmitter FIT-L012 raw flow analog input	
FIT-L012	FIT_L012.FQI	Lift pump P-L01 discharge flow transmitter FIT-L012 flow totalizer pulsed input	MOTOR ROOM
FIT-L012	FIT_L012.Flt	Lift pump P-L01 discharge flow transmitter FIT-L012 fault discrete input	MOTOR ROOM
FIT-L022	FIT_L022.In	Lift pump P-L02 discharge flow transmitter FIT-L022 raw flow analog input	MOTOR ROOM
FIT-L022	FIT_L022.FQI	Lift pump P-L02 discharge flow transmitter FIT-L022 flow totalizer pulsed input	MOTOR ROOM
FIT-L022	FIT_L022.Flt	Lift pump P-L02 discharge flow transmitter FIT-L022 fault discrete input	MOTOR ROOM
FIT-L032	FIT_L032.In	Lift pump P-L03 discharge flow transmitter FIT-L032 raw flow analog input	MOTOR ROOM
FIT-L032	FIT_L032.FQI	Lift pump P-L03 discharge flow transmitter FIT-L032 flow totalizer pulsed input	MOTOR ROOM
FIT -L032	FIT_L032.Flt	Lift pump P-L03 discharge flow transmitter FIT-L032 fault discrete input	MOTOR ROOM
LSH-L501	LSH_L501.In	Pump room flood switch	PUMP ROOM
LSH-L502	LSH_L502.In	Comminutor chamber flood switch	COMMINUTOR CHAMBER
PSL-L526	PSL_L526.In	Station main water low pressure switch	MOTOR ROOM

3.2.2 INTERNAL VARIABLES

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
FIT_L012.Out	Scaled pump 1 discharge flow	0 – 100 l/s	-
FIT_L022.Out	Scaled pump 2 discharge flow	0 – 100 l/s	-
FIT_L023.Out	Scaled pump 2 discharge flow	0 – 100 l/s	-
FQI_L012_DayC	Pump1 current day totalized flow; resets to 0 every 24 hours at 12:00am	0 – # m^3	-
FQI_L022_DayC	Pump2 current day totalized flow; resets to 0 every 24 hours at 12:00am	0 – # m^3	-

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
FQI_L032_DayC	Pump3 current day totalized flow; resets to 0 every 24 hours at 12:00am	0 – # m^3	-
FIT_L012.AF	Flow alarm fault from FIT-L012	-	-
FIT_L022.AF	Flow alarm fault from FIT-L022	-	-
FIT_L032.AF	Flow alarm fault from FIT-L032	-	-
FQI_L001_DayC	Station current day totalized flow. Every 24 hours at 12:00am the value is stored in FQI_L002_DayP, then FQI_L001_DayC is reset to zero and begins totalizing again.	0 – # m^3	-
FQI_L002_DayP	Station previous day totalized flow	0 – # m^3	-

3.2.3 ALARMS

The following alarms shall be generated based on the corresponding process conditions:

- LSH-L501: Station Flood
- LSH-L502: Comminutor Chamber Flood
- PSL-L526: Station Main Water Low Pressure
- FAL-L001: Station Low Flow Alarm (Alarm setpoint shall be determined based on quantity of lift pumps running).
    a. Qty. 1 Pump Running: FAL-L001 setpoint shall be 80% of the design flow rate of 56L/s
    b. Qty. 2 Pumps Running: FAL-L001 setpoint shall be 80% of the design flow rate of 62L/s
    c. Qty. 3 Pumps Running: FAL-L001 setpoint shall be 80% of the design flow rate of 65L/s

All low flow alarm setpoints shall be adjustable from the HMI (password protected).

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
LSH-L501	LSH_501.In	LAH_L501	Station Flood	F/S	SET(LAH_L501) on LSH_L501.In = TRUE RESET(LAH_L501) on LSH_L501.In = FALSE	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
LSH-L502	LSH_L502.In	LAH_502	Comminutor chamber flood	F/S	SET(LAH_L502) on LSH_L502.In = TRUE RESET(LAH_L502) on LSH_L502.In = FALSE	Auto
PSL-L526	PSL_L526.In	PAL_L526	Main water low pressure	F/S	SET(PAL_L526) on PSL_L526.In = TRUE RESET(PAL_L526) on PSL_L526.In = FALSE	Auto

3.2.4 CONTROL NARRATIVE

Each discharge flow meters pulse output shall be input to the PLC to perform the following totalizations.

- The flow of each individual pump shall be totalized for the current day (24hr period).
- The total station flow totalized for the current day.
- The total station flow totalized for the previous day.

All totalized flow shall be visible to the operator on the HMI.

3.3 Wet Well Level Control

The wet well level is controlled by switching one or two pumps on at one time at a constant speed to draw down the well level to the desired setpoint. All setpoints shall be configurable from the HMI, password protected with limiting ranges. Perform a range check on the start/stop setpoints to ensure that only logical and safe setpoints are selected.

3.3.1 PLC INTERFACE INPUTS AND RELATED INSTRUMENTS

INSTRUMENT TAG NUMBER	PLC INTERNAL TAG NUMBER	DESCRIPTION	LOCATION
LIC-L100-1	N/A	WET WELL LEVEL CONTROLLER ‘1’	MAIN FLOOR
LIT-L100-1	LIT_L100_1.In	WET WELL LEVEL TRANSMITTER '1' RAW INPUT	PUMP ROOM
LIC-L100-2	N/A	WET WELL LEVEL CONTROLLER ‘2’	MAIN FLOOR
LIT-L100-2	LIT_L100_2.In	WET WELL LEVEL TRANSMITTER '2'	PUMP ROOM
LSH-L100-1	LSH_L100-1.In	WET WELL HIGH-LEVEL SWITCH ‘1’ (From Precision Digital LIC-100-1)	MAIN FLOOR
LSH-L100-2	LSH_L100-2.In	WET WELL HIGH-LEVEL SWITCH ‘2’ (From Precision Digital LIC-100-1)	MAIN FLOOR

INSTRUMENT TAG NUMBER	PLC INTERNAL TAG NUMBER	DESCRIPTION	LOCATION
LSHH-L101	LSHH_L101.In	WET WELL HIGH HIGH-LEVEL SWITCH	WET WELL

3.3.2 INTERNAL VARIABLES

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
LI_L100_1.Out	Scaled level from LIT-100-1	0 – 1.981 m	-
LI_L100_2.Out	Scaled level from LIT-100-2	0 – 1.981 m	-
LI_L100	Level utilized for control	0 – 1.981 m	-
LI_L100_Mode	LI-L100 selected mode: 0=Average, 1=LI_L100-1, 2=LI_L100-2	0 – 2	0
LC_L100_Duty1_Start_SP	Duty 1 Start Setpoint	0 – 1.981 m	0.710 m
LC_L100_Duty1_Stop_SP	Duty 1 Stop Setpoint	0 – 1.981 m	0.450 m
LC_L100_Duty2_Start_SP	Duty 2 Start Setpoint	0 – 1.981 m	0.860 m
LC_L100_Duty2_Stop_SP	Duty 2 Stop Setpoint	0 – 1.981 m	0.600 m
LC_L100_Duty3_Start_SP	Duty 3 Start Setpoint (Emergency Mode = Enabled)	0 – 1.981 m	1.010 m
LC_L100_Duty3_Stop_SP	Duty 3 Stop Setpoint (Emergency Mode = Enabled)	0 – 1.981 m	0.750 m

3.3.3 ALARMS

The following alarms shall be generated based on the corresponding level conditions:

1. LSH-L100-1: High level in the wet well
    a. Wired fail safe contact from Precision Digital LIC-100-1
2. LSH-L100-2: High level in the wet well
    a. Wired fail safe contact from Precision Digital LIC-100-2
3. LSHH-L101: High high-level in the wet well
4. LI_L100_Variance: Wet well variance/deviation alarm (Alarm condition when the difference between the two wet well level transmitter readings exceeds a pre-determined threshold)

3.3.3.1 Alarm Settings

ALARM TAG NUMBER	PLC INTERNAL TAG NUMBER	ALARM LOW-LOW SETTING	ALARM LOW SETTING	ALARM HIGH SETTING	ALARM HIGH-HIGH SETTING	Notes
LAHH-L101	LAHH_L101.In	N/A	N/A	N/A	223.3 m	Geo. Elevation
LAH-L100-1	LAH_L100.In	N/A	N/A	222.8 m	N/A	Geo. Elevation
LAH-L100-2	LAH_L100.In	N/A	N/A	222.8 m	N/A	Geo. Elevation

3.3.3.2 Alarm Logic

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
LSHH-L101	LAHH_L101.In	LAHH_L101	High High Level Alarm	F/S	SET(LAHH_L101) on LAHH_L101.In = TRUE for 1sec RESET(LAHH_L101) on LAHH_L101.In = FALSE for 1sec	Auto
LSH-L100-1	LAH_L100_1.In	LAH_L100_1	High Level Switch (from LIC-100-1)	F/S	SET(LAH_L100_1) on LAH_L100_1.In = TRUE for 1 sec RESET(LAH_L100_1) on LAH_L100_1.In = FALSE for 1 sec	Auto
LSH-L100-2	LAH_L100_2.In	LAH_L100_2	High Level Switch (from LIC-100-2)	F/S	SET(LAH_L100_2) on LAH_L100_2.In = TRUE for 1 sec RESET(LAH_L100_2) on LAH_L100_2.In = FALSE for 1 sec	Auto
-	LI_L100.Vrnc	LI_L100_Variance	Level Variance Alarm	-	SET(LI_L100.Vrnc) on (ABS (LI_L100_1.Out - LI_L100_2.Out)> 0.05m) = TRUE SET(LI_L100_Variance) on LI_L100.Vrnc = TRUE for 5sec RESET(LI_L100.Vrnc) on (ABS(LI_L100_1.Out - LI_L100_2.Out)<= 0.05m) = TRUE RESET(LI_L100_Variance) on LI_L100.Vrnc = TRUE for 5sec	Auto
-	LI_L100_1.Flt	LI_L100_1_Flt	Level transmitter 1 failure	-	SET(LI_100_1.Flt) on OR(LI_L100_1 <4mA, LI_L100_1 >20mA) = TRUE SET(LI_100_1_Flt) on LI_100_1.Flt for 1 sec RESET(LI_100_1.Flt) on OR(LI_L100_1 >=4mA, LI_L100_1 <=20mA) = TRUE RESET(LI_100_1_Flt) on LI_100_1.Flt for 1 sec	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
-	LI_L100_2.Flt	LI_L100_2_Flt	Level transmitter 2 failure	-	SET(LI_L100_2_Flt) on OR(LI_L100_2 <4mA, LI_L100_1 >20mA) for 1 sec RESET(LI_L100_2_Flt) on OR(LI_L100_2 >=4mA, LI_L100_1 <=20mA) for 1 sec	Auto

3.3.4 DISCRETE CONTROL BITS

TAG	DESCRIPTION
LI_L100_Select1	Utilize LI_L100_1 for control
LI_L100_Select2	Utilize LI_L100_2 for control
LI_L100_SelectAvg	Utilize the average for control
LC_L100_Duty1_Run	Duty 1 Run
LC_L100_Duty2_Run	Duty 2 Run
LC_L100_Duty3_Run	Duty 3 Run
YC_L100_AlternatingMode	Alternating/Non-Alternating Mode; 0=Fixed, 1=Alternating
LC_L100_Duty3_Enb	Enable/Disable third duty pump

3.3.5 CONTROL NARRATIVE

3.3.5.1 Overview

Pump operation shall be of constant-speed type. Pump operation shall be determined based on discrete wet well levels, with two duty pumps and one standby pump at all times of normal operation. This excludes pump(s) that are locked out due to certain alarm conditions.

