PART VIII – PROCESS CONTROL NARRATIVE

Lift Station No. 1 Process Control Narrative

2023 Lift Station No. 1 Upgrades

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Prepared for:

City of Iqaluit

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LIFT STATION NO. 1 PROCESS CONTROL NARRATIVE

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LIFT STATION NO. 1 PROCESS CONTROL NARRATIVE

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Abbreviations

AE	Analysis Element (probe)
AIT	Analysis Indication Transmitter
AI	Analog input from a device
AO	Analog output to a device
ATS	Automatic Transfer Switch
Bool	Boolean value (on/off)
CO	Carbon Monoxide
DI	Discrete input (voltage one of two levels, from open or closed contact)
DO	Discrete output (voltage one of two levels, from open or closed contact)
ESD	Emergency Stop Device
ETM	Elapsed Time Meter
FQIT	Flow Totalization Indication Transmitter
H_2S	Hydrogen Sulfide
H	High
HL	High level
HMI	Human Machine Interface
HOA	Hand-Off-Auto
HP	Horsepower
HS	Hand Switch
HVAC	Heating, Ventilation, Air Conditioning
kW	Kilowatt
L/s	Liters per second
LEL	Lower Explosive Limit (methane CH4)
LE	Level Element (continuous level measurement device, typically an ultrasonic level element)
LIT	Level Indicating Transmitter
LT	Level Transmitter (No local LCD display)
L	Low
LL	Low level
LS	Level Switch
MCC	Motor Control Center
N/A	Not Applicable
NOx	Nitric Oxide (gas)
O_2	Oxygen
P	Pump (Raw Wastewater)

PG	Pressure Gauge
PIT	Pressure Indication Transmitter
PLC	Programmable Logic Controller
SCADA	Supervisory Control and Data Acquisition
SP	Setpoint
TDH	Total Dynamic Head
TT	Temperature Transmitter
UL	Multivariable Light
UPS	Uninterruptible Power Supply
V(ac)	Volts (alternating current)
VFD	Variable Frequency Drive
ZSC	Position Switch - Closed

1.0 INTRODUCTION

This narrative shall be the basis for the PLC, HMI, and SCADA programming as well as basic testing and commissioning expectations of the new Lift Station No.1 expansion in terms of verifying system functionality. This controls narrative describes the required operation of the wastewater pumping system, and associated building appurtenances, for the Lift Station No. 1 infrastructure in the City of Iqaluit.

The following document is a brief overview of the system operational philosophy and control narrative to assist the contractor and operator with startup and commissioning of the system, as well as to allow the programmer to complete all essential site programming. An input/output listing is provided in **Appendix C**.

NOTE: This process control narrative does not discuss operation of the existing Lift Station No. 1 pumps and associated instrumentation; that equipment shall remain as is, but the existing pumps will be locked out of operation under normal Lift Station No. 1 operations, and shall remain as a cold standby to the lift station for emergency use should the new pumps both fail.

1.1 SYSTEM DESCRIPTION & EQUIPMENT OVERVIEW

The City of Iqaluit's Lift Station No. 1 has been upgraded to increase the pumping capacity and capability to macerate big solids present in the sewage through submersible chopper pumps. The new Lift Station No. 1 pumps will be able to handle future flows up to **90 L/s** (which has an assumed design horizon of 2042).

The lift station's PLC system monitors process variables such as wet well level, pump operational statuses, discharge pressure and flow, HVAC system statuses, building power and temperature, and other operating statuses, generating alarms as required for annunciation to operations. All monitored signals and alarms are displayed on the local HMI and the SCADA system. The SCADA system has access to the Lift Station's Ethernet network through Iqaluit's existing radio link to the facility. Alarms are calculated and generated in the PLC and communicated, and annunciated via the local HMI and the SCADA system.

The Lift Station No. 1 PLC system has been upgraded from an Allen Bradley SLC system to an Allen Bradley CompactLogix system.

The new lift station components monitored at the facility through instrumentation are outlined in **Section 1.1.1** below.

NOTE: this list does not include the existing Lift Station No. 1 pumps and associated instrumentation. The existing Lift Station No. 1 pumping and associated instrumentation system is to remain operational and intact, however the existing wet well pumps are to be physically locked out via the electrical distribution system and shall act as a cold standby set of pumps to the new upgraded system. The existing pumps

shall not be permitted to run while any of the new 60 HP pumps are available; in order for the existing pumps to operate, the 60 HP pumps must be physically locked out, with any valving to redirect flows to the existing wet well placed into position by Operations.

1.1.1 Lift Station No.1 Expansion Components:

- One (1) new PLC cabinet with local HMI for monitoring and control of the new equipment within the new electrical and pump rooms and upgraded building systems. Various PLC control panel components are monitored for operational statuses. Includes redundant backup controller system for new pump system.
- One (1) existing PLC cabinet with upgraded PLC chassis, interconnected into the new PLC cabinet to form a single control system. Existing Lift Station No. 1 pumps and associated process equipment to remain.
- One (1) wet well fitted with two level transmitters and transducers (one ultrasonic, one radar) and a backup high-high level switch, with signals connected to the PLC for signal display to HMI and SCADA.
- One (1) flow totalizing indicating transmitter (FQIT) and pressure indicating transmitter (PIT) for monitoring the new wet well discharge flow and pressure.
- Three (3) submersible wastewater chopper pumps, VFD driven, with associated piping that is equipped with isolation valves, check valves, pressure indication, and flow totalization. Pumps are complete with submergence, overtemperature, and oil reservoir low level monitoring instruments, interconnected into the VFD control wiring for pump protection interlocks.
- Mechanical HVAC & Plumbing upgrade systems, including new boiler system; cooling system; ventilation equipment; fuel oil system; generator HVAC system; and heating system.
- Building monitoring (temperature, gas monitoring where applicable (H_2S, LEL, CO, NOx), temperature, smoke/fire, and intrusion sensors).
- New, upsized generator with associated automatic transfer switch; expanded power distribution system including new motor control center; and electrical distribution system health monitoring and operational statuses.
- Annunciation beacons for gas detection and HVAC monitoring system alarms.

2.0 LIFT STATION NO. 1 WASTEWATER PUMPING

2.1 INTRODUCTION

NOTE: This process control narrative does not discuss operation of the existing Lift Station No. 1 pumps and associated instrumentation; that equipment shall remain as is, but the existing pumps will be locked out of operation under normal Lift Station No. 1 operations, and shall remain as a cold standby to the list station for emergency use should the new pumps both fail.

2.1.1 Pump Operation General Overview

Raw wastewater from the City's collection system enters the wet well (T-01-100) of Lift Station No. 1 (LS No.1). Three raw wastewater chopper pumps (P-01-111/121/131) located in the wet well operate in a lead/lag/standby mode to pump the raw wastewater to the Iqaluit WWTP. Each of the submersible raw wastewater pumps (P-01-111/121/131) has a capacity of 45 L/s and is driven by a variable frequency drive (VFD) and motor combination that operates based on the influent flow and corresponding wastewater level of the wet well in a Lead/Lag/Standby operation. One raw wastewater pump operates at current low influent flows (20-45 L/s) to the LS No. 1. Two raw wastewater pumps will operate at future higher influent flows (45 – 90 L/s) to the LS No. 1.

The wet well of the Lift Station No. 1 is equipped with one ultrasonic level indicator transmitter and transducer (LIT-01-011 with LE-01-011), one radar level indicator transmitter and transducer (LIT-01-012 with LE-01-012), and one high-high level switch (LSLL-01-113) to monitor the wastewater level. The level devices are used to control pump start / stops; pump speeds; and alarming.

The LS No.1 pumping system is provided with an automatic recirculation mixing system of the wastewater within the wet well with the main objective to maintain the solids in the wastewater in suspension. The automatic system incorporates a 3-way valve, installed at the discharge side of the lead pump with a linear actuator and a timer-based control relay, to control the amount of wastewater recirculation time.

2.1.2 Reference P&IDs

The following table summarizes the reference P&IDs related to the LS No.1 that should be referred to when reviewing the Process Control Narrative.

Table 2.1: LS No.1 Reference P&IDs

Drawing	Description
P-601/602/603	PIPING & INSTRUMENTATION LEGEND – SHEET 1/2/3
P-604/605	PIPING & INSTRUMENTATION DIAGRAM – LIFT STATION NO. 1 – SHEET 1/ 2

These P&IDs have been attached in **Appendix A** for easy referral.

2.1.3 Equipment and Instrumentation List

The following **Table 2.2** and **Table 2.3** outline the equipment and instrumentation associated with the LS No. 1 pumping system, and which are further reviewed as part of this Process Control Narrative. The system I/O list is also included in **Appendix C**. NOTE: fire detection equipment is not included in the below tables.

Table 2.2: Equipment Tags

Tag	Description
ARV-01-100	Air Release Valve
ATS-01-001	Automatic Transfer Switch
CV-01-100/200/300	Check Valves
FCV-01-141	Flow Control Valve for Wastewater Recirculation
GEN-01-001	Generator
HST-01-100	Electric Pump Hoist
P-01-111/121/131	Submersible Wastewater Chopper Pumps
PLV-01-100/200/300	Plug Valves
SPD-01-922	PLC Surge Protection Device
T-01-100	Lift Station No. 1 Wet Well
UPS-01-920	Uninterruptable Power Supply for PLC
VFD-01-111/121/131	Wastewater Pump Variable Frequency Drive

Table 2.3: Instrumentation Tags

Tag	Description
AIT-01-905 with AE-01-905 AIT-01-915 with AE-01-915	H_2S Gas Detector
AIT-01-906 with AE-01-906 AIT-01-916 with AE-01-916	LEL Gas Detector
AIT-01-917 with AE-01-917	NOx Gas Detector
AIT-01-918 with AE-01-918	CO Gas Detector
FQIT-01-150	Flow Totalization Indication Transmitter (Magnetic Flow Meter)
LIT-01-011, LE-01-011	Wet Well Level Indication Transmitter and Transducer (Ultrasonic)
LIT-01-012, LE-01-012	Wet Well Level Indication Transmitter and Transducer (Radar)
LSHH-01-013	Wet Well High-High Level Switch
PG-01-151	Pressure Gauge

Tag	Description
PIT-01-151	Pressure Indicator Transmitter
TT-01-903/904	Temperature Sensor
LS-01-111/121/131	Chopper Pump Oil Relay Level Switches
UL-01-908A/B	Electrical Room HVAC, CO, NOx Alarm Beacons
UL-01-909A/B	Electrical Room H_2S Alarm Beacons
UL-01-910A/B	Electrical Room LEL Alarm Beacons
UL-01-911A/B	Pump Room H_2S Alarm Beacons
UL-01-912A/B	Pump Room LEL Alarm Beacons
UL-01-913A/B	Pump Room HVAC Alarm Beacons
UL-01-914A/B	Boiler System Alarm Beacons
ZSC-01-202/203	Intrusion Detection Door Switches

Table 2.4: Major Process Equipment and Associated Valves and Instrumentation

Equipment Name	Tag	Equipment Details	Control / Isolation Valves	Instrumentation
Wastewater Pump 1	P-01-111	Make: Vaughan Co. Inc. Model: SAV-145 Power: 45 kW	PLV-01-100 CV-01-100	VFD-01-111 HS-01-111 MS-01-111 TS-01-111 LS-01-111
Wastewater Pump 2	P-01-121	Make: Vaughan Co. Inc. Model: SAV-145 Power: 45 kW	PLV-01-200 CV-01-200	VFD-01-121 HS-01-121 MS-01-121 TS-01-121 LS-01-121
Wastewater Pump 3	P-01-131	Make: Vaughan Co. Inc. Model: SAV-145 Power: 45 kW	PLV-01-300 CV-01-300	VFD-01-131 HS-01-131 MS-01-131 TS-01-131 LS-01-131
LS No. 1 Wet Well	T-01-111	N/A	N/A	LIT-01-011, LE-01-011 LIT-01-012, LE-01-012 LSHH-013

2.2 SETPOINTS

2.2.1 Wet Well Levels

The operational setpoints for the new LS No. 1 wet well were selected based on the useful volume of the wet well, which is summarized in the table below:

Table 2.5: Wet Well Dimensions and Useful Volume

Parameter	Value
Wet Well Dimensions	
Total Width	4.0 m
Total Length	3.3 m
Total Depth	5.5 m
Wet Well Volume	
Total Volume	72.4 m^3
Useful Depth	3.23 m
Useful Volume	42.6 m^3

The pre-established elevations of operation for the new wet well of the LS No. 1, are as listed in **Table** 2.6 below, along with its corresponding useful wet well volume:

Table 2.6 Lift Station No. 1 Wet Well Level Setpoints and Corresponding Useful Volume

Setpoint	Applicable Instruments	Absolute Geodetic Elevation (m)	PLC / HMI / SCADA Set Point Value (m)	Wet Well Volume (m^3)	Adjustable? (Y/N)
High High Level Alarm (LAHH) – Backup Bulb	LSHH-01-013	4.622	3.250	42.9	N
Radar High High Level Alarm (Zelio LAH) – Transmitter Relay Output	LIT-01-012	4.572	3.200, hard set in transmitter	42.2	N
High High Level Alarm (LAHH) – Non-Contact Instruments	LIT-01-011/012	4.522	3.150	41.6	Y
Radar High Level Alarm (Zelio LAH) – Transmitter Relay Output	LIT-01-012	4.122	2.750, hard set in transmitter	36.3	N
High Level Alarm (LAH)	LIT-01-011/012	4.022	2.650	35.0	Y
Lag Pump Starts	LIT-01-011/012	3.522	2.150	28.4	Y
Lead Pump Starts	LIT-01-011/012	3.022	1.650	21.8	Y
Recirculation Mode Stop	LIT-01-011/012	2.872	Lead Pump Start setpoint minus 0.050 m	19.8	N
Recirculation Mode Start	LIT-01-011/012	2.372	1.400	13.2	N
Lag Pump Stops	LIT-01-011/012	2.522	1.150	15.2	Y
Lead Pump Stops	LIT-01-011/012	2.022	0.650	8.6	Y
Low Level Alarm (LAL)	LIT-01-011/012	1.822	0.450	5.9	Y
Radar Low Level Alarm (Zelio LAL) – Transmitter Relay Output	LIT-01-012	1.822	0.450, hard set in transmitter	5.9	N
Low-Low Level Alarm (LALL)	LIT-01-011/012	1.622	0.250	3.3	Y
Radar Low Low Level Alarm (Zelio LALL) – Transmitter Relay Output	LIT-01-012	1.622	0.250, hard set in transmitter	3.3	N
Bottom of Wet Well	–	1.372	0.000	-	N

The ultrasonic level indication transmitter LIT-01-011 monitors wet well level and provides the continuous level signal and a digital loss of echo (fault) signal to the PLC for monitoring and display on HMI / SCADA. The radar level indication transmitter LIT-01-012 monitors wet well level and provides the continuous level signal and a digital loss of echo (fault) signal to the PLC for monitoring and display on HMI / SCADA. Additionally, LIT-01-012 provides four digital level alarm signals (low low, low, high, high high) to the Zelio backup controller for use in a backup pumping system which runs the pumps in the event of a PLC failure.

