

## **PART 1 General**

### **1.1 RELATED REQUIREMENTS**

1. Section 31 32 19.01 – Geotextile.
2. Section 31 32 19.02 – Geomembrane.
3. Section 31 23 33.02 – Fill.

### **1.2 MEASUREMENT AND PAYMENT**

1. Section 01 29 00 – Price and Payment Procedures.
2. Leachate Collection System Perforated Pipe:
  1. Measurement Basis: Item measured by the lineal metre in place for length of perforated leachate collection pipe installed.
  2. Payment Basis: Unit Price. Includes supply, fusion, and installation of perforated leachate collection system pipe, and fittings.
3. Leachate Collection System Cleanout Riser Pipe:
  1. Payment Basis: Unit price. Includes supply, fusion, and installation of non-perforated clean-out pipe and fittings including elbow, blind flange plates, backup rings, flange adapters, neoprene gaskets, stainless steel bolt sets.
4. Leachate Collection System Manhole:
  1. Payment Basis: Unit price. Includes supply and installation of corrugated HDPE pipe to be used as vertical manhole and inclusion of perforations a portion of the pipe according to Drawings.

### **1.3 REFERENCES**

1. Definitions:
  1. HDPE: High density polyethylene.
  2. IPS: Iron pipe size.
2. Reference Standards:
  1. ASTM International:
    1. ASTM A536 - Standard Specification for Ductile Iron Castings.
    2. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
    3. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
    4. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
    5. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

## **1.4 SCHEDULING**

1. Section 01 33 00 – Submittal Procedures: Detailed Work Schedules.
2. Do not allow or cause any of work performed to be covered up or enclosed prior to required inspections, tests, or approvals.

## **1.5 SUBMITTALS**

1. Section 01 33 00 – Submittal Procedures.
2. Product Data: Piping and fitting dimensions including test reports and material property sheets.
3. Manufacturer's Certificate: Quality control certificates pertaining to each lot of pipe produced.
4. Manufacturer's Instructions: Indicate special procedures required to install products specified.

## **1.6 QUALITY ASSURANCE**

1. HDPE Pipe:
2. Pipe Resin: ASTM D1248 for material indicating a Type 3, Category 5, Class C, Grade PE3608 (ASTM D3350 Cell Classification 344464C) with long-term hydrostatic strength (LTHS) of 11 MPa (1,600 psi) when tested and analyzed by ASTM D2837.
3. Raw Material: Containing a minimum 2 percent carbon black, well dispersed by recompounding to protect the pipe from degradation by ultraviolet light.
4. Pipe shall not contain any recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material Supplier.
5. Pipe Sizes: ASTM F714. Pipe sizes are specified in metric units; however, equivalent IPS pipe sizes shall be used.
6. Hydrostatic Design Stress: 5,513 kPa for PE3608 materials.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

1. Section 01 61 00 – Product Requirements
2. Deliver and store piping with labelling in place.
3. Deliver, store, and handle pipe in accordance with applicable requirements of the specified references, the manufacturer's instructions, and as specified herein.
4. Use every precaution to prevent damage to the pipe. Do not permit metal tools or heavy objects to unnecessarily come in contact with the pipe.

## **PART 2 Products**

### **2.1 MATERIALS**

1. LEACHATE COLLECTION SYSTEM PIPE (PERFORATED)
  1. 200 mm diameter HDPE SDR11, as shown on the Drawings.
2. LEACHATE COLLECTION SYSTEM CLEANOUT RISER PIPE (NON-PERFORATED)

1. 200 mm diameter HDPE SDR11 as shown on the Drawings.
2. LEACHATE COLLECTION SYSTEM MANHOLE
  1. 450 mm diameter HDPE SDR11 as shown on the Drawings.

## **2.2 FITTINGS, JOINTS, FLANGES**

1. Polyethylene fittings and/or elbows shall be factory made unless otherwise shown on the Drawings. Fabricated seeps shall be large radius multi-segmented. The ends of the fitting shall not be trimmed to match the pipe section to which they are going to be joined. All polyethylene fittings will have the same or higher pressure rating as the pipe when installed in accordance with the latest technical specifications.
2. Thermal butt-fusion or electrofusion joints.
3. Flanges to be complete with one-piece moulded polyethylene stub ends, backup ring, and flange adapter, as shown on the Drawings. Flanged connections to have the same pressure ratings as the pipe or greater. Provide blind flange plates, neoprene gaskets, and stainless steel bolt sets for all blind flange installations.

## **PART 3 Execution**

### **3.1 INSTALLATION OF HDPE PIPE**

1. Keep HDPE pipe clean, both externally and internally to avoid contaminating clear stone bedding and drainage materials.
2. Do not bend HDPE pipe in a radius smaller than that recommended by the manufacturer when staged on Site or when being installed.
3. Join HDPE pipe by thermal fusion performed in an area near the installation location to avoid excessive transportation and possible damage to the pipe.
4. Water will not be allowed to flow through the pipe during construction. Keep the work area dry and do not lay pipe in water.
5. Prior to initiating thermal fusion in the field on any pipe on a given day, Contractor may be requested to provide a test weld and operating data to Contract Administrator, including welding temperature, machine number, date of last service and clearance certificate.
6. Place perforated HDPE pipe on non-woven geotextile true to line and grade.
7. Install in accordance with the Drawings and include all required fittings/bends, piping, blind flange plates, backup ring and stainless steel bolt sets.

### **3.2 CLEANING**

1. Section 01 74 11 - Cleaning.

### **3.3 PROTECTION**

1. Section 01 73 00 – Execution Requirements: Protection of Installed Work.
2. Protect pipe and bedding from damage or displacement until backfilling operation is complete.

**3.4 DEMONSTRATION**

1. Subsequent to final cleaning, pull or force a steel mandrel or a flusher nozzle, with a diameter 25 mm less than the inside diameter of the pipe, through all installed pipelines, if directed to do so by Contract Administrator, to demonstrate the integrity of the system to the City and Contract Administrator.

**END OF SECTION**

**Part 1            General**

**1.1                SUMMARY**

- .1            Section Includes: Process and measurement instrumentation.

**1.2                REFERENCES**

- .1            National Electrical Manufacturers Association (NEMA)
  - .1            NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .2            Canadian Standards Association (CSA International).
  - .1            CSA-C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

**1.3                SUBMITTALS**

- .1            Manufacturer's Instructions:
  - .1            Include manufacturer's installation instructions for specified equipment and devices

**Part 2            Products**

**2.1                GENERAL**

- .1            Control devices of each category to be of same type and manufacturer.
- .2            External trim materials to be corrosion resistant.
- .3            Operating conditions: -40 to +40 degrees C with 5 - 95% RH (non-condensing) unless otherwise specified, and outdoors rated.
- .4            Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

**2.2                SUMP FLOAT SWITCHES**

- .1            Refer to instrumentation data sheet for level float switch LSH-01 in Appendix C.