During times of excessive inflow levels to the wet well (above design criteria), when emergency mode is activated, the third pump shall be activated by way of automatic pre-set level with annunciation to the HMI as to the abnormal condition. While the operation of the pumps is constant speed, this fixed speed can be varied or trimmed during commissioning to allow the pumps to meet the desired flow rate. This programming would be set in the PLC and not normally changed during operation.

For a redundant level measurement in the wet well, two differential pressure sensors on separate sight glass tubes with isolation valves and calibration ports will be installed in the dry well, with coring into the wet well. The Pressure transmitters will send an analog input signal (4-20 mA) to the PLC, which compares the current

water level to the desired setpoint and starts/stops the pumps based on that comparison. The level in the wet well shall be displayed on the HMI both as the local height as well as the geodetic height.

3.3.5.2 Level Utilized for Control – LI_L100

LI_L100_Select1, LI_L100_Select2 and LI_L100_SelectAvg are used to set LI_L100_Mode to 1, 2 and 0 respectively from HMI/SCADA.
While LI_L100_Mode is set 0, move the average of the two transmitters to LI_L100.
When LI_L100_Mode is set 1, move LI_L100_1 to LI_L100.
When LI_L100_Mode is set 2, move LI_L100_2 to LI_L100.

If for some reason one of the transmitters fails, the level utilized for control shall automatically be forced to the healthy level transmitter.

3.3.5.3 Level Control – Backup Operation

Both wet well level transmitters will be connected to Digital Precision Display process meters on the control panel as backup pump controls. A toggle switch shall be installed on the panel to allow for selection between wet well level transmitters 1 and 2 during backup pump control operation. The positions of the toggle switch shall be monitored on SCADA and the HMI to indicate which standalone level controller has been selected.

The level control is Fail Safe, and the pumps will continue to automatically operate shall the PLC fail or a PLC critical fault occur. PLC critical faults shall require a manual field reset to be cleared, this can be done via the PLC Reset pushbutton (HS-L524-1) located on the PLC Control Panel door. If the PLC fails, the pumps will be controlled through the Precision Digital and cycled ON/OFF as necessary to maintain level in the wet well.

When relay CR09 becomes de-energize (PLC discrete output YC-L508) the level control is switched from the PLC to the precision digital level controllers, LIC-L100-1 and LIC-L100-2. When CR09 is energized (PLC discrete output YC-L508) from the PLC connected to a PLC mode okay relay CR06 is energized, providing power to the mode pushbuttons on the PLC door (HS-L508-1). To re-establish the PLC as the primary control source the PLC mode pushbutton (HS-L508-1) must be pushed on the panel door and the PLC fault must be cleared by pressing the PLC Reset pushbutton (HS-L524-1). By pushing the PLC mode pushbutton, the CR07 PLC mode relay becomes energized, preventing the precision digital level controllers from controlling the pumps. The PLC is now in control of the pumps.

The PLC Mode signal will be used to disable PLC control of the pumps and remove all speed and pump start commands from the PLC, to be able to test the panel meter level control.

Discrete:

PHYSICAL TAG	INTERNAL VARIABLE	ALARM/ STATUS TAG	DESCRIPTION	FAIL SAFE	ALARM/STATUS LOGIC	RESET
YS-L508-1	YS_L508_1.In	YS_L508_1	PLC Mode (1=PLC Mode)	F/S	SET(YC_L508_1) on YC_L508_1.In = TRUE RESET(YC_L508_1) on YC_L508_1.In = FALSE	-

Discrete Control Bit:

PHYSICAL TAG	INTERNAL VARIABLE	DESCRIPTION
YC-L508-1	YC_L508_1.Out	PLC Mode Okay. Physical Output that indicates the PLC is okay and ready to control the pumps.
HS-L524-1	HS_L534_1.Out	PLC Reset Pushbutton. 0=Not Reset, 1=Reset

Refer to automation drawing 1-0162L-A0017-0001 for more details.

3.3.5.4 Level Control – **High (LSHH_L101)**

The high-high level switch installed in the wet well will provide indication and alarming.

If both level transmitters fail operations shall still have information about the status of the wet well level.

3.3.5.5 Level Control – Pump Operation – LC_L100

Duty pumps shall start/stop based on the wet well level and the duty pumps start/stop setpoints as listed below. The duty start/stop setpoints shall be adjustable from SCADA.

LC_L100_Duty1_Start_SP, LC_L100_Duty1_Stop_SP, LC_L100_Duty2_Start_SP, LC_L100_Duty2_Stop_SP, LC_L100_Duty3_Start_SP and LC_L100_Duty3_Stop_SP.

The duty run signals are LC_100_Duty1_Run, LC_100_Duty2_Run and LC_100_Duty3_Run.

LC_L100_Duty3_Start_SP and LC_L100_Duty3_Stop_SP (emergency level, above normal level based on design flow) may be disabled or enabled based on preference if desired.

Limit the controller minimum output to the same value as the pump minimum speed setting in the pump VFDs.

3.3.5.6 Pump Duty Sequencer – YC_L100

The Pump duty sequencer will decide which physical pump or pumps are to be called to Start/Stop based on the duty pump run signals from **LC_L100** and the selected mode of operation (alternating/non-alternating). The mode and Duty Assignment shall be able to be changed from SCADA.

When a duty pump is called to start, the pump that has been off the longest shall start. When a duty pump is called to stop, the physical pump that has been running the longest shall stop.

INTERNAL VARIABLE	DESCRIPTION
YC_L100_Duty1	Duty 1 Pump (1=P-L01, 2=P-L02, 3=P-L03, 0=Unavailable)
YC_L100_Duty2	Duty 2 Pump (1=P-L01, 2=P-L02, 3=P-L03, 0=Unavailable)
YC_L100_Duty3	Duty 3 Pump (1=P-L01, 2=P-L02, 3=P-L03, 0=Unavailable)

Note: Refer to section 3.3.2 for all LC-L100 tags.

In alternating mode, if a duty pump is called to start, start the physical pump that has been off the longest. If a duty pump is called to stop, stop the physical pump that has been running the longest.

In non-alternating mode, if a pump is called to start, start physical pumps according to their duty assignment.

When the pumps are in a combination of alternating and non-alternating duty modes, the duty pump that is in non-alternating mode shall not be considered for the duty staging, i.e., the PLC shall have the capability to have two pumps alternating while a third pump is on fixed duty.

The PLC shall have the capability to have two pumps alternating while the third pump on fixed duty

The PLC shall perform checks to ensure that selected mode/duty assignment are correct. The PLC shall allow a running pump to complete its cycle as long as it is available.

Mode selection and duty assignment are done from the local HMI (password protected and limiting range)

3.4 P-L01

3.4.1 PLC INTERFACE INPUTS AND RELATED INSTRUMENTS

PHYSICAL TAG NUMBER	PLC INTERNAL TAG NUMBER	DESCRIPTION	LOCATION
HS-L010-1M	HS_L010_1M.In	Pump P-L01 local mode	Main Floor
HS-L010-1A	HS_L010_1A.In	Pump P-L01 auto mode	Main Floor
YL-L010	YL_L010.In	Pump P-L01 ready	Main Floor
YLR-L010-1	YLR_L010_1.In	Pump P-L01 running forward	Main Floor
YLR-L010-2	YLR_L010_2.In	Pump P-L01 running reverse	Main Floor
YAF-L010	YAF_L010.In	Pump P-L01 VFD fault	Main Floor
SI-L010	SI_L010.In	Pump P-L01 motor speed indication	Main Floor
IT-L010	IT_L010.In	Pump P-L01 motor current indication	Main Floor
VSH-L010-1	VSH_L010_1.In	Pump P-L01 upper bearing vibration high	Motor Room
VSH-L010-2	VSH_L010_2.In	Pump P-L01 lower bearing vibration high	Motor Room
TSH-L011	TSH_L011.In	Pump P-L01 motor high temperature	Pump Room
VIC-L010-1	VIC_L010_1.In	Pump P-L01 upper bearing (Motor side non-drive end) vibration indicating controller	Main Floor
VIC-L010-2	VIC_L010_2.In	Pump P-L01 lower bearing (Pump side drive end) vibration indicating controller	Main Floor
TT-L010-1	TT_L010_1.In	Pump P-L01 upper bearing (Motor side non-drive end) temperature transmitter	Motor Room
TT-L010-2	TT_L010_2.In	Pump P-L01 lower bearing (Pump side drive end) temperature transmitter	Pump Room

3.4.2 INTERNAL VARIABLES

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
P_L01_InService_Cmd	In Service Command (DNP3 Binary Output sent by SCADA) 1 = In Service, 0 = Out of Service	-	-
P_L01_OutService_Cmd	Out of Service Command (DNP3 Binary Output sent by SCADA) 1 = Out of Service, 0 = In Service	-	-
P_L01_InService_Fbk	In Service Command Feedback (DNP3 Binary Input sent to SCADA) 1 = In Service, 0 = Not in Service	-	-
P_L01_OutService_Fbk	Out of Service Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Out of Service, 0 = Not Out of Service,	-	-
P_L01_OutService_Sts	Out of Service Status (DNP3 Binary Input sent to SCADA) 1 = Out of Service, 0 = Not out of Service	-	-
P_L01_RunFwd_Cmd	Run Forward Command (DNP3 Binary Output sent by SCADA) 1 = Run Forward, 0 = Do Not Run Forward	-	-
P_L01_Stop_Cmd	Stop Command (DNP3 Binary Output sent by SCADA) 1 = Stop, 0 = Okay	-	-
P_L01_RunRev_Cmd	Run Reverse Command (DNP3 Binary Output sent by SCADA) 1 = Run Reverse, 0 = Do Not Run Reverse	-	-
P_L01_RunFwd_Fbk	Run Forward Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Run Forward, 0 = Do Not Run Forward	-	-
P_L01_Stop_Fbk	Stop Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Stop, 0 = Okay	-	-
P_L01_RunRev_Fbk	Run Reverse Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Run Reverse, 0 = Do Not Run Reverse	-	-
P-L01_RunFltRst_Cmd	Run Fault Reset Command (DNP3 Binary Output sent by SCADA) 1 = Run Fault Reset, 0 = Do Not Reset	-	-