Instantaneous level readings from the level indication transmitters are to be trended on the HMI and SCADA; refer to Section **5.0 Automation and Control Systems** for additional details.

2.2.2 Pressure and Flow

The wastewater pump common discharge header is fitted with a pressure gauge (PG) instrument, along with a pressure indication transmitter (PIT-01-151) . The common discharge header is also fitted with a magnetic flowmeter (FQIT-01-150), which outputs both instantaneous and totalized flow signals.

Both pressure and flow signals are available at the PLC for trending and system performance monitoring. **Table 2.7** below summarizes the pressure and flow alarm setpoints for the system operation, when wastewater is being pumped:

Table 2.7: PIT and FQIT Alarm Setpoints

Instrument	Setpoint	Value
PIT-01-151	High Pressure Alarm	>475 kPa
PIT-01-151	High High Pressure Alarm	>525 kPa
FQIT-01-150	High Flow Alarm	>60 L/s with one pump running, >100 L/s with two pumps running
FQIT-01-150	Low Flow Alarm	>1 L/s but <10 L/s (while at least one pump is running for at least 120 seconds)
FQIT-01-150	No Flow Alarm	<1 L/s (while at least one pump is running for at least 60 seconds)

2.3 CONTROLS APPROACH

2.3.1 Manual / Automatic Operation

2.3.1.1 Manual (Local) Operation

<u>IT IS IMPERATIVE THAT NO MORE THAN TWO WET WELL PUMPS ARE RUNNING SIMULTANEOUSLY</u> – the electrical system is unable to run three pumps simultaneously, and will result in main breaker (or generator breaker if on standby power) tripping, or potentially trip the Utility fuses. Consequently, it is recommended to only run a single pump in manual mode of operation at a time, and to ensure that no more than two pumps are running at any given time, which can be accommodated by temporarily putting the third pump that is not running into OFF (via Hand switch, or via HMI remote OFF setting); if two pumps are running in manual mode of operation it is strongly advised to place the third pump into OFF position to prevent automated starting of a third pump from the PLC or Zelio controller systems.

Operations may directly manipulate the VFD controls via a local keypad, HOA switch, and potentiometer at each of the VFDs for the pumps at the MCC. The local control of the VFDs should only be required in the event of a complete controls failure, during maintenance, or for diagnostic purposes.

2.3.1.2 Automatic (Remote) Operation

<u>IT IS IMPERATIVE THAT NO MORE THAN TWO WET WELL PUMPS ARE RUNNING SIMULTANEOUSLY</u> – the electrical system is unable to run three pumps simultaneously, and will result in main breaker (or generator breaker if on standby power) tripping, or potentially trip the Utility fuses. As such, the PLC and Zelio controllers shall be programmed to only stage up to two pumps to run in an automated cycle.

For typical control of the facility, the PLC system monitors and controls the pumps based on the start/stop levels in the wet well, calling pumps to run/stop based on the selected pump sequencing below. Pumps are available for operating in Auto if the respective pump's HOA switch is set to the "AUTO" position; and the pump does not have an active fault, motor fault, or no-flow (pump running but no output flow detected for sixty seconds) alarm condition.

The primary level input (AI signal) to the PLC is from the ultrasonic level indication transmitter LIT-01-011 by default. The radar level indication transmitter LIT-01-012 provides a secondary backup level AI signal to the PLC, plus HH, H, L, and LL DI signals to a backup Zelio logic controller within the PLC control panel. The two analog level signals are used in conjunction with each other to verify the validity of the analog level measurement, which provide an alarm, indicating level measurement system mismatch, if the instruments are not within 250mm of each other. By default, LIT-01-011 is the lead transmitter, but LIT-01-012 will be called in as the lead transmitter for continuous level measurement if LIT-01-011 is faulted or unavailable. Additionally, the HMI and SCADA screens shall allow for manual toggling of the lead transmitter via a toggle selector.

In the event that LIT-01-011 becomes unavailable (loss of echo or analog signal out of range), the transmitter LIT-01-012 provides a secondary backup analog signal to the PLC. Additionally, the LIT-01-012 provides HH, H, L, and LL signals to the backup Zelio smart relay logic controller via relay outputs from the transmitter. Refer to Table 2.5 for the LIT-01-012 relay output setpoints from the transmitter to the Zelio controller.

Under normal operating conditions, the PLC will call the lead pump to run upon wet well level reaching the Lead Pump Start elevation, and will also call the lag pump to run upon Lag Pump Start elevation. A high-level alarm signal or a high-high level alarm signal will call both pumps to stage up and run. The lag pump will be called to stop at the Lag Pump Stop elevation, and the lead pump will be called to stop at the Lead Pump Stop elevation. All pumps will have their run commands unlatched at either of the low or low low levels, provided no high or high high level alarm condition is in effect (high level alarms are prioritized over low level alarms).

A high high level bulb LSHH-01-013 provides a redundant high priority high high level alarm to annunciate a high high critical level alarm for annunciation to operations, and redundantly is used to stage both lead and lag pumps into operation. If the level bulb's level alarm signal triggers the pumps to stage up and run, it will pump the wet well down until a low or low low level alarm is reached and no active high high level alarm remaining (high level alarms are prioritized over low level alarms).

2.3.1.3 Backup Automatic Operation

In the event of a failure of the PLC or analog level control that prevents proper pump operation through the PLC, redundant backup automated control of the pumps will be provided by the Zelio smart relay logic controller installed within the site PLC control panel. The Zelio will use the LIT-01-012 level alarm relays, programmed for the high-high, high, low, and low-low alarm elevations (HH, H, L, and LL), as digital signals to provide start and stop commands to the pumps, independent of the PLC.

The Zelio backup system can be enabled / disabled via an AUTO-OFF selector switch on the front of the PLC panel. If the switch is in "AUTO" position, the Zelio controller will function per the philosophy outlined below. In the OFF position, the Zelio logic is inhibited within the Zelio controller itself. An indicator light on the PLC panel door provides additional visual indication on if the backup system is on or off.

The Zelio logic controller accepts HH, H, L, and LL digital signals from the radar LIT-01-012 relay outputs, as well as Zelio Auto status and pump run status signals. In the Zelio logic, high level signals are prioritized over low level signals. If a HH or H signal remains active in the Zelio for three straight minutes, a pump will be called to run by issuing a run-high-speed command (run VFD at full speed) from the Zelio controller to the respective pump VFD. If the HH or H signal(s) remain active in the Zelio for seven straight minutes, a second pump will be called to run by issuing a run-high-speed command (run VFD at full speed). At the completion of a pump cycle, the Zelio controller shall rotate the lead/lag/standby pump sequence.

If maintenance is being performed on the radar level instrument LIT-01-012, it is recommended to disable the Zelio backup system via the selector switch on the PLC control panel to avoid potential starting of pumps due to nuisance alarms.

The PLC monitors the Zelio backup controller health via a watchdog bit that changes state every 30 seconds; failure of the bit to change state after 2 minutes will generate and alarm for annunciation via HMI and SCADA. The PLC also monitors the Zelio AUTO/OFF selector switch for auto status, for display on HMI and SCADA.

2.3.1.4 Default Mode of Operation

The wastewater pumping system shall be set for Automatic operation under normal operation of the system. Manual operation of the pumping system shall only be utilized to troubleshoot and test the system.

2.3.1.5 Existing Pumping System

The existing Lift Station No. 1 pumping and associated instrumentation system is to remain operational and intact, however the existing wet well pumps are to be physically locked out via the electrical distribution system and shall act as a cold standby set of pumps to the new upgraded system. The existing pumps shall not be permitted to run while any of the new 60 HP pumps are available. In order for the existing pumps to operate, the 60 HP pumps must be physically locked out, with any valving to redirect flows to the existing wet well placed into position by Operations.

2.3.2 Normal Conditions

2.3.2.1 Pump Operation

The operator can select / toggle the order in which the pumps are called to run. The operator may wish to change the order in which the pumps are activated for the following reason:

- Wear levelling – the process of running all the pumps roughly the same amount of time to allow the pumps to age evenly, ideally maximizing system operation time without the need for pump replacement.

The pump sequence shall also automatically rotate if the lead pump is faulted or unavailable, or if a pump that is called to run becomes faulted or unavailable. In such an event, the sequence shall be shifted such that the faulted / unavailable pump is pushed into the standby position, and if two pumps are faulted / unavailable shall be pushed into the standby and lag positions.

The following table illustrates the available pump sequences:

Table 2.8: Pump Sequences

Sequence No.	Lead	Lag	Standby
1	P-01-111	P-01-121	P-01-131
2	P-01-131	P-01-111	P-01-121
3	P-01-121	P-01-131	P-01-111
4	P-01-111	P-01-131	P-01-121
5	P-01-131	P-01-121	P-01-111
6	P-01-121	P-01-111	P-01-131

Pumps are called to run in sequence when the level of the wet well rises above certain threshold setpoints and a time delay has elapsed (20 seconds by default, to be confirmed in commissioning). Pumps are called to stop in the reverse order they started once level drops below the threshold stop setpoint (with 5 second debounce timer on level elevation setpoint transitions to confirm that level is confirmed to be outside of the elevation setpoint).

When a single pump is running, the VFD of the lead pump is utilized to speed the lead pump up (up to maximum pump speed) as level increases up to 0.050 m below the Lag Pump Start elevation and slow the pump down (down to minimum pump speed) as level decreases in the wet well towards Lag Pump Stop elevation. When two pumps are running, the lag pump shall be called to run at maximum pump speed while the lead pump continues to operate on the linear speed curve (min speed = Lag Pump Stop elevation, max speed = 0.050 m below Lag Pump Start elevation and higher); when the Lag Pump is called to stop by reaching the Lag Pump Stop elevation level, the lag pump shall stop while the lead pump continues to operate on the linear speed curve.

Pump maximum and minimum speed setpoints shall be operator adjustable through the HMI / SCADA screens. Minimum pump speed setpoint to be confirmed during commissioning onsite.

Operations can set the Pump Start Level and Pump Stop Level setpoints through the HMI/SCADA interface. Pumps alternate lead/lag/standby duty automatically upon the complete stop of the lead pump (pump sequence toggles per cycle).

Any alarms resulting in the shutdown of a pump or the inability to start a pump will remove that pump from the associated sequence chart. Note, the sequence is only automatically shifted if the lead pump is unavailable, or at the end of a pump cycle; if the lag pump becomes unavailable during a live wet well cycle, the pump sequence will not shift unless the lag pump is called to run, or until the wet well cycle completes. If a sequence is interrupted by a power failure, the sequence is reset to off and the pumps will restart as required based on level rising.

If a pump's selector switch is in Auto position, an operator has the ability to run the respective pump manually through the HMI / SCADA via the respective pump popup screen (remote manual mode). Note that an operator does not have the ability to pump down past the low and low low level alarm elevations in

this mode; such an exercise would need to be completed via Hand mode from the VFD itself (HOA selector switch on the VFD).

The pumps and VFDs are monitored at the PLC for low oil level; motor fault (overtemperature or leakage); VFD fault status; run status; auto status; and speed indication. Fail to start and fail to stop alarms are derived internally within the PLC (45 seconds elapsed after issuing run command with no run status feedback; 60 seconds elapsed after removing run command with run status continued feedback respectively). The PLC issues run and speed commands to the respective VFDs per the programmed logic when in Auto.

The following **Table 2.9** provides additional detail regarding pump performance and operational requirements:

Table 2.9: Wastewater Pump Operation Scheme – PLC Control

Scheme No.	Condition	Trigger(s)	Action
1	Lead Pump Start (Speed Curve, 60 Hz – 40 Hz)	• Lead Pump Start, from lead LIT • High level alarm • High-high level alarm	Lead pump starts running and operates on linear speed curve between 60 Hz (pump maximum speed, at elevation 0.050 m below Lag Pump Start elevation or higher) and 40 Hz (pump minimum speed, at Lag Pump Stop elevation) and continues to draw down the wet well, until the Lead Pump Stop setpoint is reached.
2	Lag Pump Start (60 Hz Lag, Speed Curve for Lead)	• Lag Pump Start, from lead LIT • High level alarm • High-high level alarm	Lag pump is called to run at 60 Hz and assists with draw down of wet well. Lead pump continues to operate on linear speed curve. Lag pump is called to stop when level falls below the Lag Pump Stop setpoint.
3	Lead and Lag Pumps Start (60 Hz Lag, Speed Curve for Lead)	• High level alarm • High-high level alarm	Both lead and lag pumps are redundantly called to start and run upon high or high-high level alarm detection.

2.3.2.2 Recirculation Operation

The wet well is outfit with a recirculation subsystem to allow for mixing agitation to off-gas some of odourous gasses and help remove buildups of solids along wet well and piping edges. This recirculation system employs a 3-way valve, outfit with open/close electrical actuator FCV-01-141, on the discharge of raw wastewater pump P-01-121. The 3-way valve is to be, by default, fully closed, which shall be defined

as the position that allows for pump discharge to the force main; if the 3-way valve is fully opened, it is in the recirculation position via pump P-01-121. A failure at the actuator shall move the valve into the closed position, defaulting to an orientation that allows for P-01-121 to discharge to the force main.

IT IS IMPERATIVE THAT NO MORE THAN TWO WET WELL PUMPS ARE RUNNING SIMULTANEOUSLY – the electrical system is unable to run three pumps simultaneously, and will result in main breaker (or generator breaker if on standby power) tripping, or potentially trip the Utility fuses. It is also important to keep as many pumps available during a pump cycle as possible to optimize the success of a pump cycle and consider if a pump may be unavailable or removed from service. Consequently, recirculation / mixing shall not occur simultaneous with lift station wet well discharge and is intended to occur in between pump cycles.

The recirculation system is programmed to run two times a day, recommended 10 – 14 hours apart from each other during low demand hours of the day, such as 2am and 2pm. These two daily trigger times shall be setpoint hours that are operator adjustable. Historical flow meter trends are recommended to be reviewed to optimize the times for the recirculation routine. The start hour for each of the two daily recirculation cycles are to be operator adjustable on HMI and SCADA.

Recirculation is intended to operate between 1 – 30 minutes (user adjustable setpoint via HMI / SCADA) at each of the two daily trigger times. There shall be an ENABLE/DISABLE selector on HMI and SCADA for this system to clearly enable or disable this feature. If an operator attempts to enter a number outside of 1 to 30 minutes, the timer setpoint shall default to 15 minutes. When a daily trigger time is reached in the PLC, Recirculation Mode will start at the Recirculation Start level setpoint (1.400 m level by default, hard programmed setpoint). NOTE: if a daily trigger time is reached during a pump cycle or above the Recirculation Stop setpoint, Recirculation Mode will not start until completion of the active pump cycle. The flow control valve FCV-01-141 shall fully open the 3-way valve into the recirculation position, closing the force main discharge pipe position. Once the recirculation valve position is open on the recirculation line, confirmed via the limit switch position for the recirculation line, pump P-01-121 shall be permitted to start and ramp up to maximum pump speed. The countdown timer shall start once pump speed is above minimum pump speed. Pump P-01-121 will run until the countdown timer has been completed, signifying a successful completion of a recirculation cycle, or until the Recirculation Stop level setpoint is reached.