**2.3                LEVEL TRANSMITTERS**

- .1            Refer to instrumentation data sheet for level transmitter LIT-01 in Appendix C.

**2.4                FLOW TRANSMITTERS**

- .1            Refer to instrumentation data sheet for flow transmitter FET-01 in Appendix C.

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**Part 3            Part 3 Execution**

**3.1                INSTALLATION**

- .1    Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2    Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3    Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .4    Electrical:
  - .1    Complete installation in accordance with Section 26 05 01 - Common Work Results - Electrical.
  - .2    Install communication wiring in conduit or utilizing ACIC cabling if shown on the drawings.
    - .1    Provide complete conduit /cable system to link instrumentation and the control panel(s).
    - .2    Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
    - .3    Maximum conduit fill not to exceed 40%.
    - .4    Design drawings do not show conduit layout.

**3.2                FLOOD SWITCHES AND SUMP FLOAT SWITCHES**

- .1    Install in a manner to allow easy removal of the transducer and cable assembly for maintenance purposes.

**3.3                LEVEL TRANSMITTERS**

- .1    Install in a manner to allow easy removal of the transducer and cable assembly for maintenance purposes.

**3.4                FLOW TRANSMITTERS**

- .1    Install in a manner to allow easy removal of the transducer and cable assembly for maintenance purposes.

**3.5                IDENTIFICATION**

- .1    Identify field devices with lamacoids label on a stamped stainless steel tag fastened to the instrument with stainless steel wire. Install in a conspicuous location.

**END OF SECTION**

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**Part 1            General**

**1.1                GENERAL REQUIREMENTS**

- .1 All Control Panels shall be built by a CSA/cUL-approved manufacturer and shall bear the CSA/cUL seal with the manufacturer's file number.
- .2 All Control Panels shall be factory assembled and pre-wired. The Control Panel wiring shall be verified at the manufacturer's factory and completely tested before being shipped to the site.
- .3 Supply, install, wire and test all components inside the Control Panels according to the specifications herein and the drawings.

**1.2                SUBMITTALS**

- .1 Prior to construction:
  - .1 Submit product datasheets, and wait for approval, prior to construction of the Control Panels.
  - .2 Submit stamped red-line mark-ups of the proposed modifications to the control panels. If significant modifications are proposed/required, AutoCAD drawings will be supplied to the Contractor for revision.
- .2 Prior to shipment:
  - .1 Submit electronic pictures of enclosure exterior and interior, including door interior.
    - .1 Pictures to be of sufficient resolution to read component labels.
  - .2 As-built drawings:
    - .1 Submit as-built drawings. Minor changes may be made via red-line mark-ups.
    - .2 Draft significant changes on AutoCAD drawings.
  - .3 Do not ship control panel until approval from Contract Administrator is received.

**1.3                INSPECTION**

- .1 A factory inspection of the control panels will be performed at the discretion of the Contract Administrator based upon the pre-shipment submittals.
- .2 If requested, demonstrate and test the control panel in presence of the Contract Administrator designated representative.

**Part 2            Products**

**2.1                GENERAL**

- .1 Construction of the control panels is required, in accordance with the supplied drawings.
- .2 Control devices of each category shall be of same type and manufacturer.

## **2.2 ENCLOSURES**

- .1 Install lamacoids as per the control panel layout drawings.
- .2 All indoor control panels shall be NEMA 12 or as shown on drawings.
- .3 All outdoor control panels shall be NEMA 4 or as shown on drawings.
- .4 All enclosure angles and cut-outs shall be free of dents, gouges or weld marks, and shall present a clean, smooth appearance.
- .5 No screws, fittings or other fastenings shall be used on external panel faces, which must be free of any marks, scratches or defaults.
- .6 The door is to be a minimum fourteen (14) gauge steel plate, full height and flush with adjacent surfaces.
- .7 The exterior of the control panel shall be painted ANSI 61 grey.
- .8 The interior of the control panel shall be painted gloss white.
- .9 Component mounting plates shall be three (3) mm thick steel and shall be painted with one (1) coat of primer and one (1) coat of white baked enamel.
- .10 All control panel doors shall be 900 mm (36 inches) wide maximum.
- .11 All control panel doors shall open through 180 degrees without restriction.
- .12 All control panels of a depth greater than or equal to twelve (12) inches shall be equipped with a fluorescent lighting device located in the cabinet's upper portion with a door switch. Whenever the door is opened, the lighting system shall automatically be activated.
- .13 All floor-mounted control panels shall be equipped with lifting eyes that are attached to a structural member that is capable of bearing the control panel load.
- .14 Enclosure brand shall be Hoffman or an approved equivalent in accordance with B7.

## **2.3 POWER SOURCE**

- .1 Each power source must be protected by a CSA approved circuit breaker or fuse.
- .2 The location of each power source must be clearly shown.
- .3 Panels powered by more than 1 electrical source shall display on their door; "Caution: This panel is electrically powered by more than one source".

## **2.4 COMPONENTS**

- .1 Unless written approval for use of unapproved components is received from The City, all electrical materials (e.g., conduit, fittings, wireways, etc.) shall be CSA or cUL approved.
- .2 Terminals
  - .1 Requirements:

- .1 Voltage rating:
  - .1 240V for general control circuits.
  - .2 240V for power circuits.
- .2 Manufacturer: Phoenix Contact or equivalent in accordance with B7.
- .2 Terminal blocks shall be designed for the size of the wires to be connected to them. Terminal blocks used for analog, digital, and power cables shall be identified and physically separated from each other.
- .3 Each terminal shall bear an identification number on both sides.
- .4 Drawings and templates supplied may not detail all hardware components such as labels, stoppers, rail lifters, end plates, separators, etc. The supplier must supply and install such components when required.
- .3 Ground Bus Bar
  - .1 Supply a ground bus bar in each control panel.
  - .2 Requirements:
    - .1 Tapped holes in screws.
    - .2 Bar to have sufficient connection points for all cables entering the control panel, plus 25% spare
    - .3 Maximum one wire termination per screw.
- .4 Pushbutton, Switch and Indicator Light
  - .1 When required, all control panel pushbuttons, switches and indicator lights shall be as specified in Section 29 29 03 – Control Devices.
  - .2 Manufacturer: Allen-Bradley or equivalent in accordance with B7.
- .5 General Purpose Relays
  - .1 When required, all general purpose relays shall be as specified in Section 26 29 03 – Control Devices
  - .2 Type: DPDT or as indicated on drawings
  - .3 Indication: LED
  - .4 Coil Voltage: As per drawings
  - .5 Contact Rating: 5A (120 VAC), 5A (24 VDC)
  - .6 Approvals: CSA
  - .7 Manufacturer: Omron or equivalent in accordance with B7
- .6 24 VDC Power Supplies
  - .1 Capacity: As shown on the drawings
  - .2 Supply Voltage: 120 VAC, 1phase
  - .3 Approvals: CSA
  - .4 Manufacturer: Sola or equivalent in accordance with B7
- .7 Uninterruptible Power Supply
  - .1 Size: 480 VA
  - .2 Input Voltage: 24 VDC
  - .3 Output Voltage: 24 VDC
  - .4 Battery: DIN Rail Mount
  - .5 Monitoring Contacts: Battery Fault, Low Battery (Form C SPDT)