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
P-L01_RunFltRst_Fbk	Run Fault Reset Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Reset, 0 = Do Not Reset	-	-
VI_L010_1.Out	Scaled vibration from VIC-L010-1	0 – 25.4 mm/s	-
VI_L010_2.Out	Scaled vibration from VIC-L010-2	0 – 25.4 mm/s	-
TI_L010_1.Out	Scaled temperature from TT-L010-1	0 – 125 ◦C	-
TI_L010_2.Out	Scaled temperature from TT-L010-2	0 – 125 ◦C	-
P_L01.S	Scaled speed from SI-L010	0 – 1181 RPM	-
P_L01.I	Scaled motor current from IT-L010	0 –40 A	-
P_L01.K	Total run time	0 – # hours	-
P_L01.K1	On run time (reset to 0 when the pump stops)	0 – # hours	-
P_L01.K2	Off run time (reset to 0 when the pump runs)	0 – # hours	-
P_L01.S_SP	Speed setpoint 68% = 41Hz 100% = 60Hz	68-100 %	96.3 %
P_L01.BackflushS_SP	Backflush speed setpoint 0% = 0Hz 30% = 18Hz	0-30 %	30%
P_L01.BackflushTimer_SP	Backflush timer setpoint	0 – 10 sec	5 sec

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
P_L01.BackflushTimer_Acc	Backflush timer accumulated value	0 – 10 sec	0 sec
P_L01.Backflush_Abort	Backflush cycle stop	-	-
P_L01.Duty	Pump duty assignment. Example: If P_L01.Duty = 1 then YC_L100_Duty1 = 1; 1st Duty = P-L01 Else If P_L01.Duty = 2 then YC_L100_Duty2 = 1; 2nd Duty = P-L01 Else If P_L01.Duty = 3 then YC_L100_Duty3 = 1; 3rd Duty = P-L01 Else If P_L01.Duty = 0; P-L01 is unavailable for duty assignment	0-3	0

3.4.3 INTERNAL ALARMS/STATUSES

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
YLR-L010-1	P_L01.StsRun1	YLR_L010_1	P-L01 Running forward	-	SET(YLR_L010_1) on P_L01.StsRun1 = TRUE RESET(YLR_L010_1) on P_L01.StsRun1 = FALSE	Auto
YLR-L010-2	P_L01.StsRun2	YLR_L010_1	P-L01 Running reverse	-	SET(YLR_L010_2) on P_L01.StsRun2 = TRUE RESET(YLR_L010_2) on P_L01.StsRun2 = FALSE	Auto
HS-L010-1M	P_L01.HS_Man	HS_L010_1M	P-L01 Manual Mode	-	SET(HS_L010_1M) on P_L01.HS_Man = TRUE RESET(HS_L010_1M) on P_L01.HS_Man = FALSE	Auto
HS-L010-1A	P_L01.HS_Auto	HS_L010_1A	P-L01 Auto Mode	-	SET(HS_L010_1A) on P_L01.HS_Auto = TRUE RESET(HS_L010_1A) on P_L01.HS_Auto = FALSE	Auto
YL-L010	P_L010.Rdy	YL_L010	P-L01 Ready	-	SET(YL_L010) on P_L010.Rdy = TRUE RESET(YL_L010) on P_L010.Rdy = FALSE	-
YAF-L010 (Note 1)	P-L01.Flt	YAF_L010	P-L01 VFD Fault	F/S	SET(YAF_L010) on P-L01.Flt = TRUE RESET(YAF_L010) on P-L01.Flt = FALSE	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
VSH-L010-1	VSH_L010_1.In	VAH_L010_1	Upper bearing vibration high	F/S	SET(VAH_L010_1) on VSH_L010_1.In = TRUE for 3sec RESET(VAH_L010_1) on VSH_L010_1.In = FALSE for 5sec	Auto
VIC-L0101-1	VIC_L010_1.AlmH (Note 2)	VIC_L010_1_AlmH	High Vibration alarm	-	SET(VIC_L010_1.AlmH) on VI_L010_1.Out >= (Note 2) SET(VIC_L010_1_AlmH) on VIC_L010_1.AlmH = TRUE RESET(VIC_L010_1.AlmH) on VI_L010_1.Out < (Note 2) RESET(VIC_L010_1_AlmH) on VIC_L010_1.AlmH = FALSE	Auto
VIC-L0101-1	VIC_L010_1.AlmHH (Note 2)	VIC_L010_1_AlmHH	High Vibration alarm	-	SET(VIC_L010_1.AlmHH) on VI_L010_1.Out >= (Note 2) SET(VIC_L010_1_AlmHH) on VIC_L010_1.AlmHH = TRUE RESET(VIC_L010_1.AlmHH) on VI_L010_1.Out < (Note 2) RESET(VIC_L010_1_AlmHH) on VIC_L010_1.AlmHH = FALSE	Auto
VSH-L010-2	VSH_L010_2.In	VAH_L010_2	Lower bearing vibration high	F/S	SET(VAH_L010_2) on VSH_L010_2.In = TRUE for 3sec RESET(VAH_L010_2) on VSH_L010_2.In = FALSE for 5sec	Auto
VIC-L0101-2	VIC_L010_2.AlmH (Note 2)	VIC_L010_2_AlmH	High Vibration alarm	-	SET(VIC_L010_2.AlmH) on VI_L010_2.Out >= (Note 2) SET(VIC_L010_2_AlmH) on VIC_L010_2.AlmH = TRUE RESET(VIC_L010_2.AlmH) on VI_L010_2.Out < (Note 2) RESET(VIC_L010_2_AlmH) on VIC_L010_2.AlmH = FALSE	Auto
VIC-L0101-2	VIC_L010_2.AlmHH (Note 2)	VIC_L010_2_AlmHH	High Vibration alarm	-	SET(VIC_L010_2.AlmHH) on VI_L010_2.Out >= (Note 2) SET(VIC_L010_2_AlmHH) on VIC_L010_2.AlmHH = TRUE RESET(VIC_L010_2.AlmHH) on VI_L010_2.Out < (Note 2) RESET(VIC_L010_2_AlmHH) on VIC_L010_2.AlmHH = FALSE	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
TSH-L011	TSH_L011.In	TAH_L011	Motor high temp.	F/S	SET(TAH-L011) on TSH_L011.In = TRUE for 3sec RESET(TAH-L011) on TSH_L011.In = FALSE for 5sec	Auto
TI-L0101-1	TI_L010_1.AlmH (Note 3)	TI_L010_1_AlmH	High Vibration alarm	-	SET(TI_L010_1.AlmH) on TI_L010_1.Out >= (Note 3) SET(TI_L010_1_AlmH) on TI_L010_1.AlmH = TRUE RESET(TI_L010_1.AlmH) on TI_L010_1.Out < (Note 3) RESET(TI_L010_1_AlmH) on TI_L010_1.AlmH = FALSE	Auto
TI-L0101-1	TI_L010_1.AlmHH (Note 3)	TI_L010_1_AlmHH	High Vibration alarm	-	SET(TI_L010_1.AlmHH) on TI_L010_1.Out >=(Note 3) SET(TI_L010_1_AlmHH) on TI_L010_1.AlmHH = TRUE RESET(TI_L010_1.AlmHH) on TI_L010_1.Out < (Note 3) RESET(TI_L010_1_AlmHH) on TI_L010_1.AlmHH = FALSE	Auto
TI-L0101-2	TI_L010_2.AlmH (Note 2)	TI_L010_2_AlmH	High Vibration alarm	-	SET(TI_L010_2.AlmH) on TI_L010_2.Out >= (Note 2) SET(TI_L010_2_AlmH) on TI_L010_2.AlmH = TRUE RESET(TI_L010_2.AlmH) on TI_L010_2.Out < (Note 2) RESET(TI_L010_2_AlmH) on TI_L010_2.AlmH = FALSE	Auto
TI-L0101-2	TI_L010_2.AlmHH (Note 2)	TI_L010_2_AlmHH	High Vibration alarm	-	SET(TI_L010_2.AlmHH) on TI_L010_2.Out >=(Note 2) SET(TI_L010_2_AlmHH) on TI_L010_2.AlmHH = TRUE RESET(TI_L010_2.AlmHH) on TI_L010_2.Out < (Note 2) RESET(TI_L010_2_AlmHH) on TI_L010_2.AlmHH = FALSE	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
FIT-L012	FIT_L012.AlmL	FAL_L012	P-L01 Low Flow Alarm	-	SET(FIT_L012.AlmL) on OR(CASE1 = 1 Pump Running: FIT-L012.Out < (80%)·(56/1) L/s for 3sec, CASE2 = 2 Pumps Running: FIT-L012.Out < (80%)·(62/2) L/s for 3sec, CASE3 = 3 Pumps Running: FIT-L012.Out < (80%)·(65/3) L/s for 3sec) SET(FAL_L012) on FIT_L012.AlmL = TRUE RESET(FIT_L012.AlmL) on OR(CASE1 = 1 Pump Running: FIT-L012.Out >= (80%)·(56/1) L/s for 3sec, CASE2 = 2 Pumps Running: FIT-L012.Out >= (80%)·(62/2) L/s for 3sec, CASE3 = 3 Pumps Running: FIT-L012.Out >= (80%)·(65/3) L/s for 3sec) RESET(FAL_L012) on FIT_L012.AlmL = FALSE	Auto
-	P_L01.RunFlt	P_L01_RunFlt	Run fault	-	SET(P_L01.RunFlt) on OR(AND(P_L01_RunFWD_Cmd, NOT(YLR_L010_1), AND(P_L01_RunREV_Cmd, NOT(YLR_L010_2), AND(P_L01_Stop_Cmd, NAND(YLR_L010_1, YLR_L010_2)) SET(P_L01_RunFlt) on P_L01.RunFlt = TRUE RESET(P_L01.RunFlt) on P-L01_RunFltRst_Cmd = TRUE RESET(P_L01_RunFlt) on P_L01.RunFlt = FALSE	Manual
-	P_L01.Avail	P_L01_Avail	Pump available	-	SET(P_L01.Avail) on AND(NOT(HS_L010_1M), NOT(P_L01_RunFlt), NOT(YAF_L010), YL_L010) for 3sec SET(P_L01_Avail) on P_L01.Avail = TRUE RESET(P_L01.Avail) on NAND(NOT(HS_L010_1M), NOT(P_L01_RunFlt), NOT(YAF_L010), YL_L010) for 3sec RESET(P_L01_Avail) on P_L01.Avail = FALSE	Auto
-	P_L01.Backflush	P_L01_Backflush	Backflush InProgress	-	SET(P_L01.Backflush) on YLR_L010_2=1 for 1 sec SET(P_L01_Backlfush) on P_L01.Backfush = TRUE RESET(P_L01.Backflush) on OR(P_L01.Backflush_Abort, P_L01.BackflushTimer_Acc = P_L01.BackflushTimer_SP)) RESET(P_L01_Backlfush) on P_L01.Backfush = FALSE	Auto

Notes:

1.VFD Fault Alarm is generated by the internal programming of the VFD.

