Appendix E:

Specifications

WIGNELL MUNICIPAL DRAIN PROJECT SPECIFICATIONS

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A1. ROLES

The Contractor is responsible for the construction site including all approvals required for compliance with applicable legislation not already completed by the City of Port Colborne.

The City of Port Colborne, who is further recognized as The Owner, shall be responsible party for allocation of resources in support of construction where required, such as road occupancy permits during construction.

The Drainage Engineer or the Drainage Superintendent shall supervise construction and the Drainage Engineer, Drainage Superintendent or their representative shall respond to any requests by the Contractor and identify any deficiencies between the Contractor's work and the Design documents.

The Drainage Engineer is the responsible designer and will provide technical direction to the Contractor on an as needed and as requested basis from the Drainage Superintendent or their representative.

A2 ENVIRONMENTAL CONDITIONS AND COMPLIANCE

The Contractor is wholly responsible for the site environmental conditions, compliance with applicable approvals and existing legislation. The Owner will facilitate environmental approvals, but the Contractor shall control the site and be the responsible party for all construction activities.

General requirements to be fulfilled by Contractor:

a) Department of Fisheries and Oceans, DFO.
Requirements to protect Fish and Fish habitat.

b) Endangered Species Act, 2007 ONTARIO REGULATION 230/08
https://www.ontario.ca/page/species-risk

c) Ontario Water Resources Act, R.S.O. 1990, c. O.40

d) On-Site and Excess Soil Management, 2019 ONTARIO REGULATION 406/19 Environmental Protection Act

e) O. Reg. 675/98: Classification and Exemption of Spills and Reporting of Discharges, Environmental Protection Act, R.S.O. 1990

Any other legislation applicable to the jurisdiction of the works.

A3 CONSTRUCTION LAYOUT

Conditions stipulated in the Niagara Peninsula Standard Contract Document also apply. Failure to comply with these conditions will result in a reduction in payment to this item.

a) Stakes

Contractor is responsible for setting any layout, alignment or grade control stakes required for construction. A Stake shall be placed to mark every cross-section grade and a second stake shall be placed to mark the limits of the Working Zone. Work Zone Stake shall be 4' wooden stake painted red at the top of the stake. Grade stake shall be placed at the Work Zone Top of Bank. X-Section stakes shall be placed at a maximum spacing of 25m. A recommended spacing shall coincide with the Profile drawings.

Prior to the start of Construction, the Contractor will stake and identify the difference between the existing grade and the design grade. The Drainage Engineer shall review the stakes and the measurement of the soil to be removed. Post Construction, the Contractor shall remove all stakes.

b) Project Signage

The Contractor is responsible for the installation and removal of all construction signage and is responsible for daily maintenance of all signage throughout the contract.

A4 INSTALL AND MAINTAIN SEDIMENT CONTROL DEVICES

In addition to the conditions stipulated in the Niagara Peninsula Standard Contract Document and OPSS 577, the following shall also apply:

a) SILT FENCE

Silt fence is to be placed prior to disturbing soil adjacent to the drain that could be carried by runoff into the drain. This excludes the area of the drain where The Contractor is working to re-establish Drain grade and cross-section. It includes areas adjacent to the drain impacted by clearing and grubbing for work access.(missing is a description of where a silt fence is to be placed. How frequently across the drain.)

Silt fence shall be installed in accordance with OPSD 219.190 except that the minimum height above the invert of the drain shall be 500 mm. Silt fence materials shall be in accordance with OPSS 577.05.02.02 for geotextile and OPSS 577.05.03 for stakes. Stakes shall be 1.5 m minimum height.

The silt fence shall remain in place for the duration of the section that the Contractor is working and the Contractor shall make every effort to maintain it throughout the project. The Contractor shall request Approval from the Engineer or the Drainage Superintendent for the removal of the silt fence once each section of the drain is complete. Prior to the removal of the silt fence, the accumulated silt shall be removed and leveled adjacent to the drain in accordance with the disposal of excavated material section.

b) SEDIMENT BASINS

Sediment basins have been provided along the length of the drain in an effort to minimize the transport of sediment. The Contractor shall construct the sediment basins in accordance with the construction drawings in the locations indicated. Relocation of sediment basins can only be undertaken upon approval of the Engineer.