- .6 Manufacturer: Sola or equivalent in accordance with B7
- .8 Grounding
  - .1 All control panel components shall be adequately grounded in accordance with the component manufacturer, especially control system components.
  - .2 Firmly bond all panel mounted devices on or within the panels to ground. Provide supplementary bonding conductors for back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.
  - .3 Where ground bars are installed on to the rear or side wall of the enclosure, seal screw penetrations to maintain enclosure rating.
- .9 Wiring
  - .1 Panel wiring shall be installed in a neat and orderly manner.
  - .2 All conductors shall be securely fastened to terminals at both ends; no splices are allowed inside the panel.
  - .3 No more than two (2) conductors may be terminated under each terminal screw. All internal panel conductors shall be connected to the same side of a terminal block, and external conductors to the other side. The only exception is for fused terminals which require connection to the field side for internal wiring.
  - .4 All wires and cables inside the control panels shall be identified on both ends with non-erasable markers.
  - .5 Identification shall follow the supplied documents, such as wiring diagrams.
    - .1 Label both ends of each wire.
    - .2 Utilize machine printed non-slip labels. Wrap-around or self-adhesive markers shall not be permitted.
    - .3 Wherever possible wire labels shall be positioned to be read from the panel opening without removal of wire duct covers or other wiring.
  - .6 Individual conductors or wires exiting a cable shall be identified using nonerasable markers.
  - .7 The routing of all analog, digital, and power cable wiring inside control panels shall be segregated as much as possible, in distinct wiring ducts, by the type of signal they are carrying. All wires shall be physically protected by wiring ducts with covers. The wiring ducts shall be of sufficient size to be filled to a maximum of 50% when all wires are inside.
  - .8 All 24 VDC or 120 VAC discrete signal panel wiring shall be 14 AWG TEW stranded conductor.
    - .1 Increase the size of power wiring, 12 AWG minimum.
  - .9 The sizes and colours of wires shall be in accordance with the CSA and the Canadian Electrical Code.
  - .10 The panel builder shall group and form wiring into a loop when going from a fixed part of the panel to a door such that there is sufficient slack to minimize strand fatigue and breaking. Each end of the loop shall be properly supported.
  - .11 Wiring Duct
    - .1 All wires shall be run in narrow slot wiring duct such as such as Panduit or an approved equivalent in accordance with B7.
    - .2 Wiring Duct shall be installed on both sides of the panel and between the DIN rails.

- .3 Wire or cable, connected to internal device or arriving from external device, shall be uncovered by Wiring Duct for a maximum of 10 cm.
- .4 120 VAC wires cannot share wiring duct with 10 VDC, 24 VDC or 4-20 mA wires, but can cross their path.
- .5 All DC, AC, and thermocouple wiring shall be routed in separate wireways to prevent signal interference.
- .12 Wire ties shall be non-metallic.
- .13 Wiring shall be arranged to be readily accessible for inspection and maintenance.
- .14 The wiring arrangement shall not interfere with access to panel-mounted devices or spaces for future equipment.
- .10 Overcurrent Protection
  - .1 Panel-mounted devices and all control circuits shall be protected by appropriately sized fuses or circuit breakers.
- .11 Internal Lighting
  - .1 Enclosure luminaire shall be LED type controlled by an enclosure door switch.
- .12 Cooling and Heating Systems
  - .1 Control panels shall be designed for the environmental conditions of the installation location. Cooling and heating systems shall be in accordance with the specific NEMA rating required by NEMA ICS 6 and NEMA 250.

## 2.5 TRUCK FILL CONTROL PANEL

- .1 'Truck Fill Control Panel' shall include the following:
  - .1 Keyed selector switch for ON – OFF operation
  - .2 Automatic 'fill' push button to provide continuous signal for the leachate truck fill pump
  - .3 Manual 'override' push button to provide a jog function for the leachate truck fill pump
  - .4 Automatic E-STOP push button to provide immediate shutdown
  - .5 Yellow LED indicating light
  - .6 Red LED indicating light
  - .7 Four (4) adjustable thumbwheels dials
  - .8 PLC with discrete and analog inputs & outputs as required
  - .9 24VDC, 4 amp power supply
  - .10 Uninterruptible power supply
  - .11 24VDC contact output to control truck fill valves XV-1 and XV-2
  - .12 SD Card to store fill volume and time stamp and be easily accessible by City personnel
  - .13 Dry contact output to control truck fill pump
  - .14 Enclosure environmental controls to suit the outdoor environment and components housed with the control panel
  - .15 Fusing/protection as specified by manufacturer
  - .16 Door controlled enclosure light
  - .17 Duplex 15A receptacle, fused at 5 amps mounted within enclosure labeled for laptop computer use only

- .18 Flow transmitter (magnetic flow meter element is remote from respective transmitter)
- .19 Lamacoid label instructing operator on the operation of the control panel.

### **Part 3 Execution**

#### **3.1 COMPONENT INSTALLATION**

- .1 Components on the front of the panel shall be identified with an individual permanent nameplate installed in an organized manner. The nameplate must identify the component's function.
- .2 Each component inside the control panel shall be identified with a nameplate corresponding to the drawings.
- .3 All non-DIN rail mountable devices in the control panel shall be mechanically affixed to the back panel with either tapped or self-tapping screws.
- .4 All control devices shall be mounted so that any component can be replaced without removing the sub-panel or other components.
- .5 Components and/or auxiliary instruments mounted at the rear of the panel shall be readily accessible and their installation shall not be affected by, or interfere with the removal of any panel instrument.
- .6 Nameplates shall be made of lamacoid material with a white background and engraved black letters for internal and external components. Nameplates must resist harsh industrial conditions.
- .7 Supply and install all required fuses.
- .8 Control devices must be spaced adequately to allow for cooling, replacement, servicing, and wiring access.
- .9 Control devices shall be grouped according to voltage and function to reduce electrical noise.
- .10 Cut-outs for instruments shall be within the tolerances specified by the instrument manufacturer.
- .11 If cut-outs are specified for future instruments, the cut-outs shall be covered by removable steel plates 3 mm (1/8 inch) thick. The cover plates shall be finished and painted with the same paint as applied to the front panel.
- .12 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.
- .13 Panel areas designated for future equipment shall be kept clear of stiffening members, rear-mounted equipment, wiring, and all other interferences.

- .14 Ample space shall be provided for the entrance of external cables into the panel and for routing the cables to terminating points within the panel.