The Recirculation Stop level setpoint cannot be higher than the Lead Pump Start elevation setpoint - it shall be hard programmed to always be set to 0.050 m below Lead Pump Start elevation. If the Recirculation Stop level setpoint is reached and the timer is not complete, it will pause the recirculation mode timer and retain the remaining time for the recirculation, and reconfigure the 3-way valve via FCV-01-141 to be back to fully closed (open to the force main discharge line), confirmed via the limit switch position for the force main discharge line. This prepares P-01-121 for the next pump cycle and keeps the pump available for the lift station discharge cycle. The recirculation mode will resume and continue the timer following completion of the pump discharge cycle, once the level rises to hit the Recirculation Start level setpoint once again. This process repeats until the timer has fully completed.

Number of daily successful completions is counted and displayed on HMI and SCADA; failure to reach 2 within a 24-hour interval generates an alarm for display on HMI and SCADA.

Recirculation mode is cancelled if P-01-121 is unavailable or faulted, or if FCV-01-141 is DISABLED via the HMI / SCADA.

The 3-way recirculation valve, driven by electrical actuator FCV-01-141, must never be allowed to discharge above the water level in the wet well since the splashing would aerate the pumps and possibly damaging them due to resultant cavitation. As such, the Recirculation Start setpoint is set to 1.400 m.

The electrical actuator FCV-01-141 is monitored at the PLC for fully open and fully closed statuses , with statuses displayed on HMI and SCADA. Additionally, the actuator shall have alarms for fail to open and fail to close (90 seconds of no confirmed opened or closed status corresponding with request to open or close). The PLC provides digital open / close control signals to the actuator to open and close the valve.

The actuator FCV-01-141 and 3-way valve can be manually engaged for control at the actuator via the interface pushbuttons, or via pushing in the handwheel to declutch the gear mechanism and manually adjusting the valve position.

2.3.2.3 Pump and Recirculation Sequencing

The sequence of operation of the pumps and the automatic mixing recirculation system includes the following stages:

1. Initially, the pumps are off when the wet well is filling with wastewater.
2. The 3-way valve, controlled via an electrical actuator (FCV-01-141), may be called to run in recirculation mode (i.e., fully open to recirculate to the wet well) if a daily time trigger has been initiated once the Recirculation Start level setpoint has been reached.
3. If a recirculation mode is in effect, it will continue to operate per the logic outlined in Section 2.3.2.2.
4. The lead pump starts when the level in the wet well has reached the Lead Pump Start elevation. Recirculation Mode will either be completed, or paused, by the time the lead pump starts.
5. Wastewater is pumped out of the wet well to the WWTP.
6. While only the lead pump is operating and actively pumping, the pumped effluent average wastewater discharge flows will be up to 45 L/s.
7. If the level of the wastewater in the wet well continues to increase up to the Lag Pump Start elevation, the lag pump starts to pump water out of the wet well along with the lead pump.

8. While both the lead and lag pumps are operational and actively pumping, the pumped effluent average wastewater discharge flows will be between 45 – 90 L/s.
9. The lag pump stops when the level of the wastewater in the wet well decreases below the Lag Pump Stop elevation.
10. The lead pump stops when the level of the wastewater in the wet well decreases below the Lead Pump Stop elevation.
11. For the new cycle, the operation of the pumps is modified (sequence shifted). Refer to Section 3.3.2 for pump sequencing.
12. If the recirculation timer has yet to be completed, it will resume on the next fill cycle.

2.3.2.4 Discharge Flow Monitoring

The pumped wastewater discharge flow rate from LS No. 1 is measured and totalized with FQIT-01-150. The flowmeter will provide the instantaneous flow rate (L/s) and a totalizer pulse (pulse width to be minimum 50 ms, pulse sent every 1 m^3) to the PLC, to allow for instantaneous flow and totalized volumes to be displayed on the HMI and SCADA systems.

The PLC uses the instantaneous and totalized flow volumes from the flowmeter to calculate the daily minimum, maximum, and average discharge flow rate (L/s) and totalized volumes, for present day and previous seven days history, and lifelong total (L/s for instantaneous flow, m^3 for volume totals). This last seven days of discharge flow and volume data plus lifelong total are to be displayed on local HMI and SCADA. At midnight of each day, flow volume totals are shifted into the seven days of PLC holding registers.

If, during the operation of a pump, the flowmeter registers a flow rate significantly lower than the anticipated pump discharge rate for a period (<10 L/s (to be confirmed during commissioning) with pump running above minimum pump speed), a low flow alarm will be triggered and displayed on the HMI and SCADA systems. The pre-set time (pump running but no flowmeter output) can be set as 1 minute default and will be finely tuned during commissioning.

Instantaneous flow rates are to be trended on the HMI and SCADA; refer to Section **5.0 Automation and Control Systems** for additional details.

2.3.2.5 Discharge Pressure Monitoring

The header discharge pressure is measured with PIT-01-151. If the pressure in the discharge piping increases above the pressure alarm setpoint (adjustable), an alarm is activated and displayed on the HMI and SCADA systems. An alarm callout will be initiated from SCADA if the high high pressure alarm setpoint is reached.-The PIT alarms have adjustable HMI and SCADA control and alarm setpoints. The PIT alarm setpoint, as identified in **Table 2.7,** is to help identify if there is a blockage or obstruction in the

discharge piping that is resulting in larger system pressures than typically experienced under normal operation.

Instantaneous pressure is to be trended on the HMI and SCADA; refer to Section **5.0 Automation and Control Systems** for additional details.

2.3.3 Abnormal Conditions

2.3.3.1 Wastewater Pumping System Responses

The following **Table 2.10** outlines the possible failure scenarios of the wastewater pumping system, the causes of the failures, and the systems response to the failure scenario. All alarm triggers have a 5 second debounce timer filter to prevent nuisance alarms (alarm must be held active for 5 continuous seconds to register a valid alarm). Refer to the alarm listing in **Appendix B** for complete list of alarms. Response actions are taken after the completed debounce timer filter.

Table 2.10: Wastewater Pump Monitoring System Responses

Description	Cause	Response
Wet Well High-High Level	LSHH-01-013 triggers LAHH at high-high level setpoint Possible pumping system failure (fail to start) Possible ultrasonic of radar level instrument failure	Alarm generated in PLC, displayed on HMI and SCADA Alarm callout from SCADA for critical high high level Attempt staged Pump Start for lead and lag pumps, rotate through pump order if pump fails to start
Wet Well High Level	LIT-01-011/012 triggers LAH at high level setpoint Possible pumping system failure (fail to start) Possible ultrasonic of radar level instrument failure	Alarm generated in PLC (active lead transmitter only), displayed on HMI and SCADA Attempt staged Pump Start for lead and lag pumps, rotate through pump order if pump fails to start
Wet Well Low Level	LIT-01-011/012 triggers LAL at low level setpoint Possible pumping system failure (fail to stop) Possible ultrasonic of radar level instrument failure	Alarm generated in PLC (active lead transmitter only), displayed on HMI and SCADA Attempt Pump Stop (assuming no active high or high high level alarm condition)
Wet Well Low-Low Level	LIT-01-011/012 triggers LALL at low-low level setpoint Possible pumping system failure (fail to stop) Possible ultrasonic of radar level instrument failure	Alarm generated in PLC (active lead transmitter only), displayed on HMI and SCADA Attempt Pump Stop (assuming no active high or high high level alarm condition)
Wet Well Level Signal Loss or Transmitter Fault	LIT-01-011/012 signal is lost to the PLC and/or instrument fault status / loss of echo signal detected	Alarm to PLC HMI and SCADA Swap standby transmitter (if available) to active transmitter if the primary transmitter is faulted

Description	Cause	Response
Flowmeter High Flow	FQIT-01-150 triggers alarm at high flow setpoint Possible break of discharge line	Alarm generated in PLC, displayed on HMI and SCADA
Flowmeter Low Flow	FQIT-01-150 triggers alarm at low flow setpoint Possible blockage of discharge line	Alarm generated in PLC, displayed on HMI and SCADA
Flowmeter No Flow	FQIT-01-150 registers no flow with the lead pump running for 1 minute Possible pump impeller break, check valve failure, VFD failure, blockage, or air lock	Alarm generated in PLC, displayed on HMI and SCADA Rotate pump sequence to select new lead pump
PIT High Pressure	PIT-01-151 triggers alarm at high pressure setpoint Possible blockage of discharge line	Alarm generated in PLC, displayed on HMI and SCADA
PIT High High Pressure	PIT-01-151 triggers alarm at high high pressure setpoint Possible blockage of discharge line, pressure critically high	Alarm generated in PLC, displayed on HMI and SCADA Alarm callout from SCADA for critical high high level
PLC Failure	PLC loses power, faults, or otherwise stops executing the program logic.	Existing SCADA communications alarm Backup Zelio logic controller provides redundant pump operations
Pump Failure	VFD fault, pump overtemperature, pump leakage, pump oil reservoir low	Alarm generated in PLC, displayed on HMI and SCADA Alarm callout from SCADA for multiple pump failures Unavailable pump(s) shifted to end of pump sequence
Recirculation Valve Stuck in Recirculation Position	Electronics failure on actuator or in circuitry / signal loop Solids buildup in valve preventing actuation	Alarm generated in PLC, displayed on HMI and SCADA Alarm callout from SCADA Operations to manually change valve position onsite, service valve

2.3.3.2 System Response and System Reset

Alarms are acknowledged via the HMI or SCADA systems, or for alarm callouts via entering the acknowledgement code. Alarms are annunciated to operations so that a team member can investigate the source of the failure / alarm event. Pump alarms that are indicative of potential equipment damage or are linked to protection systems, such as pump overtemperature, leakage, and low oil levels, provide field level interlocks that require onsite investigation for resolution of the alarm condition before the alarm can clear. Alarm conditions will appear in the alarm banner until acknowledged, even if the alarm event has cleared, to give operations notification that an alarm event has occurred; if an active alarm is acknowledged, it will be identified as an active but acknowledged alarm and will clear when the alarm condition is overcome.

3.0 BUILDING AND UTILITY SYSTEMS

The following subsections of **Section 3.0** outline the building and utility system parameters monitored as part of the LS No.1 upgrades.

3.1 GENERATOR / AUTOMATIC TRANSFER SWITCH

The Lift Station is outfitted with a standby power backup system to provide continuous operation of the facility in the event of a Utility power failure. The system includes a 175 kW diesel-powered (fuel oil) generator coupled to an open/closed automatic transfer system. The 600 V(ac) diesel (fuel oil) generator has standby capacity to operate all building loads. The ATS is normally on Utility power; should a Utility failure occur, the ATS will switch to Generator power, the generator will be automatically started (provided the Generator is in Auto), and the ATS will remain on Generator power until Utility power is restored and remains stable for several minutes. Should Utility power remain stable, the transfer switch will switch back to Utility power automatically, whereupon the generator will cool down and then shut off.

The generator is monitored at the PLC for run, fault, auto, battery voltage low, and battery charger fault DI statuses, for display to HMI / SCADA and alarming purposes.

3.2 POWER TRANSFER SWITCH STATUS MONITORING

The ATS provides Utility Power Available; Generator Power Available; ATS On Utility (switch position); and ATS On Generator (switch position) signals to the PLC to provide monitoring information for display to SCADA, as well as for alarm generation upon facility power failure.

The PLC generates a building power loss alarm if the building has a maximum of five minutes of no power (ATS On Utility but no Utility power available, or ATS On Generator but no Generator power available). No building power will trigger a high priority alarm callout.

3.3 POWER STATUS MONITORING

The PLC control panel is equipped with a surge protection device. Should the device fail, a fault DI signal will be sent to the PLC for alarm generation.

The PLC control panel dual redundant 24 Volt power supplies are each monitored for fault status, with DI signals terminated to the PLC for alarm generation.

All monitoring signals are displayed on the HMI and SCADA screens.

3.4 HVAC MECHANICAL

The lift station upgrade has resulted in several new HVAC system for the new electrical room and pump room, but also upgrades to the fuel oil transfer system, boiler system, and new generator system.

The new boiler system control panel provides a general fault alarm, terminated to the PLC. The electrical room HVAC cooling system provides a general fault alarm, terminated to the PLC. The wet well and pump room exhaust fan starters are monitored at the PLC for general fault alarms. The packaged fuel oil transfer pump skid and control panel has alarms connected to the PLC control system to monitor for transfer pump fault status; combination day tank / main fuel tank common low fuel alarm; and day tank high fuel / leakage alarm.

Signals terminated to the PLC have statuses and alarms displayed on the HMI and SCADA screens.

NOTE: the existing PLC and alarm dialer system within the existing PLC control panel has an existing "Building Mechanical Alarm" sent to the alarm dialer from the PLC. The programmer shall confirm that this existing "Building Mechanical Alarm" includes fuel tank low fuel alarm; if it does not include low fuel as part of the alarm callout condition, the PLC code shall be updated to include the day tank / main fuel tank common low fuel alarm as a callout condition.

3.5 BUILDING TEMPERATURE

The new electrical room and new pump room temperatures are monitored by analog temperature transmitters TT-01-903 and TT-01-904 respectively, with AI signals sent to the PLC. In the event the temperature falls outside of the predetermined alarm setpoints, a corresponding alarm is generated.

The temperature setpoints have default values as listed in the following table.

Table 3.1: LS No. 1 Building Temperature Alarm Setpoints

Room	High Temperature (°C)	Low Temperature (°C)
New Pump Room	24	10
New Electrical Room	24	10

3.6 UPS (UNINTERRUPTIBLE POWER SUPPLY)

The control panel is equipped with a backup power supply to maintain station controller and instrument functionality in the event of a short utility interruption and power transition between utility and generator. The UPS is monitored for battery low voltage, on bypass, on line (utility), and general fault DI statuses; these signals are displayed on the HMI / SCADA screens, with alarms generated on abnormal conditions.

The UPS is complete with a wraparound bypass switch with automatic transfer function; this switch can be used to bypass the UPS in the event of required maintenance on the UPS without interrupting power to the PLC control system and the process instruments powered from the PLC control panel. The bypass

switch is monitored at the PLC for In Bypass position, for display on HMI and SCADA. When the switch is in bypass, an alarm is generated.

3.7 BUILDING SECURITY/INTRUSION

The exterior doors are equipped with limit switches (ZSC-01-202 for new electrical room door, ZSC-01-203 for new pump room door) to detect if the respective door has been opened, with a door closed signal terminated at the PLC. The door open / closed status will be displayed on HMI and SCADA. These door switches are to tie into the existing PLC intrusion logic.