The Sediment basin is to be constructed prior to the upstream work and shall be monitored during construction for sediment accumulation and sediment removed if the basin has more than 50% of the 0.5m depth occupied with sediment. Once the upstream work is complete, the Sediment basin shall be converted from Construction to Final as per the Design Detail Drawings. Sediment accumulated during construction shall be removed and disposed of in the manner directed by the Contract.

A5 ACCESS & NOTICE

The City of Port Colborne’s Drainage Superintendent or designate shall provide affected landowners with notice of the commencement of construction.

It will be the Contractor's responsibility to inform the various businesses and residences of daily construction impacts in order to reduce/eliminate any problems with parked vehicles that may

interfere with their operations. Ingress & egress to the abutting businesses and residences must be maintained at all times.

The Contractor shall advise the Police Department, Fire Department and Niagara Emergency Medical Service on a daily basis, with current status of the construction as it pertains to the passage of traffic within the contract limits.

The Contractor will co-ordinate with local transit to ensure minimum interruption to bus schedules. Transit, school buses and garbage and recycling service vehicles will be given priority to maintain their schedule.

The Contractor shall also maintain/provide existing pedestrian access at all times to the businesses and residents during all phases of construction in an acceptable manner.

A6 AS-CONSTRUCTED DOCUMENTATION

For the 'as-constructed' works, the Contractor must provide the City of Port Colborne with an electronic version of the final drainage works as surveyed post construction, to be imported into AutoCAD or GIS. This copy must confirm that the design grade and cross-section details for all drainage work and the invert elevations and lengths for all culverts complies with the Engineer's Report. Survey spacing shall be to a minimum of 25m.

All work must be in an acceptable electronic format that the City of Port Colborne can use and all work must be completed using the verified geodetic benchmarks. The submission of the As-Constructed works will be in a common delimited format having the form as follows:

- Numeric key, Northing, Easting, Elevation, Coded identifier & optional description

For the coded identifiers, the City of Port Colborne will provide a table for reference. The City will certify the as-constructed files with respect to their completeness.

Failure to provide a certified as-built file will result in the delay of substantial completion and/or contract completion. In the event that the contractor asks the City to perform the AS CONSTRUCTED SURVEY, then payment for the lump sum item is negated.

B1 EARTH EXCAVATION

Work under this item shall include the supply of all labour, equipment and materials required for ditch excavation or any other type of excavation or earth work as outlined on the Contract Drawings. Ditch work involves clearing, excavation, leveling, and seeding as required. Specifications and information on the Contract Drawings shall take precedence over the standard specifications outlined below. The specifications below shall take precedence over the Niagara Peninsula Standard Contract Document Special Provisions B2.

B2 CONSTRUCTION

a) Vegetation Removal

All trees, brush, fallen timber and debris shall be moved from the ditch cross-section and to such a distance on each side to eliminate any interference with the spreading of the spoil. The roots shall be left in the banks if no bank excavation is required as part of the new channel excavation. In wooded or heavily overgrown areas all cleared material may be pushed into piles or rows along the edge of the cleared path and away from leveled spoil. All dead trees along either side of the drain that may impede the performance of the drain if allowed to remain and fall into the ditch, shall be removed prior to excavation and put in piles, unless directed otherwise by the Engineer.

Any tree removed will be offered as wood to the property owner in the form of logs from the trunk where they lay and to be moved from the site by the owner at their expense. Tree tops shall be cut and limbs stacked as piles adjacent to the drain and within the work zone.

b) Excavation

The bottom width and the side slopes of the ditch shall be as shown on the profile(s) and/or cross-sections on the Contract Drawings. Side slopes are normally one and one-half metre horizontal to one metre vertical (1.5:1) unless otherwise noted on the Contract Drawings. If a bottom width is not specified then any excavation required shall be from the bottom of the ditch without disturbing the bank slopes subject to the clearing of brush required as described in a).

c) Profile

The profile(s) on the Contract Drawings show the depth and grade for the drain improvements. The description and elevation of benchmarks that were established during the survey are shown on the profile(s) in the location for each benchmark.