### **3.2 IDENTIFICATION**

- .1 Perform terminal identification using a computerized device. Handwriting is not acceptable.
- .2 Label terminals as shown on drawings.
- .3 Install label above each terminal block with terminal block name.

### **3.3 TESTING**

- .1 Testing of the control panels shall be completed to the greatest extent possible prior to the FAT, and shall include at minimum:
  - .1 Provide a signed and dated inspection sheet with all tests performed listed on it.
  - .2 The list of the various test procedures described hereunder is not restrictive, and does not relieve the control panel manufacturer of his responsibility to perform any other work that is not mentioned but requested to verify the good operation of the control panels.
  - .3 Isolate all instruments and components of the control panels as required to protect them from any damage during tests.
  - .4 Provide the services of qualified personnel as well as tools and equipment required to perform all tests and inspection of the control panels.
  - .5 Tests shall include the following where applicable:
    - .1 Power supply functionality
    - .2 PLC component functionality
    - .3 Point to point tests of all inputs and outputs
    - .4 Power terminal voltage verification
    - .5 Relays and switches functionality
    - .6 E-stop system component functionality
    - .7 Receptacle and lighting functionality
    - .8 Ethernet switch and fibre transceiver functionality
    - .9 Auto-dialer functionality
  - .6 If the panel is modified after tests have been performed, tests shall be repeated.

### **3.4 SHIPMENT**

- .1 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.
- .2 Shipment of any panel having shortages of equipment shall be approved in writing by The City.

### 3.5 SPARE COMPONENTS

- .1 Supply two spares of each fuse type and rating. Place in a clear plastic bag and attach to the panel door interior.

### 3.6 TRUCK FILL CONTROL NARATIVE

- .1 After the operator has completed all hose connections and is ready to start filling a truck, the following sequence of events shall take place.
  - .1 Operator shall insert key into System ON - OFF switch and switch the system to ON
  - .2 Operator shall set volume between 0L to 30,000L using the adjustable thumbwheel dial. Minimum set volume to initiate sequence is 1,000L
    - .1 Truck fill control panel shall have four (4) adjustable thumbwheel dials
    - .2 The combination of four (4) adjustable thumbwheel dials shall indicate set volume and will be scaled by a factor of ten (10)
  - .3 Operator shall press 'fill' push button to initiate sequence and PLC shall record time stamp on SD card
  - .4 System shall receive tank level signal from Level Display within the tank level control panel to permit the PLC to determine if there is sufficient volume in the storage tank the operator is requesting above the minimum tank level (1.2m) which the pump requires to operate
    - .1 Solid red light shall indicate an 'error' status if insufficient volume in tank or if requested volume exceeds current inventory.
    - .2 If system indicates an 'error' status system shall exit sequence and record a zero (0) L volume fill on the SD card for corresponding time stamp
  - .5 Truck fill control panel shall initiate 'system verification' sequence and allow a one (1) minute time delay before 'fill progress' loading sequence commences
    - .1 Flashing yellow light shall indicate a 'system verification' status. 'System verification' status shall remain active for a duration of one (1) minute
    - .2 PLC shall open truck fill valve XV-1 and XV-2
      - .1 Valve will require approximately 7 seconds to open
      - .2 System shall receive limit switch signal from valve XV-1 actuator and XV-2 actuator to verify open position of valves
    - .3 System shall be in standby for the remainder of the time delay
  - .6 'Fill progress' sequence shall commence immediately after 'system verification' sequence executes
    - .1 Solid yellow light shall indicate a 'fill progress' status
  - .7 Start leachate pump. Flow transmitter shall send a pulse signal to permit the PLC to determine the volume delivered
  - .8 Pump shall continue filling the operator's truck until the volume set by the operator has been reached
    - .1 Flow transmitter shall send pulsed signal to permit the PLC to determine the volume transferred
  - .9 PLC shall close truck fill valve XV-1 and XV-2
    - .1 Valve will require approximately 7 seconds to close
    - .2 System shall receive limit switch signal from valve XV-1 actuator and XV-2 actuator to verify close position of valves

- .10 PLC shall record volume data and time stamp and shall store on an SD card
- .11 System shall shut down and operator shall switch the system to OFF and shall remove key from system ON - OFF
  
- .2 After the operator has completed all hose connections and is ready to start filling a truck, a manual 'override' push button shall be available to offer the following functionalities:
  - .1 Operator shall insert key into system ON - OFF switch and switch the system to ON
  - .2 Manual 'override' push button shall by-pass 'system verification' sequence
  - .3 Operator shall hold 'override' push button to initiate sequence and PLC shall record time stamp on SD card
  - .4 System shall receive tank level signal from Level Display within the tank level control panel to permit the PLC to determine if there is sufficient minimum volume in the storage tank (1.2m) which the pump requires to operate
    - .1 Solid red light shall indicate an 'error' status if insufficient volume in tank
    - .2 PLC shall open truck fill valve XV-1 and XV-2
      - .1 Valve will require approximately 7 seconds to open
      - .2 System shall receive limit switch signal from valve XV-1 actuator and XV-2 actuator to verify open position of valves
    - .3 If system indicates an 'error' status system shall exit sequence and record a zero (0) L volume fill on the SD card for corresponding time stamp
  - .5 'Fill progress' sequence shall commence immediately
    - .1 Solid yellow light shall indicate a 'fill progress' status
  - .6 Leachate tank shall override pre-set volume amount and pump leachate continuously for duration as long as push button held
    - .1 System shall monitor tank level signal to permit the PLC to determine if there is sufficient minimum volume in the storage tank (1.2m) which the pump requires to operate
    - .2 System shall shut down when insufficient minimum volume in storage tank (1.2m)
  - .7 Flow transmitter shall send a pulse signal to permit the PLC to determine the volume delivered
  - .8 PLC shall close truck fill valve XV-1 and XV-2 when operator releases 'override' push button
    - .1 Valve shall take 7 seconds to close
    - .2 System shall receive limit switch signal from valve XV-1 actuator and XV-2 actuator to verify close position of valves
  - .9 PLC shall record volume data and time stamp and shall store on an SD card.
  - .10 System shall shut down and operator shall switch the system to OFF and shall remove key from system ON - OFF
  - .11 Volume data and time stamp shall be stored on an SD card and shall be easily accessible by City personnel for data collection
  
- .3 An emergency stop push button E-STOP shall be easily accessible by the operator to shut down the system when there is a problem with filling a truck in the event of a hose failure, overflow, spill, or if the operator has incorrectly selected the wrong fill volume and the system is in 'fill progress' loading sequence

- .1 The operator shall press the E-STOP to initiate 'emergency stop' sequence.
- .2 Flashing red light shall indicate an 'error' status
- .3 PLC shall close the valve and the tank pump shall stop
  - .1 Valve will require approximately 7 seconds to close
  - .2 System shall receive limit switch signal from valve XV-1 actuator and XV-2 actuator to verify close position of valves
- .4 PLC shall record volume data and time stamp at E-STOP and shall store on an SD card
- .5 Operator shall manually reset the E-STOP push button to exit out of 'emergency stop' sequence
- .6 Operator shall have the option to continue 'fill operation' or to shut down and reset the system. To continue 'fill operation', operator shall press 'fill' push button and follow the control narrative steps 3.6.1.3 to 3.6.1.12. To reset the system operator shall switch the system to OFF with the key switch

**END OF SECTION**

**Part 1 General**

**1.1 SUBMITTALS**

- .1 Submit product data.