3.8 COMMUNICATION MONITORING

SCADA monitors communication connections with Lift Station No. 1. Communications failure shall be generated on SCADA, for alarm callout as a critical priority alarm, upon communications failure with the facility. This alarm should be existing and shall be retained, but will need to be reconfigured due to new PLC equipment being put into place at the Lift Station.

Each VFD Ethernet connection shall be monitored for communications failure, with alarms generated for display and annunciation via HMI and SCADA.

3.9 ALARM AUTODIALER

The existing alarm autodialer system shall continue to remain in operation and maintain existing functionality. However, the PLC output signals generating the alarms shall be updated to include all new associated instruments as part of the alarm generation logic. Example, “Gas Detection Alarm to Autodialer” PLC output shall be updated to include the new gas detection alarm signals added into the Lift Station No. 1 expansion.

NOTE: the existing PLC and alarm dialer system within the existing PLC control panel has an existing “Building Mechanical Alarm” sent to the alarm dialer from the PLC. The programmer shall confirm that this existing “Building Mechanical Alarm” includes fuel tank low fuel alarm; if it does not include low fuel as part of the alarm callout condition, the PLC code shall be updated to include the day tank / main fuel tank common low fuel alarm as a callout condition.

4.0 LIFE SAFETY SYSTEMS

The following subsections of **Section 4.0** outline the life safety and security system parameters monitored as part of the LS No.1 upgrades.

4.1 CARBON MONOXIDE (CO) DETECTION

The electrical room is equipped with a carbon monoxide detector (AIT-01-918 transmitter with AE-01-918 sensor) for detection of potential CO emissions from the indoor standby generator. The transmitter sends an analog signal and instrument fault status signal to the PLC for monitoring and alarming. The design setpoints for CO alarms are listed in the table below.

Table 4.1: Alarm Setpoints for Carbon Monoxide Detection

Parameter	Setpoint
High Alarm	10 ppm
High-High Alarm	20 ppm

4.2 NITROGEN OXIDES (NO_X) DETECTION

The electrical room is equipped with a NO detector (AIT-01-917 transmitter with AE-01-917 sensor) and a NO_2 detector (AIT-01-919 transmitter with AE-01-919 sensor) for detection of nitrogen oxides (NO_x) from the indoor standby generator. Each transmitter sends an analog signal and instrument fault status signal to the PLC for monitoring and alarming. The design setpoints for NO_X alarms are summarized in the table below.

Table 4.2: Alarm Setpoints for NOx Detection

Parameter	Setpoint
NO High Alarm	10 ppm
NO High-High Alarm	20 ppm
NO_2 High Alarm	0.5 ppm
NO_2 High-High Alarm	1 ppm

4.3 COMBUSTIBLE GAS (LEL) DETECTION

The electrical room and pump room are equipped with LEL detectors (AIT-01-916 transmitter with AE-01-916 sensor, AIT-01-906 transmitter with AE-01-906 sensor respectively) for detection of methane levels. The transmitters send analog signals and instrument fault status signals to the PLC for monitoring and alarming. The design setpoints for LEL alarms are listed in the table below.

Table 4.3: Alarm Setpoints for LEL Detection

Parameter	Setpoint
High Alarm	10 %LEL
High-High Alarm	20 %LEL

4.4 HYDROGEN SULFIDE (H_2S) DETECTION

The electrical room and pump room are equipped with H_2S detectors (AIT-01-915 transmitter with AE-01-915 sensor, AIT-01-905 transmitter with AE-01-905 sensor respectively) for detection of H_2S levels. The transmitters send analog signals and instrument fault status signals to the PLC for monitoring and alarming. The design setpoints for H_2S alarms are listed in the table below.

Table 4.4: Alarm Setpoints for H2S Detection

Parameter	Setpoint
High Alarm	4 ppm
High-High Alarm	8 ppm

4.5 FIRE DETECTION

The new electrical and pump rooms are outfit with fire detectors, manual fire alarm pull stations, and combination horn/strobe annunciators. The fire detectors and pull stations are Class A addressable devices, with the horn/strobe units Class B devices. These devices are integrated into the existing fire alarm system. Updates and verifications are to be coordinated with the fire alarm system integrator.

4.6 LIFT STATION SECURITY

Each exterior door is equipped with a limit switch to detect if the door has been opened, with DI door closed signals terminated at the site PLC.

New door switches are to be connected into the PLC system. The existing intrusion detection program is to be updated to include the new door switch monitoring.

The facility will be undergoing security and access system upgrades in the near future as part of another project.

4.7 BEACONS

Blue, red, and amber beacons are installed throughout the interior and exterior of the station, to provide for engineering controls annunciation of the presence of hazardous gases and HVAC system faults.

The electrical room interior and exterior blue beacons shall be energized if there is any active high or high high H_2S alarm condition within the electrical room. The pump room interior and exterior blue beacons shall be energized if there is any active high or high high H_2S alarm condition within the pump room.

The electrical room interior and exterior red beacons shall be energized if there is any active high or high high LEL alarm condition within the electrical room. The pump room interior and exterior red beacons shall be energized if there is any active high or high high LEL alarm condition within the pump room.

The electrical room interior and exterior amber beacons shall be energized if there is any active high or high high CO or NOx alarm condition within the electrical room, or if an HVAC cooling fan system fault occurs.

The pump room interior and exterior amber beacons shall be energized if any active pump room HVAC system fault occurs.

The clean room (existing room) interior and exterior amber beacons shall be energized if a boiler system fault occurs.

Beacons are powered via UPS 24 V(dc) power through interposing relays and PLC outputs.

5.0 AUTOMATION & CONTROL SYSTEMS

5.1 SYSTEM OPERATION INTERFACES

Overall operation of the system is done automatically by the site PLC. The operator will have the ability to set operational and alarm setpoints via the local HMI interface as required, and remotely via SCADA. The existing HMI shall be updated to include the new Lift Station No. 1 components, and a second HMI on the new PLC control panel shall complement the existing HMI and execute the same program, allowing operations monitoring and control from either PLC control panel onsite.

System monitoring and alarms may be accessed via the HMI screen located on the main PLC control panel door. In addition, the control system shall be remotely monitored via the SCADA system. Additionally, both the local HMI and the SCADA shall have the ability to change setpoints and control the wastewater pumps and mixing recirculation control valve.

Alarms shall be visible on both the local HMI and the SCADA and shall share the same description. Critical alarms, identified and confirmed in coordination with Operations, are to be annunciated via callouts in addition to alarm banners on HMI and SCADA screens.

In the event of required field-level manual Operations intervention, equipment may be manually controlled via the HOA switches, keypads, speed potentiometers, displays, and controls interfaces at the respective VFD / starter / actuator / control station. Equipment can also be controlled manually via the HMI / SCADA screens (Remote Manual mode of operation); when in remote manual mode, all automatic control for that equipment is cancelled and control relies strictly on Operations until put back into Auto mode.

5.2 ANALYTICS

For every analog input to the PLC, basic statistics are gathered. The PLC will calculate minimum, maximum, and average values for all inputs, with exception to flow control valve position indication. For flow inputs, totalized value will also be collected. All the calculated values will be stored for the current day (running values) and previous day. Flow totalizer values also store lifetime totals and a seven-day history from present day.

5.3 GRAPHICAL REQUIREMENTS

The HMI / SCADA screens and interfaces shall be laid out consistent to that of the existing Lift Station graphical touch panel layouts / themes / block selection / operational configuration. The screens shall allow for monitoring and control of the system, and shall include but not be limited to:

1. An overall process overview page;
2. All digital and analog inputs shall be displayed throughout the HMI / SCADA screens;

3. Pump control setpoints for minimum speed, maximum speed, start and stop setpoints, operational modes;
4. Equipment control pages;
5. Dedicated screen(s) and/or popup(s) for alarm setpoints;
6. Alarm history;
7. Building monitoring, alarming, and control;
8. Screen(s) for communicating all subsystem information and inputs / control; and
9. Other screens per the existing site standards.

5.4 HISTORIAN

The SCADA system records process data in a historical database for trending and reporting. Records are sampled at least every 10s but are only stored when the process value changes significantly from the previously stored data value, or an extended interval with no record storage occurs.

Table 5.1: SCADA Recordings

Data Type	Record Storage Condition	Max. Interval Between Records
Process Analog (e.g., level, pressure, temperature, flow, etc.)	Deviation >0.5% of span	1 hour
Equipment Running	Record every change	1 hour
Setpoints	Record every change	6 hours
Totalizers (Flow and Runtime)	Record every whole unit change (1.0 hour, 1.0 m3, etc.)	6 hours

Historical data shall be retained permanently on the primary SCADA server or until manually deleted.

5.5 TRENDING

A dedicated trending page shall be available on the HMI/SCADA. Trends shall have the following requirements:

- Time-axis navigation, capable of navigating throughout the entire available historical range. The default time window shall be 12 hours. Manual time-axis pan and zoom buttons shall be available to allow operators to customize the viewed time period.
- Markers shall be available on the trends to display the data values at any point.
- Y-Axis shall be labelled with scale and units.
- Legend labels for each pen shall be unique per tag, ideally using tag description over tag identifier (e.g., “Wet Well Level” instead of “LI-011”).

The following trends shall be made available to the operators, at minimum. Additional trends may be requested by the City of Iqaluit during commissioning.

- Pump Speeds and respective Run Commands
- Levels for each Level Indication Transmitter
- Pressures for each Pressure Indication Transmitter
- Instantaneous Flow for each flow meter
- Flow totalization for Today, Previous Day to Seven Day History, and Lifelong Total for each flow meter
- Daily and Lifelong Equipment Run Totals for Pumps (discharge and metering)
- Building gas monitoring signals
- Valve position
- Two-tiered trend: Level/flow on top, pump run status on bottom
- Temperatures for each Temperature Transmitter

5.6 ALARMING

When a critical alarm occurs, an Operator must be notified. Notification is provided through the following methods:

1. Alarm signals are generated from the field equipment and provided to the PLC. An alert is displayed at the station local HMIs.
2. Primary alarm annunciation occurs via SCADA: An alert is displayed on the SCADA system, initiating a callout through the SCADA callout software per plant standards for critical alarms. All alarms are populated in the alarm banners and alarm history pages / tabs of the system.

Alarm can be acknowledged by pressing the acknowledge button on the HMI or SCADA, consistent with existing plant standards. Alarms are to be logged at the WWTP SCADA.

All alarms shall have the following minimum functionality.

Table 5.2: Alarming Properties

Property	Default	Notes
Time Delay	5s	Minimum time alarm condition needs to be true for alarm to become active
Latched	Yes	If set to 'Yes', alarm must be reset to clear
Description	-	Message shown on alarm banner and in alarm calls. Can be stored in either PLC or SCADA tags
Setpoint	-	Alarm threshold to become enabled. On/Off for discrete alarms, floating point value for analog alarms; Operator adjustable

APPENDIX A

PIPING AND INSTRUMENTATION DIAGRAMS

Appendix A PIPING AND INSTRUMENTATION DIAGRAMS

REFER TO TENDER DRAWINGS FOR RELEVANT P&IDS

APPENDIX B

ALARM LIST FOR NEW EXPANSION

Appendix B ALARM LIST FOR NEW EXPANSION

The following alarm list are the new additional alarms being added into Lift Station No. 1; this alarm list does not include existing alarms already accounted for in the existing PLC. Those existing alarms are to remain unless otherwise removed or superseded by the work completed within the Lift Station No. 1 Upgrade.

No.	ALARM	ACQUISITION METHOD	RESULTING PRIME ACTIONS
1.	Wet Well Exhaust Fan Fault Alarm	Digital Input XA-01-925	Alarm Notification on HMI / SCADA
2.	Pump Room Exhaust Fan Fault Alarm	Digital Input XA-01-926	Alarm Notification on HMI / SCADA
3.	Boiler System Alarm	Digital Input XA-01-927	Alarm Notification on HMI / SCADA
4.	Electrical Room HVAC Cooling System Alarm	Digital Input XA-01-928	Alarm Notification on HMI / SCADA
5.	Fuel Oil Transfer Pump Fault Alarm	Digital Input XA-01-002	Alarm Notification on HMI / SCADA, alarm callout condition
6.	Fuel Oil Day Tank Low Fuel Alarm	Digital Input LAL-01-002	Alarm Notification on HMI / SCADA, alarm callout condition
7.	Fuel Oil Day Tank High Fuel / Leakage Alarm	Digital Input LAH-01-002	Alarm Notification on HMI / SCADA, alarm callout condition
8.	Generator Fault Status	Digital Input XA-01-001A	Alarm Notification on HMI / SCADA, alarm callout condition
9.	Generator Battery Charger / Battery Alarm	Digital Input XA-01-001B	Alarm Notification on HMI / SCADA
10.	Generator Battery Voltage Low Alarm	Digital Input EAL-01-001	Alarm Notification on HMI / SCADA
11.	Generator Running	Digital Input YI-01-001	Alarm Notification on HMI / SCADA, alarm callout condition
12.	Generator Not in Auto Status	Digital Input HI-01-001	Alarm Notification on HMI / SCADA
13.	ATS On Utility	Digital Input EI-01-001A	Used to derive power failure alarm
14.	ATS On Generator	Digital Input EI-01-001B	Used to derive power failure alarm
15.	ATS Utility Available	Digital Input EY-01-001A	Used to derive power failure alarm
16.	ATS Generator Available	Digital Input EY-01-001B	Used to derive power failure alarm
17.	Building Power Fail	Derived from EI-01-001A, EI-01-001B, EY-01-001A, EY-01-001B	If not On Utility with Utility Power Available or if not On Generator with Generator Power Available for 5 minutes, Alarm Notification on HMI / SCADA, alarm callout condition
18.	UPS System Fault Alarm	Digital Input XA-01-920	Alarm Notification on HMI / SCADA, alarm callout condition
19.	UPS System Battery Low Alarm	Digital Input EAL-01-920	Alarm Notification on HMI / SCADA
20.	UPS System on Bypass	Digital Input ES-01-920A	Alarm Notification on HMI / SCADA