d) Line

The drain shall follow the course of the existing channel and/or shall be constructed in a straight line as outlined on the Contract Drawings. A uniform grade shall be maintained in accordance with the profile(s). A variation of one hundred millimeters (100mm) above the required grade will require the Contractor to remedy the grade to that given on the profile. The Contractor may be required to backfill any portion of the ditch that is excavated more than two hundred millimeters (200mm) below the required grade. All curves shall be made with a minimum radius of fifteen metres (15m).

e) Excavated Material

Excavated material (spoil) shall be deposited on either or both sides of the drain as directed on the Contract Drawings. Spoil upon excavation shall be placed a minimum one (1) metre back from the top of the bank, either existing or new. No excavated material shall be placed in tributary drains, depressions, or low areas, which direct or channel water into the ditch so that

no water will be trapped behind the spoil bank. The excavated material shall be placed and leveled to a maximum depth of three hundred millimeters (300mm); unless otherwise instructed. The edge of the spoil bank away from the ditch shall be feathered down to existing ground. The edge of the spoil bank nearest the ditch shall have a maximum slope of 2:1. The material shall be leveled such that it may be cultivated with ordinary equipment without causing undue hardship on farm machinery and farm personnel. Wherever clearing is necessary prior to leveling, the Contractor shall remove all stumps unless the Contract Drawings specify that stumps can be covered with the leveled spoil. No excavated material shall cover any logs, brush or rubbish of any kind. Large stones or boulders in the leveled spoil that are heavier than fifteen kilograms (15kg or approximately 300mm in size roughly referred to as man stone or the size of a stone that a single person can carry.) shall be moved to the edge of the leveled spoil nearest to the ditch but in general no closer than one metre (1) to the top of bank.

Where it is necessary to straighten any unnecessary bends or irregularities in the alignment of the ditch or to relocate any portion of an existing ditch, the excavation from the new cut shall be used for backfilling the original ditch. Regardless of the distance between the new ditch and old ditch, no extra compensation will be allowed for this work.

If the Contractor obtains written permission from an affected landowner stating that the owner does not wish the spoil to be leveled and such is approved by the Engineer, the Engineer may release the Contractor from the obligation to level the spoil. If spoil is not leveled that was to be leveled as part of the Contract, the Engineer shall determine the credit to be applied to the Contractor's payment. No additional compensation is provided to the owner if the spoil is not leveled.

If the affected landowner requests that the spoil be removed from the site instead of being spread adjacent to the drain within the work zone or that the grading requirement is to a higher standard than suitable for agricultural cultivation, then the Contractor shall provide trucking of the spoil including disposal at a suitable site or additional grading and shall provide the Drainage Superintendent with the specific costs for each landowner who requests such work. The Engineer shall assess the cost of the trucking of spoil to the landowner making such request.

The Engineer may require the Contractor to obtain written statements from any or all of the landowners affected by the leveling of the spoil. A written statement from the owners indicating their complete satisfaction with the leveling of the spoil is sufficient to comply with this specification. The final decision, with respect to leveling of the spoil, shall be made by the Engineer.

f) Excavation Through Woodlots

The Contractor shall minimize disturbance through woodlots by reducing the limit of excavation to the bottom width of the drain and a minimum side slopes. The drain shall be routed around existing trees at the direction of the Drainage Superintendent or where requested by the Engineer.

Prior to performing work through a woodlot, the Contractor in coordination with the Drainage Superintendent shall mark all trees for preservation or removal within the Drain or Workzone. This mark will consist of a physical identification that will be easily understood by the landowner and consist of either colour ribbons or specific paint markings (green to keep, red mark of an ‘X’ for removal).

g) Excavation at Bridge and Culvert Sites

The Contractor shall excavate or clean through all bridges and culverts to match the grade line and the downstream channel cross-section. Bridges that span from bank to bank may be carefully removed to permit excavation below the bridge and then replaced to original condition. Permanent bridges must be left intact. All necessary care and precautions shall be taken to protect the structure. The Contractor shall notify the Engineer before completing excavation in the area of a bridge or culvert if the excavation will expose the footings or otherwise cause bridge instability.