**Part 2 Products**

**2.1 GENERAL**

- .1 Unless otherwise specified, provide outside finishes on all enclosures in ANSI 61 Grey.
- .2 The enclosures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors without any warpage.
- .3 Provide a lamacoid for the junction box with identifier.
- .4 Provide a lamacoid for the junction box with power panel and circuit number, if applicable.

**2.2 ENCLOSURES**

- .1 Enclosures shall be NEMA 4 rated unless located in electrical or control rooms.
- .2 Enclosures shall be applicable for Zone 2 hazardous locations where located within hazardous areas according to the hazardous location plans.
- .3 Enclosures shall provide IP66 rating.
- .4 Enclosures shall have a continuous hinge with clamps for closing.
- .5 Manufacturer: Hoffman or equivalent in accordance with B7.

**2.3 WIRING AND ACCESSORIES**

- .1 Provide wiring inside the panels according to the following Specifications:
  - .1 Control wiring to be a minimum of 16 AWG tinned stranded copper; insulation rated at 240 V.
  - .2 Wiring for power distribution shall be a minimum of 14 AWG tinned stranded copper; insulation rated at 240 V.
  - .3 Install cables in accordance with the requirements of Division 26.
- .2 Tag each wire at both ends with a heat shrink sleeve that is machine printed. Allow approximately 20 mm of wire insulation between the tag and the bare wire.
- .3 Wiring systems with different voltage levels or types shall be suitably segregated within the panel, according to relevant electrical codes.
- .4 Run all wiring in enclosed plastic wireways such as Panduit. Size all wireways so that the total cross sectional area of the insulated wire and cable does not exceed 40 percent of the cross sectional area of the wire way.

- .5 Provide a minimum clearance of 50 mm between wire ways and any point of wire termination.
- .6 Terminate all wiring, incoming and outgoing, at terminal strips mounted inside the panels. Identify each terminal strip with a terminal strip number, as per the drawings.
- .7 Provide sufficient terminals so that not more than two wires are connected under the same terminal.
- .8 Provide nameplates for each device on or within the enclosure.

**2.4 PANEL GROUNDING**

- .1 Firmly bond all panel-mounted devices on or within the panels to ground. Provide supplementary bonding conductors for backpanels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

**Part 3 Execution**

**3.1 MOUNTING HEIGHTS**

- .1 Unless otherwise specified or a conflict exists, mount all panels, starters and disconnects 2000 mm to top of cover.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes: Process and measurement instrumentation.

**1.2 REFERENCES**

- .1 National Electrical Manufacturers Association (NEMA)
  - .1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .2 Canadian Standards Association (CSA International).
  - .1 CSA-C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

**1.3 SUBMITTALS**

- .1 Manufacturer's Instructions:
  - .1 Include manufacturer's installation instructions for specified equipment and devices

**Part 2 Products**

**2.1 GENERAL**

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant.
- .3 Operating conditions: -40 to +40 degrees C with 5 - 95% RH (non-condensing) unless otherwise specified, and outdoors rated.
- .4 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

**2.2 SUMP FLOAT SWITCHES**

- .1 Refer to instrumentation data sheet for level float switch LSH-01 in Appendix C.

**2.3 LEVEL TRANSMITTERS**

- .1 Refer to instrumentation data sheet for level transmitter LIT-01 in Appendix C.

**2.4 FLOW TRANSMITTERS**

- .1 Refer to instrumentation data sheet for flow transmitter FET-01 in Appendix C.

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**Part 3            Part 3 Execution**

**3.1                INSTALLATION**

- .1    Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2    Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3    Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .4    Electrical:
  - .1    Complete installation in accordance with Section 26 05 01 - Common Work Results - Electrical.
  - .2    Install communication wiring in conduit or utilizing ACIC cabling if shown on the drawings.
    - .1    Provide complete conduit /cable system to link instrumentation and the control panel(s).
    - .2    Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
    - .3    Maximum conduit fill not to exceed 40%.
    - .4    Design drawings do not show conduit layout.

**3.2                FLOOD SWITCHES AND SUMP FLOAT SWITCHES**

- .1    Install in a manner to allow easy removal of the transducer and cable assembly for maintenance purposes.

**3.3                LEVEL TRANSMITTERS**

- .1    Install in a manner to allow easy removal of the transducer and cable assembly for maintenance purposes.

**3.4                FLOW TRANSMITTERS**

- .1    Install in a manner to allow easy removal of the transducer and cable assembly for maintenance purposes.

**3.5                IDENTIFICATION**

- .1    Identify field devices with lamacoids label on a stamped stainless steel tag fastened to the instrument with stainless steel wire. Install in a conspicuous location.

**END OF SECTION**

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**Part 1            General**

**1.1                GENERAL REQUIREMENTS**

- .1 All Control Panels shall be built by a CSA/cUL-approved manufacturer and shall bear the CSA/cUL seal with the manufacturer's file number.
- .2 All Control Panels shall be factory assembled and pre-wired. The Control Panel wiring shall be verified at the manufacturer's factory and completely tested before being shipped to the site.
- .3 Supply, install, wire and test all components inside the Control Panels according to the specifications herein and the drawings.

**1.2                SUBMITTALS**

- .1 Prior to construction:
  - .1 Submit product datasheets, and wait for approval, prior to construction of the Control Panels.
  - .2 Submit stamped red-line mark-ups of the proposed modifications to the control panels. If significant modifications are proposed/required, AutoCAD drawings will be supplied to the Contractor for revision.
- .2 Prior to shipment:
  - .1 Submit electronic pictures of enclosure exterior and interior, including door interior.
    - .1 Pictures to be of sufficient resolution to read component labels.
  - .2 As-built drawings:
    - .1 Submit as-built drawings. Minor changes may be made via red-line mark-ups.
    - .2 Draft significant changes on AutoCAD drawings.
  - .3 Do not ship control panel until approval from Contract Administrator is received.

**1.3                INSPECTION**

- .1 A factory inspection of the control panels will be performed at the discretion of the Contract Administrator based upon the pre-shipment submittals.
- .2 If requested, demonstrate and test the control panel in presence of the Contract Administrator designated representative.