2. Vibration limits for motors 7.5 to 75 kW shall be determined as follows:

- Maximum allowable level = 6.6 to 8.0 mm/s (0.22 to 0.32 in/s)
- N, nominal vibration level as measured on a fully commissioned (new) pump
- High Alarm = N x 1.25
- High-High Alarm/Trip = N x 2.0

3. Temperature limits for grease lubricated bearings shall be determined as follows:

- Record benchmark temperature during commissioning (t) and ambient temperature (ta)
- Estimate the likely maximum ambient temperature (tb)
- High Alarm = (t + tb-ta+5) °C
- High-High Alarm/Trip = 105 °C

3.5 P-L02

3.5.1 PLC INTERFACE INPUTS AND RELATED INSTRUMENTS

PHYSICAL TAG NUMBER	PLC INTERNAL TAG NUMBER	DESCRIPTION	LOCATION
HS-L020-1M	HS_L020_1M.In	Pump P-L02 local mode	Main Floor
HS-L020-1A	HS_L020_1A.In	Pump P-L02 auto mode	Main Floor
YL-L020	YL_L020.In	Pump P-L02 ready	Main Floor
YLR-L020-1	YLR_L020_1.In	Pump P-L02 running forward	Main Floor
YLR-L020-2	YLR_L020_2.In	Pump P-L02 running reverse	Main Floor
YAF-L020	YAF_L020.In	Pump P-L02 VFD fault	Main Floor
SI-L020	SI_L020.In	Pump P-L02 motor speed indication	Main Floor
IT-L020	IT_L020.In	Pump P-L02 motor current indication	Main Floor
VSH-L020-1	VSH_L020_1.In	Pump P-L02 upper bearing vibration high	Motor Room
VSH-L020-2	VSH_L020_2.In	Pump P-L02 lower bearing vibration high	Motor Room
TSH-L021	TSH_L021.In	Pump P-L02 motor high temperature	Pump Room

PHYSICAL TAG NUMBER	PLC INTERNAL TAG NUMBER	DESCRIPTION	LOCATION
HS-L020-1M	HS_L020_1M.In	Pump P-L02 local mode	Main Floor
HS-L020-1A	HS_L020_1A.In	Pump P-L02 auto mode	Main Floor
YL-L020	YL_L020.In	Pump P-L02 ready	Main Floor
YLR-L020-1	YLR_L020_1.In	Pump P-L02 running forward	Main Floor
YLR-L020-2	YLR_L020_2.In	Pump P-L02 running reverse	Main Floor
YAF-L020	YAF_L020.In	Pump P-L02 VFD fault	Main Floor
SI-L020	SI_L020.In	Pump P-L02 motor speed indication	Main Floor
IT-L020	IT_L020.In	Pump P-L02 motor current indication	Main Floor
VSH-L020-1	VSH_L020_1.In	Pump P-L02 upper bearing vibration high	Motor Room
VSH-L020-2	VSH_L020_2.In	Pump P-L02 lower bearing vibration high	Motor Room
VIC-L020-1	VIC_L020_1.In	Pump P-L02 upper bearing (Motor side non-drive end) vibration indicating controller	Main Floor
VIC-L020-2	VIC_L020_2.In	Pump P-L02 lower bearing (Pump side drive end) vibration indicating controller	Main Floor
TT-L020-1	TT_L020_1.In	Pump P-L02 upper bearing (Motor side non-drive end) temperature transmitter	Motor Room
TT-L020-2	TT_L020_2.In	Pump P-L02 lower bearing (Pump side drive end) temperature transmitter	Pump Room

3.5.2 INTERNAL VARIABLES

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
P_L02_InService_Cmd	In Service Command (DNP3 Binary Output sent by SCADA) 1 = In Service, 0 = Out of Service	-	-
P_L02_OutService_Cmd	Out of Service Command (DNP3 Binary Output sent by SCADA) 1 = Out of Service, 0 = In Service	-	-

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
P_L02_InService_Fbk	In Service Command Feedback (DNP3 Binary Input sent to SCADA) 1 = In Service, 0 = Not in Service	-	-
P_L02_OutService_Fbk	Out of Service Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Out of Service, 0 = Not Out of Service,	-	-
P_L02_OutService_Sts	Out of Service Status (DNP3 Binary Input sent to SCADA) 1 = Out of Service, 0 = Not out of Service	-	-
P_L02_RunFwd_Cmd	Run Forward Command (DNP3 Binary Output sent by SCADA) 1 = Run Forward, 0 = Do Not Run Forward	-	-
P_L02_Stop_Cmd	Stop Command (DNP3 Binary Output sent by SCADA) 1 = Stop, 0 = Okay	-	-
P_L02_RunRev_Cmd	Run Reverse Command (DNP3 Binary Output sent by SCADA) 1 = Run Reverse, 0 = Do Not Run Reverse	-	-
P_L02_RunFwd_Fbk	Run Forward Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Run Forward, 0 = Do Not Run Forward	-	-
P_L02_Stop_Fbk	Stop Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Stop, 0 = Okay	-	-
P_L02_RunRev_Fbk	Run Reverse Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Run Reverse, 0 = Do Not Run Reverse	-	-
P-L02_RunFltRst_Cmd	Run Fault Reset Command (DNP3 Binary Output sent by SCADA) 1 = Run Fault Reset, 0 = Do Not Reset	-	-
P-L02_RunFltRst_Fbk	Run Fault Reset Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Reset, 0 = Do Not Reset	-	-
PLC_Auto_Cmd	PLC Auto Command (DNP3 Binary Output sent by SCADA) 1 = Auto, 0 = Not Auto	-	-
PLC_Manual_Cmd	PLC Manual Command (DNP3 Binary Output sent by SCADA) 1 = Manual, 0 = Not Manual	-	-

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
PLC_Auto_Fbk	In Service Command Feedback (DNP3 Binary Input sent to SCADA): 1 = In Auto, 0 = Not In Auto	-	-
PLC_Manual_Fbk	PLC Manual Feedback (DNP3 Binary Input sent to SCADA) 1 = Manual, 0=Not Manual	-	-
PLC_AutoMan_Sts	PLC Auto/Manual Status (DNP3 Binary Input sent to SCADA) 1 = Auto, 0 = Manual	-	-
VI_L020_1.Out	Scaled vibration from VIC-L020-1	0 – 25.4 mm/s	-
VI_L020_2.Out	Scaled vibration from VIC-L020-2	0 – 25.4 mm/s	-
TI_L020_1.Out	Scaled temperature from TT-L020-1	0 – 125 ◦C	-
TI_L020_2.Out	Scaled temperature from TT-L020-2	0 – 125 ◦C	-
P_L02.S	Scaled speed from SI-L020	0 – 1181 RPM	-
P_L02.I	Scaled motor current from IT-L020	0 –40 A	-
P_L02.K	Total run time	0 – # hours	-
P_L02.K1	On run time (reset to 0 when the pump stops)	0 – # hours	-
P_L02.K2	Off run time (reset to 0 when the pump runs)	0 – # hours	-
P_L02.S_SP	Speed setpoint 68% = 41Hz 100% = 60Hz	68-100 %	96.3 %

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
P_L02.BackflushS_SP	Backflush speed setpoint 0% = 0Hz 30% = 18Hz	0-30 %	30%
P_L02.BackflushTimer_SP	Backflush timer setpoint	0 – 10 sec	5 sec
P_L02.BackflushTimer_Acc	Backflush timer accumulated value	0 – 10 sec	0 sec
P_L02.Backflush_Abort	Backflush cycle stop	-	-
P_L02.Duty	Pump duty assignment. Example: If P_L02.Duty = 1 then YC_L100_Duty1 = 2; 1st Duty = P-L02 Else If P_L02.Duty = 2 then YC_L100_Duty2 = 2; 2nd Duty = P-L02 Else If P_L02.Duty = 3 then YC_L100_Duty3 = 2; 3rd Duty = P-L02 Else If P_L02.Duty = 0; P-L02 is unavailable for duty assignment	0-3	0

3.5.3 INTERNAL ALARMS/STATUSES

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
YLR-L020-1	P_L02.StsRun1	YLR_L020_1	P-L02 Running forward	-	SET(YLR_L020_1) on P_L02.StsRun1 = TRUE RESET(YLR_L020_1) on P_L02.StsRun1 = FALSE	Auto
YLR-L020-2	P_L02.StsRun2	YLR_L020_1	P-L02 Running reverse	-	SET(YLR_L020_2) on P_L02.StsRun2 = TRUE RESET(YLR_L020_2) on P_L02.StsRun2 = FALSE	Auto
HS-L020-1M	P_L02.HS_Man	HS_L020_1M	P-L02 Manual Mode	-	SET(HS_L020_1M) on P_L02.HS_Man = TRUE RESET(HS_L020_1M) on P_L02.HS_Man = FALSE	Auto
HS-L020-1A	P_L02.HS_Auto	HS_L020_1A	P-L02 Auto Mode	-	SET(HS_L020_1A) on P_L02.HS_Auto = TRUE RESET(HS_L020_1A) on P_L02.HS_Auto = FALSE	Auto
YL-L020	P_L02.Rdy	YL_L020	P-L02 Ready	-	SET(YL_L020) on P_L02.Rdy = TRUE RESET(YL_L020) on P_L02.Rdy = FALSE	-