No.	ALARM	ACQUISITION METHOD	RESULTING PRIME ACTIONS
21.	UPS System Not on Utility	Digital Input ES-01-920B	Alarm Notification on HMI / SCADA
22.	UPS Wraparound Bypass Switch In Bypass	Digital Input ES-01-921	Alarm Notification on HMI / SCADA
23.	PLC Control Panel Surge Protection Device Fault	Digital Input XA-01-922	Alarm Notification on HMI / SCADA
24.	PLC Control Panel 24Vdc Power Supply #1 Fault	Digital Input XA-01-923	Alarm Notification on HMI / SCADA
25.	PLC Control Panel 24Vdc Power Supply #2 Fault	Digital Input XA-01-924	Alarm Notification on HMI / SCADA
26.	PLC Control Panel Both 24Vdc Power Supplies Faulted	Derived from Digital Input XA-01-923, Digital Input XA-01-924	Alarm Notification on HMI / SCADA, alarm callout condition
27.	PLC Minor Fault	Derived Internally in PLC	Alarm Notification on HMI / SCADA
28.	PLC Major Fault	Derived Internally in PLC	Alarm Notification on HMI / SCADA, alarm callout condition
29.	Zelio Controller Fault	Derived from Digital Input YI-01-929	Alarm Notification on HMI / SCADA
30.	Zelio Controller Not in Auto	Digital Input HI-01-930	Alarm Notification on HMI / SCADA
31.	Electrical Room #102A Door Open	Digital Input ZIC-01-202	Alarm Notification on HMI / SCADA, ties into intrusion detection logic
32.	Pump Room #100A Door Open	Digital Input ZIC-01-202	Alarm Notification on HMI / SCADA, ties into intrusion detection logic
33.	Electrical Room #102A Low Temperature Alarm	Derived from Analog Input TI-01-903	Alarm Notification on HMI / SCADA, alarm callout condition
34.	Electrical Room #102A High Temperature Alarm	Derived from Analog Input TI-01-903	Alarm Notification on HMI / SCADA
35.	Electrical Room #102A Temperature Transmitter Signal Fault (Over-range, Under-range)	Derived from Analog Input TI-01-903	Alarm Notification on HMI / SCADA
36.	Pump Room #100A Low Temperature Alarm	Derived from Analog Input TI-01-904	Alarm Notification on HMI / SCADA, alarm callout condition
37.	Pump Room #100A High Temperature Alarm	Derived from Analog Input TI-01-904	Alarm Notification on HMI / SCADA
38.	Pump Room #100A Temperature Transmitter Signal Fault (Over-range, Under-range)	Derived from Analog Input TI-01-904	Alarm Notification on HMI / SCADA
39.	Pump Room #100A High H_2S Alarm	Derived from Analog Input AI-01-905	Alarm Notification on HMI / SCADA
40.	Pump Room #100A High High H_2S Alarm	Derived from Analog Input AI-01-905	Alarm Notification on HMI / SCADA, alarm callout condition
41.	Pump Room #100A H_2S Analyzer Fault Alarm	Digital Input XA-01-905	Alarm Notification on HMI / SCADA

No.	ALARM	ACQUISITION METHOD	RESULTING PRIME ACTIONS
42.	Pump Room #100A H_2S Analyzer Signal Fault (Over-range, Under-range)	Derived from Analog Input AI-01-905	Alarm Notification on HMI / SCADA
43.	Electrical Room #102A High H_2S Alarm	Derived from Analog Input AI-01-915	Alarm Notification on HMI / SCADA
44.	Electrical Room #102A High High H_2S Alarm	Derived from Analog Input AI-01-915	Alarm Notification on HMI / SCADA, alarm callout condition
45.	Electrical Room #102A H_2S Analyzer Fault Alarm	Digital Input XA-01-915	Alarm Notification on HMI / SCADA
46.	Electrical Room #102A H_2S Analyzer Signal Fault (Over-range, Under-range)	Derived from Analog Input AI-01-915	Alarm Notification on HMI / SCADA
47.	Pump Room #100A High LEL Alarm	Derived from Analog Input AI-01-906	Alarm Notification on HMI / SCADA
48.	Pump Room #100A High High LEL Alarm	Derived from Analog Input AI-01-906	Alarm Notification on HMI / SCADA, alarm callout condition
49.	Pump Room #100A LEL Analyzer Fault Alarm	Digital Input XA-01-906	Alarm Notification on HMI / SCADA
50.	Pump Room #100A LEL Analyzer Signal Fault (Over-range, Under-range)	Derived from Analog Input AI-01-906	Alarm Notification on HMI / SCADA
51.	Electrical Room #102A High LEL Alarm	Derived from Analog Input AI-01-916	Alarm Notification on HMI / SCADA
52.	Electrical Room #102A High High LEL Alarm	Derived from Analog Input AI-01-916	Alarm Notification on HMI / SCADA, alarm callout condition
53.	Electrical Room #102A LEL Analyzer Fault Alarm	Digital Input XA-01-916	Alarm Notification on HMI / SCADA
54.	Electrical Room #102A LEL Analyzer Signal Fault (Over-range, Under-range)	Derived from Analog Input AI-01-916	Alarm Notification on HMI / SCADA
55.	Electrical Room #102A High NOx Alarm	Derived from Analog Input AI-01-917	Alarm Notification on HMI / SCADA
56.	Electrical Room #102A High High NOx Alarm	Derived from Analog Input AI-01-917	Alarm Notification on HMI / SCADA, alarm callout condition
57.	Electrical Room #102A NOx Analyzer Fault Alarm	Digital Input XA-01-917	Alarm Notification on HMI / SCADA
58.	Electrical Room #102A NOx Analyzer Signal Fault (Over-range, Under-range)	Derived from Analog Input AI-01-917	Alarm Notification on HMI / SCADA
59.	Electrical Room #102A High CO Alarm	Derived from Analog Input AI-01-918	Alarm Notification on HMI / SCADA
60.	Electrical Room #102A High High CO Alarm	Derived from Analog Input AI-01-918	Alarm Notification on HMI / SCADA, alarm callout condition
61.	Electrical Room #102A CO Analyzer Fault Alarm	Digital Input XA-01-918	Alarm Notification on HMI / SCADA

No.	ALARM	ACQUISITION METHOD	RESULTING PRIME ACTIONS
62.	Electrical Room #102A CO Analyzer Signal Fault (Over-range, Under-range)	Derived from Analog Input AI-01-918	Alarm Notification on HMI / SCADA
63.	Electrical Room #102A High NO_2 Alarm	Derived from Analog Input AI-01-919	Alarm Notification on HMI / SCADA
64.	Electrical Room #102A High High NO_2 Alarm	Derived from Analog Input AI-01-919	Alarm Notification on HMI / SCADA, alarm callout condition
65.	Electrical Room #102A NO_2 Analyzer Fault Alarm	Digital Input XA-01-919	Alarm Notification on HMI / SCADA
66.	Electrical Room #102A NO_2 Analyzer Signal Fault (Over-range, Under-range)	Derived from Analog Input AI-01-919	Alarm Notification on HMI / SCADA
67.	Discharge Pressure High Alarm	Derived from Analog Input PI-01-151	Alarm Notification on HMI / SCADA
68.	Discharge Pressure High High Alarm	Derived from Analog Input PI-01-151	Alarm Notification on HMI / SCADA, alarm callout condition
69.	Discharge Pressure Transmitter Signal Fault (Over-range, Under-range)	Derived from Analog Input PI-01-151	Alarm Notification on HMI / SCADA
70.	Discharge Flow Low Alarm	Derived from Analog Input FI-01-150	Alarm Notification on HMI / SCADA
71.	Discharge Flow High Alarm	Derived from Analog Input FI-01-150	Alarm Notification on HMI / SCADA
72.	Discharge Flow No Flow Alarm	Derived from Analog Input FI-01-150 and pump run statuses	Alarm Notification on HMI / SCADA, alarm callout condition
73.	Discharge Flow Meter Signal Fault (Over-range, Under-range)	Derived from Analog Input FI-01-150	Alarm Notification on HMI / SCADA
74.	New Wet Well High High Level Alarm	Digital Input LAHH-01-013	Alarm Notification on HMI / SCADA, alarm callout condition
75.	New Wet Well High Level Alarm	Derived from Analog Input LI-01-011 and Analog Input LI-01-012 based on lead transmitter	Alarm Notification on HMI / SCADA
76.	New Wet Well Low Level Alarm	Derived from Analog Input LI-01-011 and Analog Input LI-01-012 based on lead transmitter	Alarm Notification on HMI / SCADA
77.	New Wet Well Low Low Level Alarm	Derived from Analog Input LI-01-011 and Analog Input LI-01-012 based on lead transmitter	Alarm Notification on HMI / SCADA, alarm callout condition
78.	Ultrasonic Level Transmitter LIT-01-011 Loss of Echo	Digital Input XA-01-011	Alarm Notification on HMI / SCADA
79.	LIT-01-011 Signal Fault (Over-range, Under-range)	Derived from Analog Input LI-01-011	Alarm Notification on HMI / SCADA
80.	Radar Level Transmitter LIT-01-012 Fault	Digital Input XA-01-012	Alarm Notification on HMI / SCADA

No.	ALARM	ACQUISITION METHOD	RESULTING PRIME ACTIONS
81.	LIT-01-012 Signal Fault (Over-range, Under-range)	Derived from Analog Input LI-01-012	Alarm Notification on HMI / SCADA
82.	Both Wet Well Level Transmitters Unavailable	Derived from Digital Input XA-01-011 and XA-01-012; loss of analog signal for LI-01-011 and LI-01-012	Alarm Notification on HMI / SCADA, alarm callout condition
83.	Level Transmitters Out of Sync (more than 0.200m away from each other's reading)	Derived from Analog Input LI-01-011 and LI-01-012	Alarm Notification on HMI / SCADA
84.	Raw Wastewater Pump P-01-111 Low Oil Level Alarm	Digital Input LAL-01-111	Alarm Notification on HMI / SCADA, alarm callout condition
85.	Raw Wastewater Pump P-01-111 Motor Fault Alarm (Overtemperature, Leakage)	Digital Input UA-01-111	Alarm Notification on HMI / SCADA, alarm callout condition
86.	Raw Wastewater Pump P-01-111 VFD Fault Alarm	Digital Input XA-01-111	Alarm Notification on HMI / SCADA
87.	Raw Wastewater Pump P-01-111 VFD Not in Auto	Digital Input HI-01-111	Alarm Notification on HMI / SCADA
88.	Raw Wastewater Pump P-01-111 Fail to Start	Derived from Digital Input YI-01-111 and Relay Output YC-01-111	Alarm Notification on HMI / SCADA
89.	Raw Wastewater Pump P-01-111 Fail to Stop	Derived from Digital Input YI-01-111 and Relay Output YC-01-111	Alarm Notification on HMI / SCADA
90.	Raw Wastewater Pump P-01-111 Speed Indication Signal Fault (Over-range, Under-range)	Derived from Analog Input SI-01-111	Alarm Notification on HMI / SCADA
91.	Raw Wastewater Pump P-01-121 Low Oil Level Alarm	Digital Input LAL-01-121	Alarm Notification on HMI / SCADA, alarm callout condition
92.	Raw Wastewater Pump P-01-121 Motor Fault Alarm (Overtemperature, Leakage)	Digital Input UA-01-121	Alarm Notification on HMI / SCADA, alarm callout condition
93.	Raw Wastewater Pump P-01-121 VFD Fault Alarm	Digital Input XA-01-121	Alarm Notification on HMI / SCADA
94.	Raw Wastewater Pump P-01-121 VFD Not in Auto	Digital Input HI-01-121	Alarm Notification on HMI / SCADA
95.	Raw Wastewater Pump P-01-121 Fail to Start	Derived from Digital Input YI-01-121 and Relay Output YC-01-121	Alarm Notification on HMI / SCADA
96.	Raw Wastewater Pump P-01-121 Fail to Stop	Derived from Digital Input YI-01-121 and Relay Output YC-01-121	Alarm Notification on HMI / SCADA
97.	Raw Wastewater Pump P-01-121 Speed Indication Signal Fault (Over-range, Under-range)	Derived from Analog Input SI-01-121	Alarm Notification on HMI / SCADA

No.	ALARM	ACQUISITION METHOD	RESULTING PRIME ACTIONS
98.	Raw Wastewater Pump P-01-131 Low Oil Level Alarm	Digital Input LAL-01-131	Alarm Notification on HMI / SCADA, alarm callout condition
99.	Raw Wastewater Pump P-01-131 Motor Fault Alarm (Overtemperature, Leakage)	Digital Input UA-01-131	Alarm Notification on HMI / SCADA, alarm callout condition
100.	Raw Wastewater Pump P-01-131 VFD Fault Alarm	Digital Input XA-01-131	Alarm Notification on HMI / SCADA
101.	Raw Wastewater Pump P-01-131 VFD Not in Auto	Digital Input HI-01-131	Alarm Notification on HMI / SCADA
102.	Raw Wastewater Pump P-01-131 Fail to Start	Derived from Digital Input YI-01-131 and Relay Output YC-01-131	Alarm Notification on HMI / SCADA
103.	Raw Wastewater Pump P-01-131 Fail to Stop	Derived from Digital Input YI-01-131 and Relay Output YC-01-131	Alarm Notification on HMI / SCADA
104.	Raw Wastewater Pump P-01-131 Speed Indication Signal Fault (Over-range, Under-range)	Derived from Analog Input SI-01-131	Alarm Notification on HMI / SCADA
105.	All Raw Wastewater Pumps Unavailable	Derived Internally in PLC from Pump Statuses	Alarm Notification on HMI / SCADA, alarm callout condition
106.	Dewatering Submersible Pump 110-P-403 Fail to Stop	Derived from 110-YI-401 and 110-YC-403	Alarm Notification on HMI / SCADA
107.	Recirculation Valve Actuator FCV-01-141 Fail to Open	Derived from Digital Input ZIO-01-141 and Analog Output ZC-01-141	Alarm Notification on HMI / SCADA
108.	Recirculation Valve Actuator FCV-01-141 Fail to Close	Derived from Digital Input ZIC-01-141 and Analog Output ZC-01-141	Alarm Notification on HMI / SCADA
109.	Recirculation Valve Actuator FCV-01-141 Failure to Run Minimum Number of Daily Recircs	Counter of number of completed recirculation cycles against minimum daily requirement	Alarm Notification on HMI / SCADA
110.	Recirculation Valve Stuck in Recirculation	Derived from Digital Input ZIC-01-141 / ZIO-01-141 and Analog Input ZI-01-141	Alarm Notification on HMI / SCADA, alarm callout condition
111.	Communications Loss Between PLC and SCADA	Existing alarm, to be updated with new PLC upgrade	Alarm Notification on HMI / SCADA, callout condition
112.	Raw Wastewater Pump VFD-01-111 Ethernet Communications Loss	Derived Internally in PLC	Alarm Notification on HMI / SCADA
113.	Raw Wastewater Pump VFD-01-121 Ethernet Communications Loss	Derived Internally in PLC	Alarm Notification on HMI / SCADA
114.	Raw Wastewater Pump VFD-01-131 Ethernet Communications Loss	Derived Internally in PLC	Alarm Notification on HMI / SCADA

APPENDIX C

INPUT/OUTPUT LIST

Appendix C INPUT/OUTPUT LIST

The following Input/Output List includes a provisional list for the existing Lift Station No. 1 PLC tags, and a list for the new Lift Station No. 1 upgrade / expansion PLC tags. Existing PLC tags are permitted to be retagged by the programmer as required to avoid tagging conflicts and for consistency with site tagging convention. Where current PLC tags are unknown, they have been marked in the list as “TBD”; final tags for these signals shall be selected by the site programmer. Signals marked in red are signals either added or deleted as part of the Lift Station No. 1 upgrades.