**Part 2            Products**

**2.1                GENERAL**

- .1 Construction of the control panels is required, in accordance with the supplied drawings.
- .2 Control devices of each category shall be of same type and manufacturer.

## **2.2 ENCLOSURES**

- .1 Install lamacoids as per the control panel layout drawings.
- .2 All indoor control panels shall be NEMA 12 or as shown on drawings.
- .3 All outdoor control panels shall be NEMA 4 or as shown on drawings.
- .4 All enclosure angles and cut-outs shall be free of dents, gouges or weld marks, and shall present a clean, smooth appearance.
- .5 No screws, fittings or other fastenings shall be used on external panel faces, which must be free of any marks, scratches or defaults.
- .6 The door is to be a minimum fourteen (14) gauge steel plate, full height and flush with adjacent surfaces.
- .7 The exterior of the control panel shall be painted ANSI 61 grey.
- .8 The interior of the control panel shall be painted gloss white.
- .9 Component mounting plates shall be three (3) mm thick steel and shall be painted with one (1) coat of primer and one (1) coat of white baked enamel.
- .10 All control panel doors shall be 900 mm (36 inches) wide maximum.
- .11 All control panel doors shall open through 180 degrees without restriction.
- .12 All control panels of a depth greater than or equal to twelve (12) inches shall be equipped with a fluorescent lighting device located in the cabinet's upper portion with a door switch. Whenever the door is opened, the lighting system shall automatically be activated.
- .13 All floor-mounted control panels shall be equipped with lifting eyes that are attached to a structural member that is capable of bearing the control panel load.
- .14 Enclosure brand shall be Hoffman or an approved equivalent in accordance with B7.

## **2.3 POWER SOURCE**

- .1 Each power source must be protected by a CSA approved circuit breaker or fuse.
- .2 The location of each power source must be clearly shown.
- .3 Panels powered by more than 1 electrical source shall display on their door; "Caution: This panel is electrically powered by more than one source".

## **2.4 COMPONENTS**

- .1 Unless written approval for use of unapproved components is received from The City, all electrical materials (e.g., conduit, fittings, wireways, etc.) shall be CSA or cUL approved.
- .2 Terminals
  - .1 Requirements:

- .1 Voltage rating:
  - .1 240V for general control circuits.
  - .2 240V for power circuits.
- .2 Manufacturer: Phoenix Contact or equivalent in accordance with B7.
- .2 Terminal blocks shall be designed for the size of the wires to be connected to them. Terminal blocks used for analog, digital, and power cables shall be identified and physically separated from each other.
- .3 Each terminal shall bear an identification number on both sides.
- .4 Drawings and templates supplied may not detail all hardware components such as labels, stoppers, rail lifters, end plates, separators, etc. The supplier must supply and install such components when required.
- .3 Ground Bus Bar
  - .1 Supply a ground bus bar in each control panel.
  - .2 Requirements:
    - .1 Tapped holes in screws.
    - .2 Bar to have sufficient connection points for all cables entering the control panel, plus 25% spare
    - .3 Maximum one wire termination per screw.
- .4 Pushbutton, Switch and Indicator Light
  - .1 When required, all control panel pushbuttons, switches and indicator lights shall be as specified in Section 29 29 03 – Control Devices.
  - .2 Manufacturer: Allen-Bradley or equivalent in accordance with B7.
- .5 General Purpose Relays
  - .1 When required, all general purpose relays shall be as specified in Section 26 29 03 – Control Devices
  - .2 Type: DPDT or as indicated on drawings
  - .3 Indication: LED
  - .4 Coil Voltage: As per drawings
  - .5 Contact Rating: 5A (120 VAC), 5A (24 VDC)
  - .6 Approvals: CSA
  - .7 Manufacturer: Omron or equivalent in accordance with B7
- .6 24 VDC Power Supplies
  - .1 Capacity: As shown on the drawings
  - .2 Supply Voltage: 120 VAC, 1phase
  - .3 Approvals: CSA
  - .4 Manufacturer: Sola or equivalent in accordance with B7
- .7 Uninterruptible Power Supply
  - .1 Size: 480 VA
  - .2 Input Voltage: 24 VDC
  - .3 Output Voltage: 24 VDC
  - .4 Battery: DIN Rail Mount
  - .5 Monitoring Contacts: Battery Fault, Low Battery (Form C SPDT)

- .6 Manufacturer: Sola or equivalent in accordance with B7
- .8 Grounding
  - .1 All control panel components shall be adequately grounded in accordance with the component manufacturer, especially control system components.
  - .2 Firmly bond all panel mounted devices on or within the panels to ground. Provide supplementary bonding conductors for back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.
  - .3 Where ground bars are installed on to the rear or side wall of the enclosure, seal screw penetrations to maintain enclosure rating.
- .9 Wiring
  - .1 Panel wiring shall be installed in a neat and orderly manner.
  - .2 All conductors shall be securely fastened to terminals at both ends; no splices are allowed inside the panel.
  - .3 No more than two (2) conductors may be terminated under each terminal screw. All internal panel conductors shall be connected to the same side of a terminal block, and external conductors to the other side. The only exception is for fused terminals which require connection to the field side for internal wiring.
  - .4 All wires and cables inside the control panels shall be identified on both ends with non-erasable markers.
  - .5 Identification shall follow the supplied documents, such as wiring diagrams.
    - .1 Label both ends of each wire.
    - .2 Utilize machine printed non-slip labels. Wrap-around or self-adhesive markers shall not be permitted.
    - .3 Wherever possible wire labels shall be positioned to be read from the panel opening without removal of wire duct covers or other wiring.
  - .6 Individual conductors or wires exiting a cable shall be identified using nonerasable markers.
  - .7 The routing of all analog, digital, and power cable wiring inside control panels shall be segregated as much as possible, in distinct wiring ducts, by the type of signal they are carrying. All wires shall be physically protected by wiring ducts with covers. The wiring ducts shall be of sufficient size to be filled to a maximum of 50% when all wires are inside.
  - .8 All 24 VDC or 120 VAC discrete signal panel wiring shall be 14 AWG TEW stranded conductor.
    - .1 Increase the size of power wiring, 12 AWG minimum.
  - .9 The sizes and colours of wires shall be in accordance with the CSA and the Canadian Electrical Code.
  - .10 The panel builder shall group and form wiring into a loop when going from a fixed part of the panel to a door such that there is sufficient slack to minimize strand fatigue and breaking. Each end of the loop shall be properly supported.
  - .11 Wiring Duct
    - .1 All wires shall be run in narrow slot wiring duct such as such as Panduit or an approved equivalent in accordance with B7.
    - .2 Wiring Duct shall be installed on both sides of the panel and between the DIN rails.