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
YAF-L020 (Note 1)	P-L02.Flt	YAF_L020	P-L02 VFD Fault	F/S	SET(YAF_L020) on P_L02.Flt = TRUE RESET(YAF_L020) on P_L02.Flt = FALSE	Auto
VSH-L020-1	VSH_L020_1.In	VAH_L020_1	Upper bearing vibration high	F/S	SET(VAH_L020_1) on VSH_L020_1.In = TRUE for 3sec RESET(VAH_L020_1) on VSH_L020_1.In = FALSE for 5sec	Auto
VIC-L0201-1	VIC_L020_1.AlmH (Note 2)	VIC_L020_1_AlmH	High Vibration alarm	-	SET(VIC_L020_1.AlmH) on VI_L020_1.Out >= (Note 2) SET(VIC_L020_1_AlmH) on VIC_L020_1.AlmH = TRUE RESET(VIC_L020_1.AlmH) on VI_L020_1.Out < (Note 2) RESET(VIC_L020_1_AlmH) on VIC_L020_1.AlmH = FALSE	Auto
VIC-L0201-1	VIC_L020_1.AlmHH (Note 2)	VIC_L020_1_AlmHH	High Vibration alarm	-	SET(VIC_L020_1.AlmHH) on VI_L020_1.Out >= (Note 2) SET(VIC_L020_1_AlmHH) on VIC_L020_1.AlmHH = TRUE RESET(VIC_L020_1.AlmHH) on VI_L020_1.Out < (Note 2) RESET(VIC_L020_1_AlmHH) on VIC_L020_1.AlmHH = FALSE	Auto
VSH-L020-2	VSH_L020_2.In	VAH_L020_2	Lower bearing vibration high	F/S	SET(VAH-L020-2) on VSH-L020-2 = TRUE for 3sec RESET(VAH-L020-2) on VSH-L020-2 = FALSE for 5sec	Auto
VIC-L0201-2	VIC_L020_2.AlmH (Note 2)	VIC_L020_2_AlmH	High Vibration alarm	-	SET(VIC_L020_2.AlmH) on VI_L020_2.Out >= (Note 2) SET(VIC_L020_2_AlmH) on VIC_L020_2.AlmH = TRUE RESET(VIC_L020_2.AlmH) on VI_L020_2.Out < (Note 2) RESET(VIC_L020_2_AlmH) on VIC_L020_2.AlmH = FALSE	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
VIC-L0201-2	VIC_L020_2.AlmHH (Note 2)	VIC_L020_2_AlmHH	High Vibration alarm	-	SET(VIC_L020_2.AlmHH) on VI_L020_2.Out >= (Note 2) SET(VIC_L020_2_AlmHH) on VIC_L020_2.AlmHH = TRUE RESET(VIC_L020_2.AlmHH) on VI_L020_2.Out < (Note 2) RESET(VIC_L020_2_AlmHH) on VIC_L020_2.AlmHH = FALSE	Auto
TSH-L021	TSH_L021.In	TAH_L021	Motor high temp.	F/S	SET(TAH-L021) on TSH_L021.In = TRUE for 3sec RESET(TAH-L021) on TSH_L021.In = FALSE for 5sec	Auto
TI-L0201-1	TI_L020_1.AlmH (Note 3)	TI_L020_1_AlmH	High Vibration alarm	-	SET(TI_L020_1.AlmH) on TI_L020_1.Out >= (Note 3) SET(TI_L020_1_AlmH) on TI_L020_1.AlmH = TRUE RESET(TI_L020_1.AlmH) on TI_L020_1.Out < (Note 3) RESET(TI_L020_1_AlmH) on TI_L020_1.AlmH = FALSE	Auto
TI-L0201-1	TI_L020_1.AlmHH (Note 3)	TI_L020_1_AlmHH	High Vibration alarm	-	SET(TI_L020_1.AlmHH) on TI_L020_1.Out >=(Note 3) SET(TI_L020_1_AlmHH) on TI_L020_1.AlmHH = TRUE RESET(TI_L020_1.AlmHH) on TI_L020_1.Out < (Note 3) RESET(TI_L020_1_AlmHH) on TI_L020_1.AlmHH = FALSE	Auto
TI-L0201-2	TI_L020_2.AlmH (Note 2)	TI_L020_2_AlmH	High Vibration alarm	-	SET(TI_L020_2.AlmH) on TI_L020_2.Out >= (Note 2) SET(TI_L020_2_AlmH) on TI_L020_2.AlmH = TRUE RESET(TI_L020_2.AlmH) on TI_L020_2.Out < (Note 2) RESET(TI_L020_2_AlmH) on TI_L020_2.AlmH = FALSE	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
TI-L0201-2	TI_L020_2.AlmHH (Note 2)	TI_L020_2_AlmHH	High Vibration alarm	-	SET(TI_L020_2.AlmHH) on TI_L020_2.Out >=(Note 2) SET(TI_L020_2_AlmHH) on TI_L020_2.AlmHH = TRUE RESET(TI_L020_2.AlmHH) on TI_L020_2.Out < (Note 2) RESET(TI_L020_2_AlmHH) on TI_L020_2.AlmHH = FALSE	Auto
FIT-L022	FIT_L022.AlmL	FAL_L022	P-L02 Low Flow Alarm	-	SET(FIT_L022.AlmL) on OR(CASE1 = 1 Pump Running: FIT-L022.Out < (80%)·(56/1) L/s for 3sec, CASE2 = 2 Pumps Running: FIT-L022.Out < (80%)·(62/2) L/s for 3sec, CASE3 = 3 Pumps Running: FIT-L022.Out < (80%)·(65/3) L/s for 3sec) SET(FAL_L022) on FIT_L022.AlmL = TRUE RESET(FIT_L022.AlmL) on OR(CASE1 = 1 Pump Running: FIT-L022.Out >= (80%)·(56/1) L/s for 3sec, CASE2 = 2 Pumps Running: FIT-L022.Out >= (80%)·(62/2) L/s for 3sec, CASE3 = 3 Pumps Running: FIT-L022.Out >= (80%)·(65/3) L/s for 3sec) RESET(FAL_L022) on FIT_L022.AlmL = FALSE	Auto
-	P_L02.RunFlt	P_L02_RunFlt	Run fault	-	SET(P_L02.RunFlt) on OR(AND(P_L02_RunFWD_Cmd, NOT(YLR_L020_1), AND(P_L02_RunREV_Cmd, NOT(YLR_L020_2), AND(P_L02_Stop_Cmd, NAND(YLR_L020_1, YLR_L020_2)) SET(P_L02_RunFlt) on P_L02.RunFlt = TRUE RESET(P_L02.RunFlt) on P_L02_RunFltRst_Cmd = TRUE RESET(P_L02_RunFlt) on P_L02.RunFlt = FALSE	Manual
-	P_L02.Avail	P_L02_Avail	Pump available	-	SET(P_L02.Avail) on AND(NOT(HS_L020_1M), NOT(P_L02_RunFlt), NOT(YAF_L020), YL_L020) for 3sec SET(P_L02_Avail) on P_L02.Avail = TRUE RESET(P_L02.Avail) on NAND(NOT(HS_L020_1M), NOT(P_L02_RunFlt), NOT(YAF_L020), YL_L020) for 3sec RESET(P_L02_Avail) on P_L02.Avail = FALSE	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
-	P_L02.Backflush	P_L02_Backflush	Backflush InProgress	-	SET(P_L02.Backflush) on YLR_L020_2=1 for 1 sec SET(P_L02_Backlfush) on P_L02.Backfush = TRUE RESET(P_L02.Backflush) on OR(P_L02.Backflush_Abort, P_L02.BackflushTimer_Acc = P_L02.BackflushTimer_SP)) RESET(P_L02_Backlfush) on P_L02.Backfush = FALSE	Auto

Notes:

1.VFD Fault Alarm is generated by the internal programming of the VFD.

2. Vibration limits for motors 7.5 to 75 kW shall be determined as follows:

- Maximum allowable level = 6.6 to 8.0 mm/s (0.22 to 0.32 in/s)
- N, nominal vibration level as measured on a fully commissioned (new) pump
- High Alarm = N x 1.25
- High-High Alarm/Trip = N x 2.0

3. Temperature limits for grease lubricated bearings shall be determined as follows:

- Record benchmark temperature during commissioning (t) and ambient temperature (ta)
- Estimate the likely maximum ambient temperature (tb)
- High Alarm = (t + tb-ta+5) °C
- High-High Alarm/Trip = 105 °C

3.6 P-L03

3.6.1 PLC INTERFACE INPUTS AND RELATED INSTRUMENTS

PHYSICAL TAG NUMBER	PLC INTERNAL TAG NUMBER	DESCRIPTION	LOCATION
HS-L030-1M	HS_L030_1M.In	Pump P-L03 local mode	Main Floor
HS-L030-1A	HS_L030_1A.In	Pump P-L03 auto mode	Main Floor
YL-L030	YL_L030.In	Pump P-L03 ready	Main Floor
YLR-L030-1	YLR_L030_1.In	Pump P-L03 running forward	Main Floor
YLR-L030-2	YLR_L030_2.In	Pump P-L03 running reverse	Main Floor
YAF-L030	YAF_L030.In	Pump P-L03 VFD fault	Main Floor
SI-L030	SI_L030.In	Pump P-L03 motor speed indication	Main Floor
IT-L030	IT_L030.In	Pump P-L03 motor current indication	Main Floor
VSH-L030-1	VSH_L030_1.In	Pump P-L03 upper bearing vibration high	Motor Room
VSH-L030-2	VSH_L030_2.In	Pump P-L03 lower bearing vibration high	Motor Room
TSH-L031	TSH_L031.In	Pump P-L03 motor high temperature	Pump Room
VIC-L030-1	VIC_L030_1.In	Pump P-L03 upper bearing (Motor side non-drive end) vibration indicating controller	Main Floor
VIC-L030-2	VIC_L030_2.In	Pump P-L03 lower bearing (Pump side drive end) vibration indicating controller	Main Floor
TT-L030-1	TT_L030_1.In	Pump P-L03 upper bearing (Motor side non-drive end) temperature transmitter	Motor Room
TT-L030-2	TT_L030_2.In	Pump P-L03 lower bearing (Pump side drive end) temperature transmitter	Pump Room

3.6.2 INTERNAL VARIABLES

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
P_L03_InService_Cmd	In Service Command (DNP3 Binary Output sent by SCADA) 1 = In Service, 0 = Out of Service	-	-
P_L03_OutService_Cmd	Out of Service Command (DNP3 Binary Output sent by SCADA) 1 = Out of Service, 0 = In Service	-	-
P_L03_InService_Fbk	In Service Command Feedback (DNP3 Binary Input sent to SCADA) 1 = In Service, 0 = Not in Service	-	-
P_L03_OutService_Fbk	Out of Service Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Out of Service, 0 = Not Out of Service,	-	-
P_L03_OutService_Sts	Out of Service Status (DNP3 Binary Input sent to SCADA) 1 = Out of Service, 0 = Not out of Service	-	-
P_L03_RunFwd_Cmd	Run Forward Command (DNP3 Binary Output sent by SCADA) 1 = Run Forward, 0 = Do Not Run Forward	-	-
P_L03_Stop_Cmd	Stop Command (DNP3 Binary Output sent by SCADA) 1 = Stop, 0 = Okay	-	-
P_L03_RunRev_Cmd	Run Reverse Command (DNP3 Binary Output sent by SCADA) 1 = Run Reverse, 0 = Do Not Run Reverse	-	-
P_L03_RunFwd_Fbk	Run Forward Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Run Forward, 0 = Do Not Run Forward	-	-
P_L03_Stop_Fbk	Stop Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Stop, 0 = Okay	-	-
P_L03_RunRev_Fbk	Run Reverse Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Run Reverse, 0 = Do Not Run Reverse	-	-
P-L03_RunFltRst_Cmd	Run Fault Reset Command (DNP3 Binary Output sent by SCADA) 1 = Run Fault Reset, 0 = Do Not Reset	-	-