Where the invert of any pipe culvert is above the grade line, the Contractor will be required to remove the culvert, clean and relay it, so that the invert of the culvert is one hundred and fifty millimetres (150mm) below the grade for the ditch bottom at this location.

h) Obstructions

In all cases, the Contractor shall ensure that the finished drain is clear of obstructions to flow. The contractor will ensure that trunks are cut flush and that any debris or snags are removed as part of the bid price.

i) Fences and private furniture or equipment

The contractor will use the identified work zone for access and shall restore any fences to an equivalent or better condition than before construction. Where possible the Contractor shall perverse existing fences, private equipment and furniture in place but where it must be moved, the Contractor shall in all cases restore to a like or better condition than existed before construction.

j) Tile Outlets

The location of all existing tile outlets may not be shown on the profile for the drain. The Contractor shall contact each owner and ensure that all tile outlets are marked prior to commencing excavation on the owner's property. If a marked tile outlet is damaged during, or altered due to construction, the Contractor shall repair or replace the damaged or altered outlet as part of the Contract. If an existing outlet pipe does require replacement the Contractor shall confirm the replacement outlet pipe with the Engineer. All tile outlets identified are considered part of the bid work.

Additional payment will be allowed for the repair or replacement of any unmarked tile outlets encountered during excavation. Where stone or concrete riprap protection exists at any existing tile outlet such protection shall be removed and replaced as necessary to protect the outlet after reconstruction of the channel.

If any outlet becomes plugged as a result of construction, the Contractor shall be obligated to free such outlet of any impediments. Where any damage results to tile leading to and upstream of the outlet, as a consequence of such construction, the Engineer may direct the Contractor to repair such tile and shall determine a fair compensation to be paid to the Contractor for performing the work.

B3 INSTALLATION OF NEW CULVERT

Work under this item shall include the supply of all labour, equipment and materials required for supply and installation of culverts as outlined on the Contract Drawings. The Niagara Peninsula Standard Contract Document Special Provision B7 shall apply but the specifications and information on the Contract Drawings shall take precedence over Special Provision B7.

The size and material for any new ditch crossings shall be as specified on the Contract Drawings. Any crossings assembled on-site shall be assembled in accordance with the manufacturer's specifications for on-site assembly.

Where a new crossing replaces an existing crossing the following shall apply:

> If directed on the drawings that the existing crossing is to be salvaged for the owner the Contractor shall carefully remove the existing crossing and leave along the ditch or haul to a location as specified on the Drawings.
>
> If the existing crossing is not to be saved then the Contractor shall remove and dispose of the existing crossing. Disposal by burying on-site is not permitted.

All new pipe crossings shall be installed a minimum of 100mm below design grade (not as-constructed grade) or at the invert elevations as specified on the Drawings. If the ditch is over excavated greater than 200mm the Contractor shall confirm with the Engineer the elevations for installation of the new pipe crossing.

When an existing crossing is being replaced the contractor shall save all granular and riprap. New crossings can be backfilled with compacted on-site native material that is free of large rocks or stones. Contractor responsible for any damage to a culvert pipe as a result of rocks or stones in the backfill.

All new crossings shall have a minimum 6m laneway width and end slopes shall be at 1:1 slope or flatter. Finished crossing elevation shall provide a minimum of 300mm cover. Finished crossing surface shall be a minimum 150mm depth of Granular A for the minimum 6m width and extending from top of bank to top of bank using salvaged granular or imported granular as required.

Installation of private crossings during construction must be approved by the Engineer before the culvert is installed.

Where riprap protection is called for at either or both ends of a new culvert, such riprap shall be in accordance with Special Provision B4.

Payment will be based on plan quantity.

Riprap to be adequately keyed in along the bottom of the slope. Riprap to extend to top of pipe or as directed on the Drawings. No riprap is required in the ditch bottom on the upstream side of a crossing. If riprap is required in the ditch bottom on the downstream side of a crossing it shall be specified on the Drawings. Any new end face slope not protected by riprap shall be seeded as per specifications for ditch bank seeding.

B4 HAND LAND RIP RAP WITH FILTER CLOTH

Rip rap complete with filter fabric underlay (geotextile) shall be placed by the Contractor at the locations shown on the drawing or as requested by the Drainage Superintendent. Rip rap shall consist of 200 – 250 mm dia. stones (min.) and shall be placed at 300 mm minimum thickness. Along upstream edges, where surface water will enter the drain, the underlay shall extend a minimum of 300 mm upstream from the rip rap and be keyed into the soil a minimum of 300 mm. The finished elevation of the rip rap shall be at design elevation or flush with the ground.