- .3 Wire or cable, connected to internal device or arriving from external device, shall be uncovered by Wiring Duct for a maximum of 10 cm.
- .4 120 VAC wires cannot share wiring duct with 10 VDC, 24 VDC or 4-20 mA wires, but can cross their path.
- .5 All DC, AC, and thermocouple wiring shall be routed in separate wireways to prevent signal interference.
- .12 Wire ties shall be non-metallic.
- .13 Wiring shall be arranged to be readily accessible for inspection and maintenance.
- .14 The wiring arrangement shall not interfere with access to panel-mounted devices or spaces for future equipment.
- .10 Overcurrent Protection
  - .1 Panel-mounted devices and all control circuits shall be protected by appropriately sized fuses or circuit breakers.
- .11 Internal Lighting
  - .1 Enclosure luminaire shall be LED type controlled by an enclosure door switch.
- .12 Cooling and Heating Systems
  - .1 Control panels shall be designed for the environmental conditions of the installation location. Cooling and heating systems shall be in accordance with the specific NEMA rating required by NEMA ICS 6 and NEMA 250.

## 2.5 TRUCK FILL CONTROL PANEL

- .1 'Truck Fill Control Panel' shall include the following:
  - .1 Keyed selector switch for ON – OFF operation
  - .2 Automatic 'fill' push button to provide continuous signal for the leachate truck fill pump
  - .3 Manual 'override' push button to provide a jog function for the leachate truck fill pump
  - .4 Automatic E-STOP push button to provide immediate shutdown
  - .5 Yellow LED indicating light
  - .6 Red LED indicating light
  - .7 Four (4) adjustable thumbwheels dials
  - .8 PLC with discrete and analog inputs & outputs as required
  - .9 24VDC, 4 amp power supply
  - .10 Uninterruptible power supply
  - .11 24VDC contact output to control truck fill valves XV-1 and XV-2
  - .12 SD Card to store fill volume and time stamp and be easily accessible by City personnel
  - .13 Dry contact output to control truck fill pump
  - .14 Enclosure environmental controls to suit the outdoor environment and components housed with the control panel
  - .15 Fusing/protection as specified by manufacturer
  - .16 Door controlled enclosure light
  - .17 Duplex 15A receptacle, fused at 5 amps mounted within enclosure labeled for laptop computer use only

- .18 Flow transmitter (magnetic flow meter element is remote from respective transmitter)
- .19 Lamacoid label instructing operator on the operation of the control panel.

### **Part 3 Execution**

#### **3.1 COMPONENT INSTALLATION**

- .1 Components on the front of the panel shall be identified with an individual permanent nameplate installed in an organized manner. The nameplate must identify the component's function.
- .2 Each component inside the control panel shall be identified with a nameplate corresponding to the drawings.
- .3 All non-DIN rail mountable devices in the control panel shall be mechanically affixed to the back panel with either tapped or self-tapping screws.
- .4 All control devices shall be mounted so that any component can be replaced without removing the sub-panel or other components.
- .5 Components and/or auxiliary instruments mounted at the rear of the panel shall be readily accessible and their installation shall not be affected by, or interfere with the removal of any panel instrument.
- .6 Nameplates shall be made of lamacoid material with a white background and engraved black letters for internal and external components. Nameplates must resist harsh industrial conditions.
- .7 Supply and install all required fuses.
- .8 Control devices must be spaced adequately to allow for cooling, replacement, servicing, and wiring access.
- .9 Control devices shall be grouped according to voltage and function to reduce electrical noise.
- .10 Cut-outs for instruments shall be within the tolerances specified by the instrument manufacturer.
- .11 If cut-outs are specified for future instruments, the cut-outs shall be covered by removable steel plates 3 mm (1/8 inch) thick. The cover plates shall be finished and painted with the same paint as applied to the front panel.
- .12 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.
- .13 Panel areas designated for future equipment shall be kept clear of stiffening members, rear-mounted equipment, wiring, and all other interferences.

- .14 Ample space shall be provided for the entrance of external cables into the panel and for routing the cables to terminating points within the panel.

### **3.2 IDENTIFICATION**

- .1 Perform terminal identification using a computerized device. Handwriting is not acceptable.
- .2 Label terminals as shown on drawings.
- .3 Install label above each terminal block with terminal block name.

### **3.3 TESTING**

- .1 Testing of the control panels shall be completed to the greatest extent possible prior to the FAT, and shall include at minimum:
  - .1 Provide a signed and dated inspection sheet with all tests performed listed on it.
  - .2 The list of the various test procedures described hereunder is not restrictive, and does not relieve the control panel manufacturer of his responsibility to perform any other work that is not mentioned but requested to verify the good operation of the control panels.
  - .3 Isolate all instruments and components of the control panels as required to protect them from any damage during tests.
  - .4 Provide the services of qualified personnel as well as tools and equipment required to perform all tests and inspection of the control panels.
  - .5 Tests shall include the following where applicable:
    - .1 Power supply functionality
    - .2 PLC component functionality
    - .3 Point to point tests of all inputs and outputs
    - .4 Power terminal voltage verification
    - .5 Relays and switches functionality
    - .6 E-stop system component functionality
    - .7 Receptacle and lighting functionality
    - .8 Ethernet switch and fibre transceiver functionality
    - .9 Auto-dialer functionality
  - .6 If the panel is modified after tests have been performed, tests shall be repeated.

### **3.4 SHIPMENT**

- .1 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.
- .2 Shipment of any panel having shortages of equipment shall be approved in writing by The City.

### 3.5 SPARE COMPONENTS

- .1 Supply two spares of each fuse type and rating. Place in a clear plastic bag and attach to the panel door interior.

### 3.6 TRUCK FILL CONTROL NARATIVE

- .1 After the operator has completed all hose connections and is ready to start filling a truck, the following sequence of events shall take place.
  - .1 Operator shall insert key into System ON - OFF switch and switch the system to ON
  - .2 Operator shall set volume between 0L to 30,000L using the adjustable thumbwheel dial. Minimum set volume to initiate sequence is 1,000L
    - .1 Truck fill control panel shall have four (4) adjustable thumbwheel dials
    - .2 The combination of four (4) adjustable thumbwheel dials shall indicate set volume and will be scaled by a factor of ten (10)
  - .3 Operator shall press 'fill' push button to initiate sequence and PLC shall record time stamp on SD card
  - .4 System shall receive tank level signal from Level Display within the tank level control panel to permit the PLC to determine if there is sufficient volume in the storage tank the operator is requesting above the minimum tank level (1.2m) which the pump requires to operate
    - .1 Solid red light shall indicate an 'error' status if insufficient volume in tank or if requested volume exceeds current inventory.
    - .2 If system indicates an 'error' status system shall exit sequence and record a zero (0) L volume fill on the SD card for corresponding time stamp
  - .5 Truck fill control panel shall initiate 'system verification' sequence and allow a one (1) minute time delay before 'fill progress' loading sequence commences
    - .1 Flashing yellow light shall indicate a 'system verification' status. 'System verification' status shall remain active for a duration of one (1) minute
    - .2 PLC shall open truck fill valve XV-1 and XV-2
      - .1 Valve will require approximately 7 seconds to open
      - .2 System shall receive limit switch signal from valve XV-1 actuator and XV-2 actuator to verify open position of valves
    - .3 System shall be in standby for the remainder of the time delay
  - .6 'Fill progress' sequence shall commence immediately after 'system verification' sequence executes
    - .1 Solid yellow light shall indicate a 'fill progress' status
  - .7 Start leachate pump. Flow transmitter shall send a pulse signal to permit the PLC to determine the volume delivered
  - .8 Pump shall continue filling the operator's truck until the volume set by the operator has been reached
    - .1 Flow transmitter shall send pulsed signal to permit the PLC to determine the volume transferred
  - .9 PLC shall close truck fill valve XV-1 and XV-2
    - .1 Valve will require approximately 7 seconds to close
    - .2 System shall receive limit switch signal from valve XV-1 actuator and XV-2 actuator to verify close position of valves