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
P-L03_RunFltRst_Fbk	Run Fault Reset Command Feedback (DNP3 Binary Input sent to SCADA) 1 = Reset, 0 = Do Not Reset	-	-
PLC_Auto_Cmd	PLC Auto Command (DNP3 Binary Output sent by SCADA) 1 = Auto, 0 = Not Auto	-	-
PLC_Manual_Cmd	PLC Manual Command (DNP3 Binary Output sent by SCADA) 1 = Manual, 0 = Not Manual	-	-
PLC_Auto_Fbk	In Service Command Feedback (DNP3 Binary Input sent to SCADA): 1 = In Auto, 0 = Not In Auto	-	-
PLC_Manual_Fbk	PLC Manual Feedback (DNP3 Binary Input sent to SCADA) 1 = Manual, 0 = Not Manual	-	-
PLC_AutoMan_Sts	PLC Auto/Manual Status (DNP3 Binary Input sent to SCADA) 1 = Auto, 0 = Manual	-	-
VI_L030_1.Out	Scaled vibration from VIC-L030-1	0 – 25.4 mm/s	-
VI_L030_2.Out	Scaled vibration from VIC-L030-2	0 – 25.4 mm/s	-
TI_L030_1.Out	Scaled temperature from TT-L030-1	0 – 125 ◦C	-
TI_L030_2.Out	Scaled temperature from TT-L030-2	0 – 125 ◦C	-
P_L03.S	Scaled speed from SI-L030	0 – 1181 RPM	-
P_L03.I	Scaled motor current from IT-L030	0 –40 A	-
P_L03.K	Total run time	0 – # hours	-

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
P_L03.K1	On run time (reset to 0 when the pump stops)	0 – # hours	-
P_L03.K2	Off run time (reset to 0 when the pump runs)	0 – # hours	-
P_L03.S_SP	Speed setpoint 68% = 41Hz 100% = 60Hz	68-100 %	96.3 %
P_L03.BackflushS_SP	Backflush speed setpoint 0% = 0Hz 30% = 18Hz	0-30 %	30%
P_L03.BackflushTimer_SP	Backflush timer setpoint	0 – 10 sec	5 sec
P_L03.BackflushTimer_Acc	Backflush timer accumulated value	0 – 10 sec	0 sec
P_L03.Backflush_Abort	Backflush cycle stop	-	-
P_L03.Duty	Pump duty assignment. Example: If P_L03.Duty=1 then YC_L100_Duty1=3; 1st Duty = P-L03 Else If P_L03.Duty=2 then YC_L100_Duty2=3; 2nd Duty = P-L03 Else If P_L03.Duty=3 then YC_L100_Duty3=3; 3rd Duty = P-L03 Else If P_L03.Duty=0; P-L03 is unavailable for duty assignment	0-3	0

3.6.3 INTERNAL ALARMS/STATUSES

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
YLR-L030-1	P_L03.StsRun1	YLR_L030_1	P-L03 Running forward	-	SET(YLR_L030_1) on P_L03.StsRun1 = TRUE RESET(YLR_L030_1) on P_L03.StsRun1 = FALSE	Auto
YLR-L030-2	P_L03.StsRun2	YLR_L030_1	P-L03 Running reverse	-	SET(YLR_L030_2) on P_L03.StsRun2 = TRUE RESET(YLR_L030_2) on P_L03.StsRun2 = FALSE	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
HS-L030-1M	P_L03.HS_Man	HS_L030_1M	P-L03 Manual Mode	-	SET(HS_L030_1M) on P_L03.HS_Man = TRUE RESET(HS_L030_1M) on P_L03.HS_Man = FALSE	Auto
HS-L030-1A	P_L03.HS_Auto	HS_L030_1A	P-L03 Auto Mode	-	SET(HS_L030_1A) on P_L03.HS_Auto = TRUE RESET(HS_L030_1A) on P_L03.HS_Auto = FALSE	Auto
YL-L030	P_L03.Rdy	YL_L030	P-L03 Ready	-	SET(YL_L030) on P_L03.Rdy = TRUE RESET(YL_L030) on P_L03.Rdy = FALSE	-
YAF-L030 (Note 1)	P-L03.Flt	YAF_L030	P-L03 VFD Fault	F/S	SET(YAF_L030) on P-L03.Flt = TRUE RESET(YAF_L030) on P-L03.Flt = FALSE	Auto
VSH-L030-1	VSH_L030_1.In	VAH_L030_1	Upper bearing vibration high	F/S	SET(VAH_L030_1) on VSH_L030_1.In = TRUE for 3sec RESET(VAH_L030_1) on VSH_L030_1.In = FALSE for 5sec	Auto
VIC-L0301-1	VIC_L030_1.AlmH (Note 2)	VIC_L030_1_AlmH	High Vibration alarm	-	SET(VIC_L030_1.AlmH) on VI_L030_1.Out >= (Note 2) SET(VIC_L030_1_AlmH) on VIC_L030_1.AlmH = TRUE RESET(VIC_L030_1.AlmH) on VI_L030_1.Out < (Note 2) RESET(VIC_L030_1_AlmH) on VIC_L030_1.AlmH = FALSE	Auto
VIC-L0301-1	VIC_L030_1.AlmHH (Note 2)	VIC_L030_1_AlmHH	High Vibration alarm	-	SET(VIC_L030_1.AlmHH) on VI_L030_1.Out >= (Note 2) SET(VIC_L030_1_AlmHH) on VIC_L030_1.AlmHH = TRUE RESET(VIC_L030_1.AlmHH) on VI_L030_1.Out < (Note 2) RESET(VIC_L030_1_AlmHH) on VIC_L030_1.AlmHH = FALSE	Auto
VSH-L030-2	VSH_L030_2.In	VAH_L030_2	Lower bearing vibration high	F/S	SET(VAH_L030_2) on VSH_L030_2.In = TRUE for 3sec RESET(VAH_L030_2) on VSH_L030_2.In=FALSE for 5sec	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
VIC-L0301-2	VIC_L030_2.AlmH (Note 2)	VIC_L030_2_AlmH	High Vibration alarm	-	SET(VIC_L030_2.AlmH) on VI_L030_2.Out >= (Note 2) SET(VIC_L030_2_AlmH) on VIC_L030_2.AlmH = TRUE RESET(VIC_L030_2.AlmH) on VI_L030_2.Out < (Note 2) RESET(VIC_L030_2_AlmH) on VIC_L030_2.AlmH = FALSE	Auto
VIC-L0301-2	VIC_L030_2.AlmHH (Note 2)	VIC_L030_2_AlmHH	High Vibration alarm	-	SET(VIC_L030_2.AlmHH) on VI_L030_2.Out >= (Note 2) SET(VIC_L030_2_AlmHH) on VIC_L030_2.AlmHH = TRUE RESET(VIC_L030_2.AlmHH) on VI_L030_2.Out < (Note 2) RESET(VIC_L030_2_AlmHH) on VIC_L030_2.AlmHH = FALSE	Auto
TSH-L031	TSH_L031.In	TAH_L031	Motor high temp.	F/S	SET(TAH-L031) on TSH_L031.In=TRUE for 3sec RESET(TAH-L031) on TSH_L031.In=FALSE for 5sec	Auto
TI-L0301-1	TI_L030_1.AlmH (Note 3)	TI_L030_1_AlmH	High Vibration alarm	-	SET(TI_L030_1.AlmH) on TI_L030_1.Out >= (Note 3) SET(TI_L030_1_AlmH) on TI_L030_1.AlmH = TRUE RESET(TI_L030_1.AlmH) on TI_L030_1.Out < (Note 3) RESET(TI_L030_1_AlmH) on TI_L030_1.AlmH = FALSE	Auto
TI-L0301-1	TI_L030_1.AlmHH (Note 3)	TI_L030_1_AlmHH	High Vibration alarm	-	SET(TI_L030_1.AlmHH) on TI_L030_1.Out >=(Note 3) SET(TI_L030_1_AlmHH) on TI_L030_1.AlmHH = TRUE RESET(TI_L030_1.AlmHH) on TI_L030_1.Out < (Note 3) RESET(TI_L030_1_AlmHH) on TI_L030_1.AlmHH = FALSE	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
TI-L0301-2	TI_L030_2.AlmH (Note 2)	TI_L030_2_AlmH	High Vibration alarm	-	SET(TI_L030_2.AlmH) on TI_L030_2.Out >= (Note 2) SET(TI_L030_2_AlmH) on TI_L030_2.AlmH = TRUE RESET(TI_L030_2.AlmH) on TI_L030_2.Out < (Note 2) RESET(TI_L030_2_AlmH) on TI_L030_2.AlmH = FALSE	Auto
TI-L0301-2	TI_L030_2.AlmHH (Note 2)	TI_L030_2_AlmHH	High Vibration alarm	-	SET(TI_L030_2.AlmHH) on TI_L030_2.Out >=(Note 2) SET(TI_L030_2_AlmHH) on TI_L030_2.AlmHH = TRUE RESET(TI_L030_2.AlmHH) on TI_L030_2.Out < (Note 2) RESET(TI_L030_2_AlmHH) on TI_L030_2.AlmHH = FALSE	Auto
FIT-L032	FIT_L032.AlmL	FAL_L032	P-L03 Low Flow Alarm	-	SET(FIT_L032.AlmL) on OR(CASE1 = 1 Pump Running: FIT-L032.Out < (80%)·(56/1) L/s for 3sec, CASE2 = 2 Pumps Running: FIT-L032.Out < (80%)·(62/2) L/s for 3sec, CASE3 = 3 Pumps Running: FIT-L032.Out < (80%)·(65/3) L/s for 3sec) SET(FAL_L032) on FIT_L032.AlmL = TRUE RESET(FIT_L032.AlmL) on OR(CASE1 = 1 Pump Running: FIT-L032.Out >= (80%)·(56/1) L/s for 3sec, CASE2 = 2 Pumps Running: FIT-L032.Out >= (80%)·(62/2) L/s for 3sec, CASE3 = 3 Pumps Running: FIT-L032.Out >= (80%)·(65/3) L/s for 3sec) RESET(FAL_L032) on FIT_L032.AlmL = FALSE	Auto
-	P_L03.RunFlt	P_L03_RunFlt	Run fault	-	SET(P_L03.RunFlt) on OR(AND(P_L03_RunFWD_Cmd, NOT(YLR_L030_1), AND(P_L03_RunREV_Cmd, NOT(YLR_L030_2), AND(P_L03_Stop_Cmd, NAND(YLR_L030_1, YLR_L030_2)) SET(P_L03_RunFlt) on P_L03.RunFlt = TRUE RESET(P_L03.RunFlt) on P-L03_RunFltRst_Cmd = TRUE RESET(P_L03_RunFlt) on P_L03.RunFlt = FALSE	Manual

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
-	P_L03.Avail	P_L03_Avail	Pump available	-	SET(P_L03.Avail) on AND(NOT(HS_L030_1M), NOT(P_L03_RunFlt), NOT(YAF_L030), YL_L030) for 3sec SET(P_L03_Avail) on P_L03.Avail = TRUE RESET(P_L03.Avail) on NAND(NOT(HS_L030_1M), NOT(P_L03_RunFlt), NOT(YAF_L030), YL_L030) for 3sec RESET(P_L03_Avail) on P_L03.Avail = FALSE	Auto
-	P_L03.Backflush	P_L03_Backflush	Backflush InProgress	-	SET(P_L03.Backflush) on YLR_L030_2=1 for 1 sec SET(P_L03_Backlfush) on P_L03.Backfush =TRUE RESET(P_L03.Backflush) on OR(P_L03.Backflush_Abort, P_L03.BackflushTimer_Acc = P_L03.BackflushTimer_SP)) RESET(P_L03_Backlfush) on P_L03.Backfush = FALSE	Auto

Notes:

1.VFD Fault Alarm is generated by the internal programming of the VFD.