Work under this item shall include the supply of all labour, equipment and materials required for placing riprap as outlined on the Contract Drawings. The Niagara Peninsula Standard Contract Document Special Provision B20 shall apply but the specifications and information on the Contract Drawings shall take precedence over Special Provision B20.

B5 TREE PLANTING

All trees supplied are to be Carolinian Forest or understory native species consistent with Niagara Region.

https://www.ontario.ca/page/tree-atlas/ontario-southwest

There will be a 1 year warranty on tree survivability.

B6 BANK RESTORATION

Bank restoration extent is to the identified location indicated on plans and by the Drain Superintendent. Offset stakes are required prior to the commencement of construction. Inspection of the offset stakes is required prior to any work commencing along with the submittal of required environmental approvals.

B6.1 'IN WATER WORK'

All in-water and near water works will be conducted in the dry with appropriate erosion and sediment controls.

The erosion and sediment control strategies outlined on the plans are not static and may need to be upgraded/amended as site conditions change to minimize sediment laden runoff from leaving the work areas. If the prescribed measures on the plans are not effective in preventing the release of deleterious substance, including sediment, then alternative measures must be implemented immediately to minimize potential ecological impacts. NPCA enforcement officer should be immediately contacted, additional ESC measures such as a tarp to be kept on site and used as necessary.

An environmental monitor will attend the site to inspect all new controls, as well as on a regular basis, or following rain/snowmelt event, to monitor site conditions.

All activities, including maintenance procedures, will be controlled to prevent the entry of petroleum products, debris, rubble, concrete, or other deleterious substances into the water. Vehicular refueling and maintenance will be conducted a minimum of 30 metres from the water.

All grades within the Regulatory Flood Plain will be maintained, matched or as specified.

The Proponent/Contractor shall monitor the weather several days in advance of the onset of the project to ensure that the works will be conducted during favourable weather conditions. Should an unexpected storm arise, The Contractor will remove all unfixed items from the 100 year storm flood plain that would have the potential to cause a spill or an obstruction to flow; e.g. fuel tanks, porta-potties, machinery, equipment, construction materials, etc.

All dewatering/unwatering shall be treated and released to the environment at least 30 metres from a watercourse or wetland and allowed to drain through a well vegetated area. No dewatering effluent shall be sent directly to any watercourse, wetland or forest or allowed to drain onto disturbed soils within the work area. These control measures shall be monitored for effectiveness and maintained or revised to meet the objectives of preventing the release of sediment laden water.

All access to the work site shall be from either side of the watercourse. No equipment or vehicles are permitted to cross through the watercourse unless approved by the NPCA.

Fish and wildlife stranded within the work area shall be captured and released in a live suitable habitat upstream of the work area under the supervision of a qualified aquatic biologist. A permit from the Ministry of Environment (MOECP) may be required. The contractor is responsible for organizing any wildlife removal, if required.

Please notify NPCA enforcement officer and an NPCA project Manager 48 hours prior to commencing construction.

An environmental monitor will be on site, and provide advice, to ensure that activities that could have a negative impact to the natural environment are effectively mitigated as construction proceeds. The

environmental monitor shall notify the NPCA enforcement officer and the project manager if an issue arises.

Additional ESC measures or devices may be deemed necessary as site conditions change and shall be installed as directed by the Site Engineer, Contract Administrator or NPCA.

B6.2 LIVE STAKES AND NATIVE PLANT MATERIALS

Contractor to make good any and all damages outside of the work area that may occur as a result of construction at no extra cost.

Tree removals are to occur outside of the active period for bats (April 1st to August 31st) to avoid impacts to species at risk, including bats, birds, and Fowlers Toad. Contractor shall ensure the site complies with The Endangered Species Act.

Construction to occur during the warm water construction timing window of July 15 – March 15. No in water works to occur between March 15 and July 15. Construction timing windows are subject to DFO conditions for approval.

Quantity to be determined based on area of disturbance to be restored.

Live stakes should be from a minimum 2-year-old stock. Live stakes are to be installed at a density of 3 stakes per metre. Live stakes should be pre-soaked (submerged in water) for at least 24 hours after harvesting and immediately before installation.

Live stakes should not be stored for a period longer than 2 days, unless they are being soaked. The contractor shall protect plant materials from drying from the time of harvest until installed.