Existing PLC Tags
(Remote Rack)

DIGITAL INPUTS				
#	Signal Description	Existing PLC Tag	New PLC Tag	PLC Termination
1	SPARE	-	-	Slot 01: IN0
2	SPARE	-	-	Slot 01: IN1
3	SPARE	-	-	Slot 01: IN2
4	**SPARE**	**LAL-101**	-	Slot 01: IN3
5	**SPARE**	**LALL-101**	-	Slot 01: IN4
6	WET WELL HIGH HIGH LEVEL ALARM	LAHH-104	LAHH-01-104	Slot 01: IN5
7	LIFT PUMP P-101 VFD FAULT	YA-101a	YA-01-101A	Slot 01: IN6
8	LIFT PUMP P-101 RUNNING	YI-101a	YI-01-101A	Slot 01: IN7
9	LIFT PUMP P-101 VFD/BYPASS SELECTOR IN VFD MODE	YS-101b	YS-01-101B	Slot 01: IN8
10	LIFT PUMP P-101 MOTOR OVERLOAD ALARM	YA-101b	YA-01-101B	Slot 01: IN9
11	WET WELL GRINDER G-100 FAULT	YA-100	YA-01-100	Slot 01: IN10
12	WET WELL GRINDER G-100 RUNNING	YI-100	YI-01-100	Slot 01: IN11
13	GENERATOR ROOM DOOR ZSC-200 CLOSED (1=CLOSED, 0=OPEN)	ZSC-200	ZSC-01-200	Slot 01: IN12
14	STAND-BY GENERATOR FAIL	YA-202	YA-01-202	Slot 01: IN13
15	STAND-BY GENERATOR RUNNING	YI-202	YI-01-202	Slot 01: IN14
16	UPS ALARM	YA-201	YA-01-201	Slot 01: IN15
17	SPARE	-	-	Slot 02: IN0
18	SPARE	-	-	Slot 02: IN1
19	SPARE	-	-	Slot 02: IN2
20	WATER TANK LOW LEVEL ALARM	LAL-103	LAL-01-103	Slot 02: IN3
21	SPARE	-	-	Slot 02: IN4
22	LIFT PUMP P-102 VFD FAULT	YA-102a	YA-01-102A	Slot 02: IN5
23	LIFT PUMP P-102 RUNNING	YI-102a	YI-01-102A	Slot 02: IN6
24	LIFT PUMP P-102 MOTOR OVERLOAD	YA-102b	YA-01-102B	Slot 02: IN7
25	LIFT PUMPT P-102 VFD/BYPASS SELECTOR IN VFD MODE	YS-102b	YS-01-102B	Slot 02: IN8
26	TRANSFER SWITCH IN EMERGENCY POSITION	**TBD**	**TBD**	Slot 02: IN9
27	120VAC PANEL POWER FAIL	**TBD**	**TBD**	Slot 02: IN10
28	MECHANICAL SYSTEMS COMMON ALARM (BOILER ALARM)	CA-200	CA-01-200	Slot 02: IN11
29	DOOR ZSC-201 CLOSED (1=CLOSED, 0=OPEN)	ZSC-201	ZSC-01-201	Slot 02: IN12
30	KEY SWITCH YS-200 OCCUPIED	YS-200	YS-01-200	Slot 02: IN13
31	SPARE	-	-	Slot 02: IN14
32	AIR HANDELING UNIT COMMON ALARM YA-205 FLOW SWITCH	YA-205	YA-01-205	Slot 02: IN15
33	SPARE	-	-	Slot 03: IN0
34	SPARE	-	-	Slot 03: IN1
35	SPARE	-	-	Slot 03: IN2
36	SPARE	-	-	Slot 03: IN3
37	SPARE	-	-	Slot 03: IN4
38	SPARE	-	-	Slot 03: IN5
39	**SPARE**	**TBD**	-	Slot 03: IN6
40	**SPARE**	**TBD**	-	Slot 03: IN7
41	**SPARE**	**TBD**	-	Slot 03: IN8
42	LIFT PUMP #1 IN REMOTE	**TBD**	**TBD**	Slot 03: IN9
43	LIFT PUMP #2 IN REMOTE	**TBD**	**TBD**	Slot 03: IN10
44	**FUEL OIL TRANSFER PUMP FAULT STATUS**	-	**XA-01-002**	Slot 03: IN11
45	**DAY TANK LOW FUEL ALARM**	-	**LAL-01-002**	Slot 03: IN12
46	**DAY TANK HIGH FUEL / LEAK ALARM**	-	**LAH-01-002**	Slot 03: IN13
47	SPARE	-	-	Slot 03: IN14
48	SPARE	-	-	Slot 03: IN15

RELAY OUTPUTS				
#	Signal Description	Existing PLC Tag	New PLC Tag	PLC Termination
1	PLC HALT ALARM TO AUTODIALER	**TBD**	**TBD**	Slot 04: DO0
2	VENTILATION FAN HIGH SPEED RUN COMMAND	YS-203	YS-01-203	Slot 04: DO1
3	LIFT PUMP P-101 RUN COMMAND	**TBD**	**TBD**	Slot 04: DO2
4	LIFT PUMP P-102 RUN COMMAND	**TBD**	**TBD**	Slot 04: DO3
5	BUILDING HORN HIGH H2S ALARM	HN-100	HN-01-100	Slot 04: DO4
6	RED STROBE - HIGH H2S LIGHT	BA-101a	BA-01-101A	Slot 04: DO5
7	SPARE	-	-	Slot 04: DO6
8	PRESENCE DETECTION - BUILDING LIGHTING ON	YS-202	YS-01-202	Slot 04: DO7
9	PROCESS / PUMP ALARM TO AUTODIALER	CA-201	CA-01-201	Slot 05: DO0
10	GAS DETECTION ALARM TO AUTODIALER	CA-202	CA-01-202	Slot 05: DO1
11	AMBER STROBE - HIGH COMBUSTIBLES LIGHT	BA-102a	BA-01-102A	Slot 05: DO2
12	SPARE	-	-	Slot 05: DO3
13	DIESEL FUEL PUMP #1 START COMMAND	**TBD**	**TBD**	Slot 05: DO4
14	DIESEL FUEL PUMP #2 START COMMAND	**TBD**	**TBD**	Slot 05: DO5
15	BUILDING SECURITY ALARM TO AUTODIALER	CA-203	CA-01-203	Slot 05: DO6
16	BUILDING MECHANICAL ALARM TO AUTODIALER	CA-204	CA-01-204	Slot 05: DO7

Existing PLC Tags
(Remote Rack)

ANALOG INPUTS				
#	Signal Description	Existing PLC Tag	New PLC Tag	PLC Termination
1	SEWAGE DISCHARGE FLOW METER FIT-101 FLOW INDICATION	FIT-101	FIT-01-101	Slot 06: AI0
2	WET WELL LEVEL LI-101 LEVEL INDICATION	LI-101	LI-01-101	Slot 06: AI1
3	P-101 VFD SPEED FEEDBACK	SI-101	SI-01-101	Slot 06: AI2
4	P-102 VFD SPEED FEEDBACK	SI-102	SI-01-102	Slot 06: AI3
5	WET WELL ROOM TEMPERATURE INDICATION	TI-101	TI-01-101	Slot 06: AI4
6	GENERATOR ROOM TEMPERATURE INDICATION	TI-102	TI-01-102	Slot 06: AI5
7	SPARE	-	-	Slot 06: AI6
8	SPARE	-	-	Slot 06: AI7
9	WET WELL H2S MONITOR AIT-103 H2S INDICATION (10 PPM)	AI-103	AI-103	Slot 08: AI0
10	WET WELL H2S MONITOR AIT-104 H2S INDICATION (30 PPM)	AI-104	AI-104	Slot 08: AI1
11	WET WELL LEL MONITOR AIT-105 LEL INDICATION	AI-105	AI-105	Slot 08: AI2
12	WET WELL LEL MONITOR AIT-106 LEL INDICATION	AI-106	AI-106	Slot 08: AI3
13	SPARE	-	-	Slot 08: AI4
14	SPARE	-	-	Slot 08: AI5
15	SPARE	-	-	Slot 08: AI6
16	SPARE	-	-	Slot 08: AI7
ANALOG OUTPUTS				
#	Signal Description	Existing PLC Tag	New PLC Tag	PLC Termination
1	LIFT PUMP P-101 SPEED CONTROL	**TBD**	**TBD**	Slot 07: AO0
2	LIFT PUMP P-102 SPEED CONTROL	**TBD**	**TBD**	Slot 07: AO1
3	SPARE	-	-	Slot 07: AO2
4	SPARE	-	-	Slot 07: A03

New PLC Tags
(Primary Chassis in Expansion)

DIGITAL INPUTS				
#	Signal Description	PLC Tag	Terminal Strip	PLC Termination
1	RAW WASTEWATER PUMP VFD-01-111 RUN STATUS	YI-01-111	TS01 - 1,2	Slot 01: IN0
2	RAW WASTEWATER PUMP VFD-01-111 FAULT STATUS	XA-01-111	TS01 - 3,4	Slot 01: IN1
3	RAW WASTEWATER PUMP P-01-111 MOTOR FAULT STATUS	UA-01-111	TS01 - 5,6	Slot 01: IN2
4	RAW WASTEWATER PUMP VFD-01-111 AUTO STATUS	HI-01-111	TS01 - 7,8	Slot 01: IN3
5	RAW WASTEWATER PUMP P-01-111 LOW OIL LEVEL ALARM	LAL-01-111	TS01 - 9,10	Slot 01: IN4
6	RAW WASTEWATER PUMP VFD-01-121 RUN STATUS	YI-01-121	TS01 - 11,12	Slot 01: IN5
7	RAW WASTEWATER PUMP VFD-01-121 FAULT STATUS	XA-01-121	TS01 - 13,14	Slot 01: IN6
8	RAW WASTEWATER PUMP P-01-121 MOTOR FAULT STATUS	UA-01-121	TS01 - 15,16	Slot 01: IN7
9	RAW WASTEWATER PUMP VFD-01-121 AUTO STATUS	HI-01-121	TS01 - 17,18	Slot 01: IN8
10	RAW WASTEWATER PUMP P-01-121 LOW OIL LEVEL ALARM	LAL-01-121	TS01 - 19,20	Slot 01: IN9
11	LEVEL TRANSMITTER LIT-01-011 LOSS OF ECHO	XA-01-011	TS01 - 21,22	Slot 01: IN10
12	DISCHARGE FLOW METER TOTALIZER PULSE	FQI-01-150	TS01 - 23,24	Slot 01: IN11
13	ELECTRICAL ROOM #102A DOOR CLOSED	ZIC-01-202	TS01 - 25,26	Slot 01: IN12
14	PUMP ROOM #100A DOOR CLOSED	ZIC-01-203	TS01 - 27,28	Slot 01: IN13
15	PUMP ROOM H2S GAS DETECTOR FAULT STATUS	XA-01-905	TS01 - 29,30	Slot 01: IN14
16	PUMP ROOM LEL GAS DETECTOR FAULT STATUS	XA-01-906	TS01 - 31,32	Slot 01: IN15
17	GENERATOR GEN-01-011 FAULT STATUS	XA-01-001A	TS01 - 33,34	Slot 01: IN16
18	GENERATOR GEN-01-011 BATTERY CHARGER FAULT STATUS	XA-01-001B	TS01 - 35,36	Slot 01: IN17
19	GENERATOR GEN-01-011 RUN STATUS	YI-01-001	TS01 - 37,38	Slot 01: IN18
20	GENERATOR GEN-01-011 BATTERY LOW VOLTAGE	EAL-01-001	TS01 - 39,40	Slot 01: IN19
21	GENERATOR GEN-01-011 AUTO STATUS	HI-01-001	TS01 - 41,42	Slot 01: IN20
22	ATS-01-001 UTILITY POWER AVAILABLE	EY-01-001A	TS01 - 43,44	Slot 01: IN21
23	ATS-01-001 ON UTILITY POWER	EI-01-001A	TS01 - 45,46	Slot 01: IN22
24	ATS-01-001 GENERATOR POWER AVAILABLE	EY-01-001B	TS01 - 47,48	Slot 01: IN23
25	ATS-01-001 ON GENERATOR POWER	EI-01-001B	TS01 - 49,50	Slot 01: IN24
26	ELECTRICAL ROOM H2S GAS DETECTOR FAULT STATUS	XA-01-915	TS01 - 51,52	Slot 01: IN25
27	ELECTRICAL ROOM LEL GAS DETECTOR FAULT STATUS	XA-01-916	TS01 - 53,54	Slot 01: IN26
28	ELECTRICAL ROOM NOx GAS DETECTOR FAULT STATUS	XA-01-917	TS01 - 55,56	Slot 01: IN27
29	ELECTRICAL ROOM CO GAS DETECTOR FAULT STATUS	XA-01-918	TS01 - 57,58	Slot 01: IN28
30	SPARE		TS01 - 59,60	Slot 01: IN29
31	SPARE		TS01 - 61,62	Slot 01: IN30
32	SPARE		TS01 - 63,64	Slot 01: IN31
33	RAW WASTEWATER PUMP VFD-01-131 RUN STATUS	YI-01-131	TS02 - 1,2	Slot 02: IN0
34	RAW WASTEWATER PUMP VFD-01-131 FAULT STATUS	XA-01-131	TS02 - 3,4	Slot 02: IN1
35	RAW WASTEWATER PUMP P-01-131 MOTOR FAULT STATUS	UA-01-131	TS02 - 5,6	Slot 02: IN2
36	RAW WASTEWATER PUMP VFD-01-131 AUTO STATUS	HI-01-131	TS02 - 7,8	Slot 02: IN3
37	RAW WASTEWATER PUMP P-01-131 LOW OIL LEVEL ALARM	LAL-01-131	TS02 - 9,10	Slot 02: IN4
38	LEVEL TRANSMITTER LIT-01-012 TRANSMITTER FAULT	XA-01-012	TS02 - 11,12	Slot 02: IN5
39	FLOW CONTROL VALVE FCV-01-141 OPEN INDICATION (RECIRC)	ZIO-01-141	TS02 - 13,14	Slot 02: IN6
40	FLOW CONTROL VALVE FCV-01-141 CLOSED INDICATION (DISCHARGE)	ZIC-01-141	TS02 - 15,16	Slot 02: IN7
41	SPARE	-	TS02 - 17,18	Slot 02: IN8
42	SPARE	-	TS02 - 19,20	Slot 02: IN9
43	CONTROL PANEL UPS FAULT STATUS	XA-01-920	TS02 - 21,22	Slot 02: IN10
44	CONTROL PANEL UPS BATTERY LOW	EAL-01-920	TS02 - 23,24	Slot 02: IN11
45	CONTROL PANEL UPS ON BYPASS	ES-01-920A	TS02 - 25,26	Slot 02: IN12
46	CONTROL PANEL UPS ON UTILITY	ES-01-920B	TS02 - 27,28	Slot 02: IN13
47	UPS BYPASS SWITCH IN BYPASS	ES-01-921	TS02 - 29,30	Slot 02: IN14
48	PLC SURGE PROTECTION DEVICE FAULT STATUS	XA-01-922	TS02 - 31,32	Slot 02: IN15
49	24V POWER SUPPLY #1 FAULT STATUS	XA-01-923	TS02 - 33,34	Slot 02: IN16
50	24V POWER SUPPLY #2 FAULT STATUS	XA-01-924	TS02 - 35,36	Slot 02: IN17
51	WET WELL LEVEL SWITCH LSHH-01-013 HIGH HIGH LEVEL ALARM	LAHH-01-013	TS02 - 37,38	Slot 02: IN18
52	WET WELL EXHAUST FAN FAULT STATUS	XA-01-925	TS02 - 39,40	Slot 02: IN19
53	PUMP ROOM EXHAUST FAN FAULT STATUS	XA-01-926	TS02 - 41,42	Slot 02: IN20
54	BOILER ROOM FAULT STATUS	XA-01-927	TS02 - 43,44	Slot 02: IN21
55	ELECTRICAL ROOM HVAC COOLING SYSTEM FAULT STATUS	XA-01-928	TS02 - 45,46	Slot 02: IN22
56	ZELIO LOGIC CONTROLLER WATCHDOG BIT	YI-01-929	TS02 - 47,48	Slot 02: IN23
57	ZELIO LOGIC CONTROLLER AUTO STATUS	HI-01-930	TS02 - 49,50	Slot 02: IN24
58	SPARE		TS02 - 51,52	Slot 02: IN25
59	SPARE		TS02 - 53,54	Slot 02: IN26
60	SPARE	-	TS02 - 55,56	Slot 02: IN27
61	SPARE	-	TS02 - 57,58	Slot 02: IN28
62	SPARE	-	TS02 - 59,60	Slot 02: IN29
63	SPARE	-	TS02 - 61,62	Slot 02: IN30
64	SPARE	-	TS02 - 63,64	Slot 02: IN31