2. Vibration limits for motors 7.5 to 75 kW shall be determined as follows:

- Maximum allowable level = 6.6 to 8.0 mm/s (0.22 to 0.32 in/s)
- N, nominal vibration level as measured on a fully commissioned (new) pump
- High Alarm = N x 1.25
- High-High Alarm/Trip = N x 2.0

3. Temperature limits for grease lubricated bearings shall be determined as follows:

- Record benchmark temperature during commissioning (t) and ambient temperature (ta)
- Estimate the likely maximum ambient temperature (tb)
- High Alarm = (t + tb-ta+5) °C
- High-High Alarm/Trip = 105 °C

3.7 P-L01, P-L02, & P-L03 Controls

If a pump is not available for any reason, such as an active VFD fault Alarm, the PLC shall not consider that pump. Refer to internal variables P_L01.Avail, P_L02.Avail P_L03.Avail in Sections 3.4.3, 3.5.3, and 3.6.3 for a list pump availability conditions.

Refer to Section 3.3 for details on wet well level control and duty pump operations.

3.7.1.1 Lockouts/Permissives

For Lift pump P-L01 the permissives are:

- The pump is reporting a fault; P_L01.Flt = TRUE
- The pump is not reporting as ready; P-L01.Rdy = FALSE

For Lift pump P-L02 the permissives are:

- The pump is reporting a fault; P_L02.Flt = TRUE
- The pump is not reporting as ready; P-L02.Rdy = FALSE

For Lift pump P-L03 the permissives are:

- The pump is reporting a fault; P_L03.Flt = TRUE
- The pump is not reporting as ready; P-L03.Rdy = FALSE

3.7.1.2 Interlocks

For Lift Pump P-L01 the interlocks are:

- P-L01 has experienced a run fault; P_L01.RunFlt = TRUE
- P-L01 VFD has experience a fault; P_L01.Flt = TRUE
- P-L01 low flow condition; FIT_L012.AlmL = TRUE

For Lift Pump P-L01 the interlocks are:

- P-L02 has experienced a run fault; P_L02.RunFlt = TRUE
- P-L02 VFD has experience a fault; P_L02.Flt = TRUE
- P-L02 low flow condition; FIT_L022.AlmL = TRUE

For Lift Pump P-L01 the interlocks are:

- P-L03 has experienced a run fault; P_L03.RunFlt = TRUE
- P-L03 VFD has experience a fault; P_L03.Flt = TRUE
- P-L03 low flow condition; FIT_L032.AlmL = TRUE

3.7.1.3 Modes of operation

Each pump can be selected to run in Manual or Auto mode from the SCADA system.

In manual mode, the duty staging of the pumps is ignored. The operator shall have the ability to start, stop, and change the speed setpoints of the pumps. In manual mode, each pumps interlocks and permissives shall still operate as intended (non by-passable).

In auto mode the pumps shall operate as described in Section 3.3.5.6. Pump Duty Sequencer – YC-L100

3.7.1.4 Backflush (De-Ragging):

The backflush cycle will be programed as follows:

1. The operator will set the desired backflush time by adjusting the backflush timer from HMI or SCADAS
2. The operator will then press the “Backflush Cycle Initiate” button from the HMI or SCADAS and the pump will go through the following sequence (unless cancelled by the user or a pump alarm/fault is registered):
    a. The pump is requested out of service.
    b. The pump is commanded to run in reverse (at a reduced speed) for the amount of time as indicated by the backflush timer.
    c. The pump is commanded to stop.
    d. The pump is requested back in service.
3. During this sequence the “Backflush Cycle Initiate” button should be grayed out and the HMI/SCADA should indicate that the cycle is taking place. Following the cycle, the “Backflush Cycle Initiate” button should be made available.

3.8 Building HVAC Controls

3.8.1 HVAC INTERFACE INPUTS TO HVAC CONTROLLER (TIC-L600)

INSTRUMENT TAG NUMBER	DESCRIPTION	LOCATION
FV-L641	Main floor supply fan, SF-L64, intake air damper actuator (Controlled by HVAC Controller)	Main Floor
FV-L642	Main floor supply fan, SF-L64, return/recirculation air damper actuator (Controlled by HVAC Controller)	Main Floor
FV-L651	Main floor exhaust fan, EF-L65, exhaust air damper actuator (Controlled by HVAC Controller)	Main Floor

INSTRUMENT TAG NUMBER	DESCRIPTION	LOCATION
HS-L600	Station occupied signal from light switch (Input to PLC and HVAC Controller)	Main Floor
TE-L600	Main floor supply duct temperature sensor downstream of SCR heater (Input to HVAC Controller)	Main Floor
TIC-L600	Main floor HVAC temperature controller	Main Floor
TS-L631	Pump room unit heater, UH-L63, thermostat (Standalone Controller)	PUMP ROOM
TY-L611	Main floor duct heater, HCE-L61, SCR controller (Controlled by HVAC Controller)	MAIN FLOOR

3.8.2 HVAC INTERFACE INPUTS TO PLC

INSTRUMENT TAG NUMBER	PLC INTERNAL TAG NUMBER	DESCRIPTION	LOCATION
HS-L600	HS_L600.In	Station occupied light switch (Input to PLC and HVAC Controller)	Main Floor
PDSH-L660	PDSH_L660.In	Main floor supply duct air filter, FIL-L66, air filter plugged switch	Main Floor
TT-L691	TT_L691.In	Main floor temperature transmitter	Main Floor
TT-L681	TT_L681.In	Pump room temperature transmitter	Main Floor
FSL-L643	FSL_L643.In	Main floor supply fan airflow switch	Main Floor
FSL-L652	FSL_L652.In	Main floor exhaust fan airflow switch	Main Floor
FV-L641	FV_L641.Fbk	Intake air damper position feedback	Main Floor
FV-L642	FV_L642.Fbk	Return/recirculation air damper feedback position	Main Floor
FV-L651	FV_L651.Fbk	Exhaust air damper position	Main Floor

3.8.3 PLC HVAC ALARMS

The following alarms will be generated:

1. FSL-L643: Supply Fan (SF-L64) failure alarm
    a. Supply fan failure alarm is determined via a loss of air flow as monitored by FSL-L643
2. FSL-L652: Exhaust Fan (EF-L65) failure alarm
    a. Supply fan failure alarm is determined via a loss of air flow as monitored by FSL-L652

3. PDSH-L660: Supply Fan Filter (FIL-L66) dirty filter alarm
4. TT-L671: Motor Room Low Temperature alarm
5. TT-L671: Motor Room High Temperature alarm
6. TT-L681: Pump Room Low Temperature alarm
7. TT-L681: Pump Room High Temperature alarm
8. TT-L691: Main Level Electrical Room Low Temperature alarm
9. TT-L691: Main Level Electrical Room High Temperature alarm
10. TT-L692: Outdoor Low Temperature alarm
11. TT-L692: Outdoor High Temperature alarm

3.8.3.1 Alarm Settings

INSTRUMENT TAG	ALARM TAG NUMBER	ALARM LOW-LOW SETTING	ALARM LOW SETTING	ALARM HIGH SETTING	ALARM HIGH-HIGH SETTING
FSL_L643	FAL_L643	N/A	80% the design flow	N/A	N/A
FSL_L652	FAL_L652	N/A	80% the design flow	N/A	N/A
PDSH_L660	PDAH_L660	N/A	N/A	200 Pa	N/A
TT_L671	TAL_L671	N/A	5°C	N/A	N/A
TT_L671	TAH_L671	N/A	N/A	38°C	N/A
TT_L681	TAL_L681	N/A	5°C	N/A	N/A
TT_L681	TAH_L681	N/A	N/A	38°C	N/A
TT_L691	TAL_L691	N/A	5°C	N/A	N/A
TT_L691	TAH_L691	N/A	N/A	25°C	N/A
TT_L692	TAL_L692	N/A	-40°C	N/A	N/A
TT_L692	TAH_L692	N/A	N/A	38°C	N/A

3.8.3.2 Alarm Logic

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
FSL_L643	FSL_L643.In	FAL_L643	Main floor supply fan airflow switch	F/S	SET(FAL_L643) on FSL_L643.In = TRUE for 2sec RESET(FAL_L643) on FSL_L643.In = FALSE for 3sec	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
FSL_L652	FSL_L652.In	FAL_L652	Main floor exhaust fan airflow switch	F/S	SET(FAL_L652) on FSL_L652.In = TRUE for 2sec RESET(FAL_L652) on FSL_L652.In = FALSE for 3sec	Auto
PDSH_L660	PDSH_L660.In	PDAH_L660	Main floor supply air filter plugged	F/S	SET(PDSH_L660) on PDSH_L660.In = TRUE for 2sec RESET(PDSH_L660) on PDSH_L660.In = FALSE for 3sec	Auto
TT_L671	TT_L671.AlmL	TAL_L671	Motor room low temperature alarm	-	SET(TT_L671.AlmL) on (TI_L671.Out <= 5°C) = TRUE SET(TAL_L671) on TT_L671.AlmL = TRUE RESET(TT_L671.AlmL) on (TI_L671.Out > 5°C) = TRUE RESET(TAL_L671) on TT_L671.AlmL = FALSE	Auto
TT_L671	TT_L671.AlmH	TAH_L671	Motor room high temperature alarm	-	SET(TT_L671.AlmH) on (TI_L671.Out <= 38°C) = TRUE SET(TAH_L671) on TT_L671.AlmH = TRUE RESET(TT_L671.AlmH) on (TI_L671.Out > 38°C) = TRUE RESET(TAH_L671) on TT_L671.AlmH = FALSE	Auto
TT_L681	TT_L681.AlmL	TAL_L681	Pump room low temperature alarm	-	SET(TT_L681.AlmL) on (TI_L681.Out <= 5°C) = TRUE SET(TAL_L681) on TT_L681.AlmL = TRUE RESET(TT_L681.AlmL) on (TI_L681.Out > 5°C) = TRUE RESET(TAL_L681) on TT_L681.AlmL = FALSE	Auto
TT_L681	TT_L681.AlmH	TAH_L681	Pump room high temperature alarm	-	SET(TT_L681.AlmH) on (TI_L681.Out <= 38°C) = TRUE SET(TAH_L681) on TT_L681.AlmH = TRUE RESET(TT_L681.AlmH) on (TI_L681.Out > 38°C) = TRUE RESET(TAH_L681) on TT_L681.AlmH = FALSE	
TT_L691	TT_L691.AlmL	TAL_L691	Main floor room low temperature alarm	-	SET(TT_L691.AlmL) on (TI_L691.Out <= 5°C) = TRUE SET(TAL_L691) on TT_L691.AlmL=TRUE RESET(TT_L691.AlmL) on (TI_L691.Out > 5°C) = TRUE RESET(TAL_L691) on TT_L691.AlmL = FALSE	Auto
TT_L691	TT_L691.AlmH	TAH_L691	Main floor room high temperature alarm	-	SET(TT_L691.AlmH) on (TI_L691.Out < 25°C) = TRUE SET(TAH_L691) on TT_L691.AlmH = TRUE RESET(TT_L691.AlmH) on (TI_L691.Out >= 25°C) = TRUE RESET(TAH_L691) on TT_L691.AlmH = FALSE	Auto
TT_L692	TT_L692.AlmL	TAL_L692	Main floor outside low temperature alarm	-	SET(TT_L692.AlmL) on (TI_L1692.Out <= -40°C) = TRUE SET(TAL_L692) on TT_L692.AlmL = TRUE RESET(TT_L692.AlmL) on (TI_L692.Out > -40°C) = TRUE RESET(TAL_L692) on TT_L692.AlmL = FALSE	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
TT_L692	TT_L692.AlmH	TAH_L692	Main floor outside high temperature alarm	-	SET(TT_L692.AlmH) on (TI_L692.Out < 38°C) = TRUE SET(TAH_L692) on TT_L692.AlmH = TRUE RESET(TT_L692.AlmH) on (TI_L692.Out >= 38°C) = TRUE RESET(TAH_L692) on TT_L692.AlmH = FALSE	Auto