Live stakes are to be a minimum of 25mm in diameter and cut to a length of 1000mm. Cut angle at the bottom of the stake and flat on top. Trim all side branches while taking care not to damage the bark.

Install live stakes with the buds pointing upwards and thicker stem in the ground.

Live stakes should be installed using a large rubber mallet. 80% of the stake is to be below the surface Tamp the live stake into the ground at right angle to the surface.

In compact soil a pilot hole should be used to limit damage to the stakes. If using a pilot hole, repack the soil around the live stake. Live stakes should stand firm in the soil following installation.

All stakes not planted to the specifications above will be replaced at the contractor's expense.

B6.3 EROSION CONTROL BLANKET

A Biodegradable erosion control blanket (ECB) shall be installed on all disturbed natural surface following the placement of topsoil and application of the native seed mix.

The ECB must be constructed of 100% woven coconut fibre (eg coir) or straw mat within a geo jute netting (top and bottom) with biodegradable thread. Non - biodegradable material including polypropylene or plastic with a biodegradable rating are not acceptable. The minimum weight of the ECB must be 400g/m2 (12 oz/yd2).

To install, the ECB must be unrolled downslope or in the direction of the water flow. Adjacent ECBs should overlap a minimum of 150mm along the edges. at the end of each roll, fold back 100mm to 200mm of the ECB. Overlap this 100mm to 200mm over the start of the next roll. Secure the two layers to the ground securely.

Biodegradable or tapered wooden stakes shall be used to secure the blanket. Stakes shall be installed at the spacing recommended by the ECB manufacturer to prevent surface runoff from eroding the underlying soil.

B.9 WIGNELL DRAIN GATE IMPROVEMENT WORK

For in water work on the gates, it is allowable for the work to isolate all gates for the duration of work in the water using coffer dams or other methods of isolation in compliance with all DFO requirements.

During all phases of the work, the gate must protect from any and all storms that occur from Lake Erie such that the seiche or surge condition to a level of 176.5m does not cause a flow back across the gate during construction.

In the event that a storm does occur, the contractor is expected to bypass pump using the existing bypass system. A bypass pumping condition will exist if the gates are closed to seal against lake induced flow to a height of 176.5m and the water level on the upstream side of the gates is above 175.5m.

Bypass pumping will continue until the level is below 175.25m or the lake induced level returns to a normal, non-seiche / surge state.

B.10 WIGNELL DRAIN GATE AUTOMATION

This narrative contains two basic sections, the first will describe the overall functionality of the system, and the second contains a control description at the Input / Output (I/O) device level. Where the function of each device connected to the system is briefly described.