Iqaluit Lift Station No.1

New PLC Tags
(Primary Chassis in Expansion)

RELAY OUTPUTS				
#	Signal Description	PLC Tag	Terminal Strip	PLC Termination
1	PUMP P-01-111 RUN PERMISSIVE	YC-01-111	TS03 - 1,2,3	Slot 03: DO0
2	PUMP P-01-121 RUN PERMISSIVE	YC-01-121	TS03 - 4,5,6	Slot 03: DO1
3	ELECTRICAL ROOM HIGH H2S BLUE BEACONS	UA-01-909	TS03 - 7,8,9	Slot 03: DO2
4	ELECTRICAL ROOM HIGH LEL RED BEACONS	UA-01-910	TS03 - 10,11,12	Slot 03: DO3
5	PUMP ROOM HIGH H2S BLUE BEACONS	UA-01-911	TS03 - 13,14,15	Slot 03: DO4
6	PUMP ROOM HIGH LEL RED BEACONS	UA-01-912	TS03 - 16,17,18	Slot 03: DO5
7	FLOW CONTROL VALVE FCV-01-141 OPEN COMMAND (RECIRC)	ZCO-01-141	TS03 - 19,20,21	Slot 03: DO6
8	FLOW CONTROL VALVE FCV-01-141 CLOSE COMMAND (DISCHARGE)	ZCC-01-141	TS03 - 22,23,24	Slot 03: DO7
9	PUMP P-01-131 RUN PERMISSIVE	YC-01-131	TS04 - 1,2,3	Slot 04: DO0
10	SPARE	-	TS04 - 4,5,6	Slot 04: DO1
11	SPARE	-	TS04 - 7,8,9	Slot 04: DO2
12	SPARE	-	TS04 - 10,11,12	Slot 04: DO3
13	SPARE	-	TS04 - 13,14,15	Slot 04: DO4
14	ELECTRICAL ROOM NOx, CO, HVAC ALARM AMBER BEACONS	UA-01-908	TS04 - 16,17,18	Slot 04: DO5
15	PUMP ROOM HVAC ALARM AMBER BEACONS	UA-01-913	TS04 - 19,20,21	Slot 04: DO6
16	BOILER SYSTEM ALARM AMBER BEACONS	UA-01-914	TS04 - 22,23,24	Slot 04: DO7
ANALOG INPUTS				
#	Signal Description	PLC Tag	Terminal Strip	PLC Termination
1	WET WELL LIT-01-011 LEVEL INDICATION	LI-01-011	TS05 - 1,2,3	Slot 05: AI0
2	PUMP P-01-111 SPEED INDICATION	SI-01-111	TS05 - 4,5,6	Slot 05: AI1
3	PUMP P-01-121 SPEED INDICATION	SI-01-121	TS05 - 7,8,9	Slot 05: AI2
4	DISCHARGE FLOW METER FQIT-01-150 FLOW INDICATION	FI-01-150	TS05 - 10,11,12	Slot 05: AI3
5	SPARE	-	TS05 - 13,14,15	Slot 05: AI4
6	SPARE	-	TS05 - 16,17,18	Slot 05: AI5
7	ELECTRICAL ROOM AIT-01-917 NOx INDICATION	AI-01-917	TS05 - 19,20,21	Slot 05: AI6
8	ELECTRICAL ROOM AIT-01-917 CO INDICATION	AI-01-918	TS05 - 22,23,24	Slot 05: AI7
9	WET WELL LIT-01-012 LEVEL INDICATION	LI-01-012	TS06 - 1,2,3	Slot 06: AI0
10	PUMP P-01-131 SPEED INDICATION	SI-01-131	TS06 - 4,5,6	Slot 06: AI1
11	SPARE	-	TS06 - 7,8,9	Slot 06: AI2
12	SPARE	-	TS06 - 10,11,12	Slot 06: AI3
13	ELECTRICAL ROOM AIT-01-915 H2S INDICATION	AI-01-915	TS06 - 13,14,15	Slot 06: AI4
14	ELECTRICAL ROOM AIT-01-916 LEL INDICATION	AI-01-916	TS06 - 16,17,18	Slot 06: AI5
15	PUMP ROOM AIT-01-905 H2S INDICATION	AI-01-905	TS06 - 19,20,21	Slot 06: AI6
16	PUMP ROOM AIT-01-906 LEL INDICATION	AI-01-906	TS06 - 22,23,24	Slot 06: AI7
17	SPARE	-	TS07 - 1,2,3	Slot 07: AI0
18	SPARE	-	TS07 - 4,5,6	Slot 07: AI1
19	SPARE	-	TS07 - 7,8,9	Slot 07: AI2
20	SPARE	-	TS07 - 10,11,12	Slot 07: AI3
21	SPARE	-	TS07 - 13,14,15	Slot 07: AI4
22	ELECTRICAL ROOM TT-01-903 TEMPERATURE INDICATION	TI-01-903	TS07 - 16,17,18	Slot 07: AI5
23	PUMP ROOM TT-01-904 TEMPERATURE INDICATION	TI-01-904	TS07 - 19,20,21	Slot 07: AI6
24	DISCHARGE PRESSURE PIT-01-151 PRESSURE INDICATION	PI-01-151	TS07 - 22,23,24	Slot 07: AI7
ANALOG OUTPUTS				
#	Signal Description	PLC Tag	Terminal Strip	PLC Termination
1	PUMP P-01-111 SPEED CONTROL	SC-01-111	TS08 - 1,2	Slot 08: AO0
2	PUMP P-01-121 SPEED CONTROL	SC-01-121	TS08 - 3,4	Slot 08: AO1
3	SPARE	-	TS08 - 5,6	Slot 08: AO2
4	SPARE	-	TS08 - 7,8	Slot 08: AO3
5	PUMP P-01-131 SPEED CONTROL	SC-01-131	TS09 - 1,2	Slot 09: AO0
6	SPARE	-	TS09 - 3,4	Slot 09: AO1
7	SPARE	-	TS09 - 5,6	Slot 09: AO2
8	SPARE	-	TS09 - 7,8	Slot 09: AO3

Process Control Narrative

Septage Receiving Station

June 27, 2023

Prepared for:

City of Iqaluit

Prepared by:

Stantec Consulting Ltd.

PROCESS CONTROL NARRATIVE

Revision	M	Author		Quality Check		Independent Review	
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PROCESS CONTROL NARRATIVE

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Abbreviations

AE	Analysis Element (probe)
AIT	Analysis Indication Transmitter
AI	Analog input from a device
AO	Analog output to a device
DI	Discrete input (voltage one of two levels, from open or closed contact)
DO	Discrete output (voltage one of two levels, from open or closed contact)
EH	Electric Unit Heater
ESD	Emergency Stop Device
ETM	Elapsed Time Meter
FQIT	Flow Totalization Indication Transmitter
GDR	Grinder
H_2S	Hydrogen Sulfide
H	High
HMI	Human Machine Interface
HOA	Hand-Off-Auto
HP	Horsepower
HVAC	Heating, Ventilation, Air Conditioning
kW	Kilowatt
L/s	Liters per second
LEL	Lower Explosive Limit (methane CH4)
L	Low
MCC	Motor Control Center
N/A	Not Applicable
NPW	Non-potable Water
PLC	Programmable Logic Controller
RT	Rock Trap
SCADA	Supervisory Control and Data Acquisition
SRS	Septage Receiving Station
SV	Solenoid Valve
TSL	Temperature Switch Low
UPS	Uninterruptible Power Supply
V	Volts (ac = alternating current, dc = direct current)
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

This narrative shall be the basis for the PLC, HMI, and SCADA programming as well as testing and commissioning of the Septage Receiving Station (SRS). This controls narrative describes the required operation of the septage unloading system, and associated building appurtenances, for the SRS in the City of Iqaluit.

The following document is a brief overview of the system operational philosophy and control narrative to assist the contractor and operator with startup and commissioning of the system, as well as to allow the programmer to complete all essential site programming. An alarm listing is provided in **Appendix B**.

1.1 SYSTEM DESCRIPTION & EQUIPMENT OVERVIEW

The City of Iqaluit is installing a packaged Septage Receiving Station (SRS) to receive trucked wastewater and to macerate big solids present in the wastewater before entering the WWTP wet well. The Septage Receiving Station is a dual port system provided with actuated valves, rock traps, grinders, flow measurement, gas monitoring, HVAC, and control panel preinstalled in a heated metallic enclosure.

The SRS will have a dedicated local control panel, which monitors process variables such as grinder run status, flow rates and volumes, building gas levels, and other operating statuses, generating alarms as required. All monitored signals are available on the plant SCADA system via an EtherNet/IP communications connection, with SRS Run Status and SRS Fault Status redundantly hardwired into the plant PLC system, and a hardwired Run Permissive tied into the SRS from the plant control system. The packaged SRS supplier will provide an I/O list of their PLC tags to allow for populating monitoring statuses, signals, and alarms into SCADA.

The SRS major components are outlined in **Section 1.1.1** below.

1.1.1 Septage Receiving Station Components:

- One (1) local PLC control panel with HMI / annunciator display station for monitoring and control of the septage unloading system.
- Two (2) unloading camlocks with lockable enclosures for push buttons to operate the SRS system.
- Two (2) rock traps to minimize large debris from entering grinders.
- Two (2) grinders to reduce the solid sizes deposited to the wet well.
- Two (2) flowmeters for totalizing the flows deposited to the WWTP via truck unloading.
- Two (2) actuated valves for non-potable water connections to the system.
- Two (2) actuated valves on each camlock inlet prior to the rock traps.
- Mechanical HVAC & Plumbing systems.
- Building monitoring (H_2S, LEL methane gases; low temperature).

2.0 SEPTAGE RECEIVING SYSTEM

2.1 INTRODUCTION

2.1.1 Pump Operation Overview

Trucked wastewater from the City's truck collection system is discharged to one of the two ports of the Septage Receiving Station (SRS-05-100). Wastewater flows through actuated valve (PLV-05-100/200), rock trap (RT-05-100/200), grinder (GR-05-101/102) and flowmeter indicator and totalizer (FQIT-05-101/102), and then to the wet well of the WWTP.

2.1.2 Reference P&IDs

The following table summarizes the reference P&IDs related to the SRS system that should be referred to when reviewing the Process Control Narrative. These P&IDs have been attached in **Appendix A** for easy referral.

Table 2.1: SRS System Reference P&IDs

Drawing	Description
P-601/602/603	PIPING & INSTRUMENTATION LEGEND – SHEET 1/2/3
P-606	PIPING & INSTRUMENTATION DIAGRAM – SEPTAGE RECEIVING STATION

2.1.3 Major Equipment Components List

The following table outlines the equipment and instrumentation associated with the SRS system provided as part of the SRS package, and which are further reviewed as part of this Process Control Narrative. The system alarm list is also included in **Appendix B**.

Table 2.2: Equipment Tags and Descriptions

Tag	Description
AE/AIT-05-301	H_2S Gas Analyzer
AE/AIT-05-302	LEL (Methane) Gas Analyzer
BV-05/130	Ball Valve (NPW)
CV-05-140	Check Valve (NPW)
EH-05-100/200	Electric Unit Heaters
FQIT-05-101/102	Magnetic Flowmeters
GDR-05-101/202	Septage Receiving Station Grinders
PLV-05-100/200	Motorized Plug Valves

Tag	Description
PRV-05-110	Pressure Relief Valve (NPW)
RT-05-100/200	Rock Traps
SRS-05-100	Septage Receiving Station
SRS-05-100-CP	Septage Receiving Station PLC Control Panel
SV-05-120	Solenoid Valve (NPW)
TSL-05-303	Low Temperature Switch

Table 2.3: Major Equipment and Associated Valves and Instrumentation

Equipment Name	Tag	Equipment Details	Control / Isolation Valves	Instrumentation
Rock Traps	RT-05-100 RT-05-200	TBD	PLV-05-100 PLV-05-200	TBD
Grinders	GDR-05-100 GDR-05-100	Make: JWC Environmental Model: TBD Power: 3.7 kW	PLV-05-200 PLV-05-200	TBD
Flowmeters	FQIT-05-101 FQIT-05-102	Make: Endress+Hauser Model: Promag P300	PLV-05-100 PLV-05-200	TBD
Electric Unit Heaters	EH-05-100 EH-05-200	Make: TBD. Model: TBD Power: 10 kW	N/A	N/A
Septage Receiving Station PLC Control Panel	SRS-05-100-CP	PLC Control Panel complete with all associated control components to automate the facility	PLV-05-100 PLV-05-200 SV-05-120 SV-05-220	AIT-05-301 AIT-05-302 FQIT-05-101 FQIT-05-102 TSL-05-303

2.2 SETPOINTS

2.2.1 Flow

Each septage receiving ports discharge header at the SRS is fitted with a magnetic flowmeter (FQIT-101/102), which outputs both instantaneous and totalized flow signals to the SRS PLC.