3.8.4 CONTROL NARRATIVE

Indoor Design Temperatures

INDOOR DESIGN TEMPERATURES	HEATING	COOLING
MAIN FLOOR ELECTRICAL ROOM	18°C	26°C, 30-60% RH
LOWER LEVEL PROCESS AREAS	18°C	LOWER OF 35°C OR 5°C ABOVE AMBIENT TEMPERATURE WHEN OUTDOOR TEMPERATURE > 15°C

The supply and exhaust fans shall provide continuous ventilation at the rate of at least six (6) Air Changes per Hour (ACH). The light switch on the main level is used as an occupancy sensor. This light switch will send output to the PLC through a relay. The relay contacts will also signal the HVAC controller to modulate the return air mixing damper to provide 25% outdoor air when the station is un-occupied and 100% outdoor air when the station is occupied. Re-circulation is not permitted when the station is occupied.

Two temperature switches will be used to determine if the system should provide free air cooling. When free air cooling is requested, the dampers are modulated to 100% outdoor air. The temperature switch located outside, TSL-L600, will allow for free air cooling if the outdoor temperature is below 15°C. The indoor temperature switch TSH-L600 shall have dual temperature setpoints. The fist setpoint will call for free air cooling to happen when TSL-L600 is below 20°C and TSH-L600 is above 25°C. The second temperature setpoint of TSH-L600 shall call for free air cooling at 35°C and bypass TSL-L600. The second setpoint is provided to allow for special situations where the outdoor air temperature is above the setpoint of TSL-L600 and the building temperature is still rising. In this instance it is better to provide warmer free air cooling than no free air cooling at all.

The ventilation system will be continuously monitored by air flow switches on the supply fan (SF-L64) and exhaust fan (EF-L65). Upon loss of airflow signal from either fan, the PLC will signal and alarm indicating failure of the ventilation system.

The main floor electrical room has an air conditioning unit (AC-L68) with a wall thermostat to control the heating/cooling/economizer function to maintain the space temperature setpoint.

There are three temperature transmitters (RTDs), one located in the main floor electrical room, one located outdoors, and one in the pump room. These three RTD outputs will be given to the PLC and will be continuously monitored and alarmed (low/high temperature) as required.

The supply fan duct heater (HCE-L61) will temper supply air by modulating SCR controller based on a discharge temperature sensor. A temperature sensor connected to TIC-L600 will be located downstream of the duct heater to monitor supply air temperature.

Differential pressure switch across the supply fan air filter (FIL-L66) will be monitored and alarm for dirty filter condition.

The unit heater (UH-L63) in the pump room will be controlled by a wall thermostat.

3.9 Miscellaneous Controls

3.9.1 PLC INTERFACE INPUTS AND RELATED INSTRUMENTS

INSTRUMENT TAG NUMBER	PLC INTERNAL TAG NUMBER	DESCRIPTION	LOCATION
ESL-L528	ESL_L528	120 VAC POWER FAIL RELAY	MAIN FLOOR
ESL-L712	ESL_L712	600 VAC POWER FAIL RELAY	MAIN FLOOR
MCC-L71.PM	MCC_L71.PM	MCC-L71 600 VAC POWER METER (Via Ethernet to PLC)	MAIN FLOOR
XS-L711	XS_L711	MCC-L711 TRANSIENT VOLTAGE SURGE SUPRESSOR SWITCH	MAIN FLOOR
YA-L543	YA_L543	PLC PANEL L81 UPS FAULT ALARM	MAIN FLOOR
YS-L543-1	YS_L543	PLC PANEL L81 UPS ON BATTERY STATUS	MAIN FLOOR
YS-L543-2	YS_L543	PLC PANEL L81 UPS CHARGING STATUS	MAIN FLOOR
YA-L541-1	YA_L541_1	PS01 24VDC POWER SUPPLY FAULT	MAIN FLOOR
YA-L541-2	YA_L541_2	PS02 24VDC POWER SUPPLY FAULT	MAIN FLOOR

3.9.2 INTERNAL VARIABLES

The following variables shall be used to toggle the PLC Auto/Manual mode and to reset all alarms.

PLC INTERNAL VARIABLE	DESCRIPTION	RANGE	INITIAL VALUE
PLC_Auto_Cmd	PLC Auto Command (DNP3 Binary Output sent by SCADA) 1 = Auto, 0 = Not Auto	-	-
PLC_Manual_Cmd	PLC Manual Command (DNP3 Binary Output sent by SCADA) 1 = Manual, 0 = Not Manual	-	-
PLC_Auto_Fbk	In Service Command Feedback (DNP3 Binary Input sent to SCADA): 1 = In Auto, 0 = Not In Auto	-	-
PLC_Manual_Fbk	PLC Manual Feedback (DNP3 Binary Input sent to SCADA) 1 = Manual, 0=Not Manual	-	-
PLC_AutoMan_Sts	PLC Auto/Manual Status (DNP3 Binary Input sent to SCADA) 1 = Auto, 0 = Manual	-	-
PLC_ResetOn_Cmd	Reset ON Cmd (DNP3 Binary Output sent by SCADA) 1 = Reset Alarms, 0 = Do Not Reset Alarms		
PLC_ResetOn_Fbk	Reset ON Cmd Feedback (DNP3 Binary Input sent to SCADA) 1 = Alarms Reset, 0 = Alarms Not Reset		
PLC_ResetOn_Sts	Reset ON Status (DNP3 Binary Input sent to SCADA) 1 = Reset, 0 = Not Reset		

3.9.3 INTERNAL ALARMS

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
ESL-L712	ESL_L712.In	EAL_L712	MCC-L71 600VAC POWER FAIL ALARM	F/S	SET(ESL_L712) on ESL_L712.In = TRUE for 1sec RESET(ESL_L712) on ESL_L712.In = FALSE for 3sec	Auto
ESL-L528	ESL_L528.In	EAL_L528	120VAC POWER FAIL ALARM	F/S	SET(ESL_L528) on ESL_L528.In = TRUE for 1sec RESET(ESL_L528) on ESL_L528.In = FALSE for 3sec	Auto
YA-L543	YA_L543.In	YA_L543	PLC PANEL L81 UPS FAULT ALARM	F/S	SET(YA_L543) on YA_L543.In = TRUE for 1sec RESET(YA_L543) on YA_L543.In = FALSE for 3sec	Auto

PHYSICAL INPUT TAG	INTERNAL TAG	ALARM TAG	DESCRIPTION	FAIL SAFE	ALARM LOGIC	RESET
YA-L541-1	YA_L541_1.In	YA_L541_1	PS01 24VDC POWER SUPPLY FAULT	F/S	SET(YA_L541_1) on YA_L541_1.In = TRUE for 1sec RESET(YA_L541_1) on YA_L541_1.In = FALSE for 3sec	Auto
YA-L541-2	YA_L541_2.In	YA_L541_2	PS02 24VDC POWER SUPPLY FAULT	F/S	SET(YA_L541_2) on YA_L541_2.In = TRUE for 1sec RESET(YA_L541_2) on YA_L541_2.In = FALSE for 3sec	Auto

3.9.4 CONTROL NARRATIVE

The PLC shall monitor the following instruments:

1. MCC-L71 TVSS status
2. PLC panel UPS fault status
3. PLC panel UPS battery mode status
4. PLC panel UPS charging mode status
5. PLC panel 120VAC supply power status
6. PLC alarm mode test switch (HS-L522)
    a. The Alarm Test Switch (when the switch is in the Alarm Test position) shall prevent alarms from being reported to the SCADA system. This switch allows E&I staff to test/simulate signals at the PLC for troubleshooting purposes without sending nuisance alarms to SCADA. This switch shall not alter the system controls. i.e. If an alarm is simulated that locks out a pump the pump shall not start due to the simulated alarm, the PLC still recognizes this alarm as a real alarm.
7. PLC panel 24VDC PS01 fault status
8. PLC panel 24VDC PS21 fault status

3.9.5 TIME DELAYS

When the PLC receives a digital command from the SCADA, the PLC shall have a time delay between receiving the command and changing it back to zero so it can be detected on SCADA.

DNP3 binary outputs shall be a pulse in the PLC program. The mapped input shall be a 5 second pulse. This time shall be adjusted as necessary during commissioning.

3.9.6 ON DEMAND EVENTS

On demand events for analog points shall be generated by the NOR card periodically as required by the city

3.9.7 DEADBAND

During commissioning, Contractor to set the threshold (deadband) to 2% within the NOR card. The City will review the data coming into SCADA and provide instructions for the Contractor to adjust the deadband accordingly.

3.9.8 DNP3 DIGITAL OUTPUT MAPPING

Each DNP3 output point will need to be mapped (mirrored) to a DNP3 input point of the same type (while keeping the output point). This mapped DNP3 input point will be used in SCADA to detect change of state.

3.9.9 GENERAL I/O MAPPING & TESTING

All I/O's, Alarms and any necessary points shall be sent to the city SCADA using DNP3.

Provide testing and confirmation of the DNP3 mapping list to the city SCADA system (functional test whenever possible).

Provide testing and verification of instrument readings, alarm conditions and control logic with the city SCADA system.

3.9.10 PLC HEARTBEAT

A heartbeat is to be implemented in the PLC named as "PLC_Heartbeat" so that the station's PLC can be monitored on SCADA (i.e. a DNP3 analog input point that is incremented every one second by the PLC until it reaches 32767, reset to zero and continue incrementing).

3.9.11 ADDING ADDITIONAL TAGS

Any and all additional tags or alarm points shall be added before/during commissioning as identified by the contract administrator.

END OF CONTROL NARRATIVE