- .10 PLC shall record volume data and time stamp and shall store on an SD card
- .11 System shall shut down and operator shall switch the system to OFF and shall remove key from system ON - OFF
  
- .2 After the operator has completed all hose connections and is ready to start filling a truck, a manual 'override' push button shall be available to offer the following functionalities:
  - .1 Operator shall insert key into system ON - OFF switch and switch the system to ON
  - .2 Manual 'override' push button shall by-pass 'system verification' sequence
  - .3 Operator shall hold 'override' push button to initiate sequence and PLC shall record time stamp on SD card
  - .4 System shall receive tank level signal from Level Display within the tank level control panel to permit the PLC to determine if there is sufficient minimum volume in the storage tank (1.2m) which the pump requires to operate
    - .1 Solid red light shall indicate an 'error' status if insufficient volume in tank
    - .2 PLC shall open truck fill valve XV-1 and XV-2
      - .1 Valve will require approximately 7 seconds to open
      - .2 System shall receive limit switch signal from valve XV-1 actuator and XV-2 actuator to verify open position of valves
    - .3 If system indicates an 'error' status system shall exit sequence and record a zero (0) L volume fill on the SD card for corresponding time stamp
  - .5 'Fill progress' sequence shall commence immediately
    - .1 Solid yellow light shall indicate a 'fill progress' status
  - .6 Leachate tank shall override pre-set volume amount and pump leachate continuously for duration as long as push button held
    - .1 System shall monitor tank level signal to permit the PLC to determine if there is sufficient minimum volume in the storage tank (1.2m) which the pump requires to operate
    - .2 System shall shut down when insufficient minimum volume in storage tank (1.2m)
  - .7 Flow transmitter shall send a pulse signal to permit the PLC to determine the volume delivered
  - .8 PLC shall close truck fill valve XV-1 and XV-2 when operator releases 'override' push button
    - .1 Valve shall take 7 seconds to close
    - .2 System shall receive limit switch signal from valve XV-1 actuator and XV-2 actuator to verify close position of valves
  - .9 PLC shall record volume data and time stamp and shall store on an SD card.
  - .10 System shall shut down and operator shall switch the system to OFF and shall remove key from system ON - OFF
  - .11 Volume data and time stamp shall be stored on an SD card and shall be easily accessible by City personnel for data collection
  
- .3 An emergency stop push button E-STOP shall be easily accessible by the operator to shut down the system when there is a problem with filling a truck in the event of a hose failure, overflow, spill, or if the operator has incorrectly selected the wrong fill volume and the system is in 'fill progress' loading sequence

- .1 The operator shall press the E-STOP to initiate 'emergency stop' sequence.
- .2 Flashing red light shall indicate an 'error' status
- .3 PLC shall close the valve and the tank pump shall stop
  - .1 Valve will require approximately 7 seconds to close
  - .2 System shall receive limit switch signal from valve XV-1 actuator and XV-2 actuator to verify close position of valves
- .4 PLC shall record volume data and time stamp at E-STOP and shall store on an SD card
- .5 Operator shall manually reset the E-STOP push button to exit out of 'emergency stop' sequence
- .6 Operator shall have the option to continue 'fill operation' or to shut down and reset the system. To continue 'fill operation', operator shall press 'fill' push button and follow the control narrative steps 3.6.1.3 to 3.6.1.12. To reset the system operator shall switch the system to OFF with the key switch

**END OF SECTION**

**Part 1            General**

**1.1                SUBMITTALS**

- .1            Submit product data.

**Part 2            Products**

**2.1                GENERAL**

- .1            Unless otherwise specified, provide outside finishes on all enclosures in ANSI 61 Grey.
- .2            The enclosures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors without any warpage.
- .3            Provide a lamacoid for the junction box with identifier.
- .4            Provide a lamacoid for the junction box with power panel and circuit number, if applicable.

**2.2                ENCLOSURES**

- .1            Enclosures shall be NEMA 4 rated unless located in electrical or control rooms.
- .2            Enclosures shall be applicable for Zone 2 hazardous locations where located within hazardous areas according to the hazardous location plans.
- .3            Enclosures shall provide IP66 rating.
- .4            Enclosures shall have a continuous hinge with clamps for closing.
- .5            Manufacturer: Hoffman or equivalent in accordance with B7.

**2.3                WIRING AND ACCESSORIES**

- .1            Provide wiring inside the panels according to the following Specifications:
  - .1            Control wiring to be a minimum of 16 AWG tinned stranded copper; insulation rated at 240 V.
  - .2            Wiring for power distribution shall be a minimum of 14 AWG tinned stranded copper; insulation rated at 240 V.
  - .3            Install cables in accordance with the requirements of Division 26.
- .2            Tag each wire at both ends with a heat shrink sleeve that is machine printed. Allow approximately 20 mm of wire insulation between the tag and the bare wire.
- .3            Wiring systems with different voltage levels or types shall be suitably segregated within the panel, according to relevant electrical codes.
- .4            Run all wiring in enclosed plastic wireways such as Panduit. Size all wireways so that the total cross sectional area of the insulated wire and cable does not exceed 40 percent of the cross sectional area of the wire way.

- .5 Provide a minimum clearance of 50 mm between wire ways and any point of wire termination.
- .6 Terminate all wiring, incoming and outgoing, at terminal strips mounted inside the panels. Identify each terminal strip with a terminal strip number, as per the drawings.
- .7 Provide sufficient terminals so that not more than two wires are connected under the same terminal.
- .8 Provide nameplates for each device on or within the enclosure.

**2.4 PANEL GROUNDING**

- .1 Firmly bond all panel-mounted devices on or within the panels to ground. Provide supplementary bonding conductors for backpanels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

**Part 3 Execution**

**3.1 MOUNTING HEIGHTS**

- .1 Unless otherwise specified or a conflict exists, mount all panels, starters and disconnects 2000 mm to top of cover.

**END OF SECTION**