Flow signals are available at the local control panel for trending and system performance monitoring. Tag values can be obtained for the WWTP SCADA system via the EtherNet/IP network.

2.3 CONTROLS APPROACH

2.3.1 Manual / Automatic Operation

2.3.1.1 Manual (Local) Operation

Manual (Local) Operation of the SRS is the default operating mode for the System.

2.3.1.2 Automatic (Remote) Operation

There is no automatic or remote operation of the SRS station.

2.3.2 Normal Conditions

2.3.2.1 Septage Receiving Station Operation

The operator can select a specific septage unloading port by utilizing the specific push buttons associate with that port located on the exterior of the SRS. The operator may select a specific port for the following reasons:

- Wear levelling – the process of running the SRS trains roughly the same amount of time to allow each train to age evenly, ideally maximizing system operation time and extend maintenance timelines.
- Out-of-Service – A single train may be down for maintenance to replace specific equipment, or to perform maintenance on the rock trap assembly.

General control operation of the Septage Receiving Station follows:

1. The Hauler steps up to the Access Terminal.

2. If the Septage Receiving Station is on-line and all alarm conditions are clear, the keypad will prompt the hauler for a four-digit **ACCESS NUMBER** followed by a four-digit **PIN**. The numbers entered are compared against the Access Terminal's database to verify that the **ACCESS NUMBER** and **PIN** are valid. If the numbers entered are invalid, the keypad will display a message indicating the account numbers are invalid or the account has been disabled. This message will be displayed for a few seconds and then returns to the Enter **ACCESS NUMBER** message.

3. If the **ACCESS NUMBER** and **PIN** are valid, the hauler is prompted for a **WASTE ID** number. This is a number which represents the type of waste that they would like to unload. It can be up to 3 numeric characters in length. This message is optional. If not enabled, this message is skipped.

4. The hauler is then prompted for a **GENERATOR ID** number. This is a number which represents where they picked up the waste or how/who created it. It can be up to 4 numeric characters in length. This message is optional. If not enabled, this message is skipped.

5. The hauler is then prompted for a **MANIFEST ID** number. This is a number off the manifest transcript for the load. It can be up to 8 numeric characters in length. This message is optional. If not enabled, this message is skipped.

6. The hauler is then prompted to verify that his hose is connected. Press the START key to begin unloading or press STOP to cancel.

7. If STOP was pressed, the keypad returns to the **ENTER ACCESS NUMBER** message.

8. If START was pressed, the **TRANSFERRING LOAD** screen will appear on the keypad.

9. Depending on the options set in the software, this screen will display differently:

    a. If the system is set to bill per load, this screen will display a **TRANSFERRING LOAD** message. There will be a **TRANSFER TIMEOUT** message indicating how much time the hauler must unload the truck. They can press the START key for more time, if required.

    b. If the system is set to bill based on volume, **VOLUME REMAINING** and **VOLUME TRANSFERRED** messages will appear. The **TRANSFER TIMEOUT** message will appear if the flowmeter is not detecting flow. If no flow is detected for the set time, the transaction will end.

10. The hauler has the option to request a paper receipt, if the system is equipped with a printer (which is not the case of the Iqaluit SRS), by pressing the ENTER key. A **RECEIPT SELECTED** message will be displayed to indicate that the receipt will print at the end of the transaction.

11. The hauler can press the STOP key at any time to end the transaction.

12. When the transaction ends, the **PLEASE WAIT** message will be displayed while the valve is closing. If the system is set to read the flow, a **VOLUME TRANSFERRED** message will also be displayed. The hauler still has a chance to print the receipt while this display is shown, if equipped, as previously described.

13. If the transaction ended because of no more flow is detected by the flowmeter, the system will prompt to press the START key to flush the system.

14. After no flow is detected and the valve is fully closed, the transaction is logged and a flush is started. The flush will run for a set period. A **SYSTEM FLUSHING** message will display.

2.3.2.2 Flushing Operation

The flushing is accomplished with non-potable water from the WWTP. When there is “no septage flow” detected after a septage discharge cycle, the control valve starts to close. The flushing is activated when the control valve reaches its closed limit. The duration of a flushing period is set up at the SRS PLC control panel.

2.3.2.3 Discharge Flow Monitoring

The septage flows from each SRS port is measured and totalized with FQIT-05-101/102. The flowmeter will provide the instantaneous flowrates (L/s) and totalized volume (m^3) to the SRS PLC, for local and SCADA display.

The SRS PLC shall include the totalized flow volumes in cubic meters (m^3). If possible, the PLC shall retain the last seven days of discharge flow volume totals for display on SCADA, else the SCADA or a WWTP PLC shall be programmed to perform this calculation. At midnight of each day, flow volume totals are to be shifted into the seven days of PLC holding registers. The PLC will also log a non-resettable inlet flow total volume (m^3) from the flowmeter. Daily and previous day totals shall also be required for display onto SCADA.

2.3.3 Abnormal Conditions

2.3.3.1 Failure Response

The following **Table 2.9** outlines the possible failure messages for the SRS system, the causes of the failures, and the systems response to the failure scenario.

Table 2.4: SRS Monitoring Failure Responses

Description	Cause(s)	Response(s)
Transfer Valve Not In Auto	• Valve was put in manual control (check manual override handwheel in correct position) • Control panel failure	• Alarm to control panel and unloading unable to occur at port until alarm/issue addressed
Transfer Valve Failed to Open/Close	• Valve failed to open/close in the specified time, likely due to: ○ Power failure to the valve or control relay ○ Obstructions in pipe	• Alarm within PLC and unloading unable to occur at port until alarm/issue addressed
System Out of Service	• Triggered from control panel for a variety of reasons, such as: • Grinder issue, valve issue, control panel or PLC failure, etc.	• Alarm within PLC and unloading unable to occur at port until alarm/issue addressed

Your Account Has Been Disabled	• Disabled by the Administrators	• Unable to unload at SRS • Must contact administrator for access
Wrong Access Number / PIN Combination	• Access number and/or PIN does not align with the Terminals database	• Unable to unload at SRS • Transfer screen will be reset to start unloading process again
Administration Software Is Currently Downloading Transactions	• May be caused by communications issues with the Access Terminal	• Unable to unload at SRS until software downloads complete
Hours of Operation	• Attempting to unload outside of set operational hours	• Unable to unload at SRS

3.0 BUILDING MONITORING SYSTEMS

The following subsections of **Section 3.0** outline the building system monitoring parameters monitored as part of the SRS upgrades.

3.1 BUILDING TEMPERATURE

The SRS station is equipped with two electric unit heaters, which operate to maintain a set temperature setpoint for the station. A building low temperature switch (TSL-05-303) is provided by the SRS supplier, wired into the SRS PLC; in the event the temperature falls below the field-adjustable low temperature trigger point (recommended 10°C default), a corresponding alarm is generated.

3.2 SCADA COMMUNICATIONS

The SRS PLC is connected into the WWTP Ethernet network via an Ethernet cable connection. The SCADA system shall acquire SRS PLC tags from this Ethernet connection for display of all statuses and alarms by the SCADA programmer. Coordination will be required with the SRS supplier for the list of available tags for monitoring, alarming, and trending (for the case of flow).

Additionally, hardwired SRS run and fault statuses are redundantly wired into the WWTP PLC system for display and alarming on SCADA.

The WWTP PLC system shall provide a hardwired run permissive signal to the SRS for interlocking the SRS system to lock it out of operation via the SCADA system. An ENABLE/DISABLE button shall be programmed into the SCADA system to allow for manual engagement by operations (feature shall be password protected or require supervision level credentials to activate).

4.0 LIFE SAFETY SYSTEMS

The following subsections of **Section 4.0** outline the life safety system parameters monitored as part of the SRS upgrades.

4.1 COMBUSTIBLE GAS (LEL) DETECTION

The SRS is equipped with LEL probe AE-05-302, connected to LEL transmitter AIT-05-302, for detection of methane levels. The detector sends an analog signal to the SRS PLC for monitoring and alarming. The design setpoints for LEL alarms are listed in the table below.

Table 4.1: Alarm Setpoints for LEL Detection

Parameter	Setpoint
High Alarm	10 %LEL
High-High Alarm	20 %LEL

4.2 HYDROGEN SULFIDE (H_2S) DETECTION

The SRS is equipped with H_2S probe AE-05-301, connected to H_2S transmitter AIT-05-301, for detection of hydrogen sulfide levels. The detector sends an analog signal to the SRS PLC for monitoring and alarming. The design setpoints for H_2S alarms are listed in the table below.

Table 4.2: Alarm Setpoints for H2S Detection

Parameter	Setpoint
High Alarm	4 ppm
High-High Alarm	8 ppm

4.3 ANNUNCIATORS

The SRS package includes visual and audible alarms if high levels of gas are detected within the SRS. The audible horn is installed within the building and will utilize a digital output and control panel power distribution to energize the horn during a high or high high gas alarm condition. One beacon is installed inside the building and one beacon is installed outside the building near the entrance door; should a high or high high gas alarm condition be in effect, both beacons will be energized together via the SRS control panel utilizing a digital output and control panel power distribution to visually annunciate a gas hazard condition.

5.0 AUTOMATION & CONTROL SYSTEMS

5.1 SYSTEM OPERATION INTERFACES

Overall operation of the SRS is done directly at the SRS via the local control panels and access keypad / HMI unit. The SRS PLC is responsible for controlling the SRS equipment in coordination with the customer / operations requests; refer to the SRS User Manual for details on the SRS features and capabilities.

The SRS PLC is connected into the WWTP Ethernet network to allow for status monitoring, alarming, and trending on the SCADA system. The SRS supplier shall provide a PLC tag list to allow for the programmer to program the SCADA screens with the SRS operational status information (all digital and analog inputs to the SRS PLC) and alarms. Additionally, the SCADA screens shall be populated with the hardwired SRS Run and SRS Fault Statuses redundantly wired into the WWTP PLC system.

The WWTP SCADA system shall be capable of issuing a Run Permissive to the SRS PLC (customer-provided permissive signal) to interlock and shut down the SRS process remotely via an ENABLE/DISABLE button on SCADA. NOTE: it is recommended to have this feature password protected or requiring supervisor level login credentials to interact with.

SRS alarms shall be annunciated from SCADA.

5.2 ANALYTICS

SCADA shall be populated with:

- SRS instantaneous flow trends
- SRS flow totals (daily, previous day, seven day history, lifelong total at a minimum)
- SRS minimum and maximum daily values for each analog signal

5.3 GRAPHICAL REQUIREMENTS

The SRS SCADA screen shall be laid out consistent to that of the existing WWTP SCADA graphical layouts / themes / block selection / operational configuration. The screens shall allow for monitoring and control of the system, and shall include but not be limited to:

1. An overall process overview page;
2. All SRS digital and analog inputs shall be displayed throughout the SCADA screen;
3. Alarm history; and
4. ENABLE/DISABLE feature for the SRS Run Permissive signal (password protected or requiring supervisory level login credentials to operate).

5.4 HISTORIAN

The SCADA system records process data in a historical database for trending and reporting. Records are sampled at least every 10s but are only stored when the process value changes significantly from the previously stored data value, or an extended interval with no record storage occurs.

Table 5.1: SCADA Recordings

Data Type	Record Storage Condition	Max. Interval Between Records
Process Analog (e.g. temperature, flow, etc.)	Deviation >0.5% of span	1 hour
Equipment Running	Record every change	1 hour
Setpoints	Record every change	6 hours
Totalizers (Flow and Runtime)	Record every whole unit change (1.0 hour, 1.0 m3, etc.)	6 hours

Historical data shall be retained permanently on the primary SCADA server or until manually deleted.

5.5 TRENDING

A dedicated trending page shall be available on the HMI/SCADA. Trends shall have the following requirements:

- Time-axis navigation, capable of navigating throughout the entire available historical range. The default time window shall be 12 hours. Manual time-axis pan and zoom buttons shall be available to allow operators to customize the viewed time period.
- Markers shall be available on the trends to display the data values at any point
- Y-Axis shall be labelled with scale and units
- Legend labels for each pen shall be unique per tag, ideally using tag description over tag identifier (e.g., “Grinder 1” instead of “GDR-05-101”)

The following trends shall be made available to the operators, at minimum. Additional trends may be requested by the City of Iqaluit during commissioning.

- Flow, grinder run status
  - Two-tiered trend: Flow on top, grinder run status on bottom
- Valve positions
- Building gas monitoring for each type of gas (H_2S, LEL)

5.6 ALARMING

Alarms are generated within the SRS PLC and are communicated to the SCADA system over the Ethernet network (with redundant hardwired fault status monitored by WWTP PLC system). The SRS

supplier shall provide an alarm list and associated tags for populating into SCADA. A proposed alarm list is outlined within **Appendix B**, but this shall be coordinated with the SRS supplier's alarm list.

APPENDIX A

PIPING AND INSTRUMENTATION DIAGRAMS

Appendix A PIPING AND INSTRUMENTATION DIAGRAMS

REFER TO PDF ATTACHMENTS TAB FOR RELEVANT P&IDS

APPENDIX B

ALARM LIST

Appendix B ALARM LIST

The following alarm list are the proposed placeholder alarms for the SRS. The SRS supplier shall provide an alarms list and the associated PLC tags for the SCADA programmer to populate with available SRS system alarms:

NO.	ALARM	ACQUISITION METHOD	RESULTING PRIME ACTIONS
1.	SRS Fault Alarm	Digital Input XA-05-100, redundant acquisition over EtherNet/IP	Alarm Notification on HMI / SCADA
2.	SRS Low Temperature Alarm	EtherNet/IP Connection	Alarm Notification on HMI / SCADA, alarm callout condition
3.	SRS High H_2S Alarm	EtherNet/IP Connection	Alarm Notification on HMI / SCADA
4.	SRS High High H_2S Alarm	EtherNet/IP Connection	Alarm Notification on HMI / SCADA, alarm callout condition
5.	SRS High LEL Alarm	EtherNet/IP Connection	Alarm Notification on HMI / SCADA
6.	SRS High High LEL Alarm	EtherNet/IP Connection	Alarm Notification on HMI / SCADA, alarm callout condition
7.	SRS Grinder GRD-05-101 Fault Alarm	EtherNet/IP Connection	Alarm Notification on HMI / SCADA
8.	SRS Grinder GRD-05-102 Fault Alarm	EtherNet/IP Connection	Alarm Notification on HMI / SCADA
9.	SRS No Grinders Available	EtherNet/IP Connection	Alarm Notification on HMI / SCADA, alarm callout condition
10.	Transfer Valve PLV-05-100 Fault	EtherNet/IP Connection	Alarm Notification on HMI / SCADA
11.	Transfer Valve PLV-05-200 Fault	EtherNet/IP Connection	Alarm Notification on HMI / SCADA
12.	Communications Loss Between SRS PLC and SCADA	EtherNet/IP Connection	Alarm Notification on HMI / SCADA

PROCESS CONTROL NARRATIVE