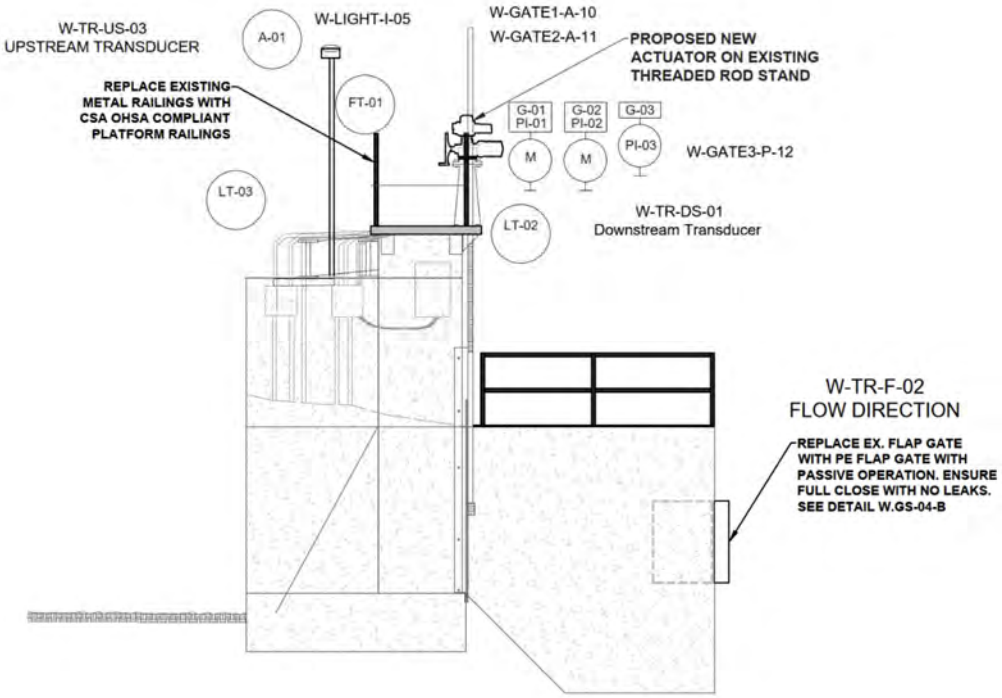


Figure 1 Process Instrument Diagram

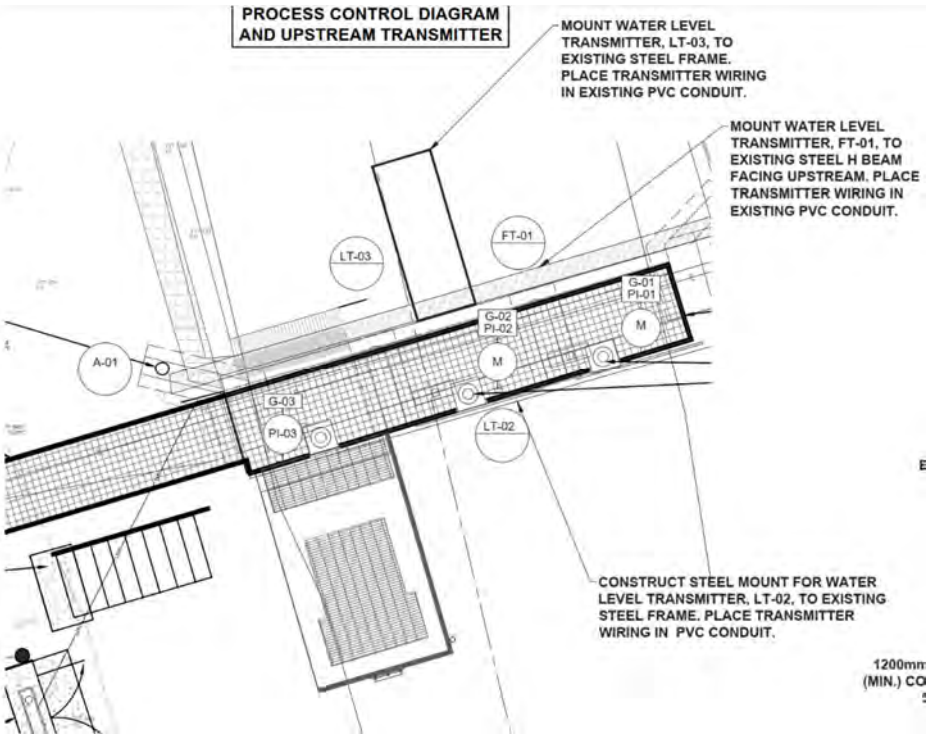


Figure 2 Plan View Wignell Gate Automation

A-01 warning light and audible

PI – Position (level) indicator

LT – Level Transmitter

FT – Flow Transmitter

M – Gate motorized actuator

B10.1 PROCESS CONTROL NARATIVE (PCN)

The two of the three existing knife gates are to have actuators installed and used to power the gates open and closed. The gates are to be closed when the system detects that the lake water level is higher than the drain water level which indicates that water is flowing backwards through the gate from the lake into the drain instead of out of the drain. The gates are closed to prevent this from continuing to occur.

Once the lake level has lowered or the drain level has risen above the lake level such that flow would resume downstream if the gates are open, then the gates are opened to allow downstream flow.

The following elements are part of the process control.

Gate #1 (W-GATE1) eastern gate, Gate #2 (W-GATE2) centre gate, are to be converted to actuator-controlled knife gates whose open / close position is used to permit flow out or block flow from the lake water flowing backwards into the drain.

Gate #3 (W-GATE3) is a blocked gate controlling the entrance to the former pump wet well. There is no active control on this gate and the gate is manually operated.

A-01 is an alarm composed of an audible and flashing light alarm to provide a warming indication prior to gate movement. The A-01 light is off for normal status and on as solid light for alarm indicating that there is a fault detected.

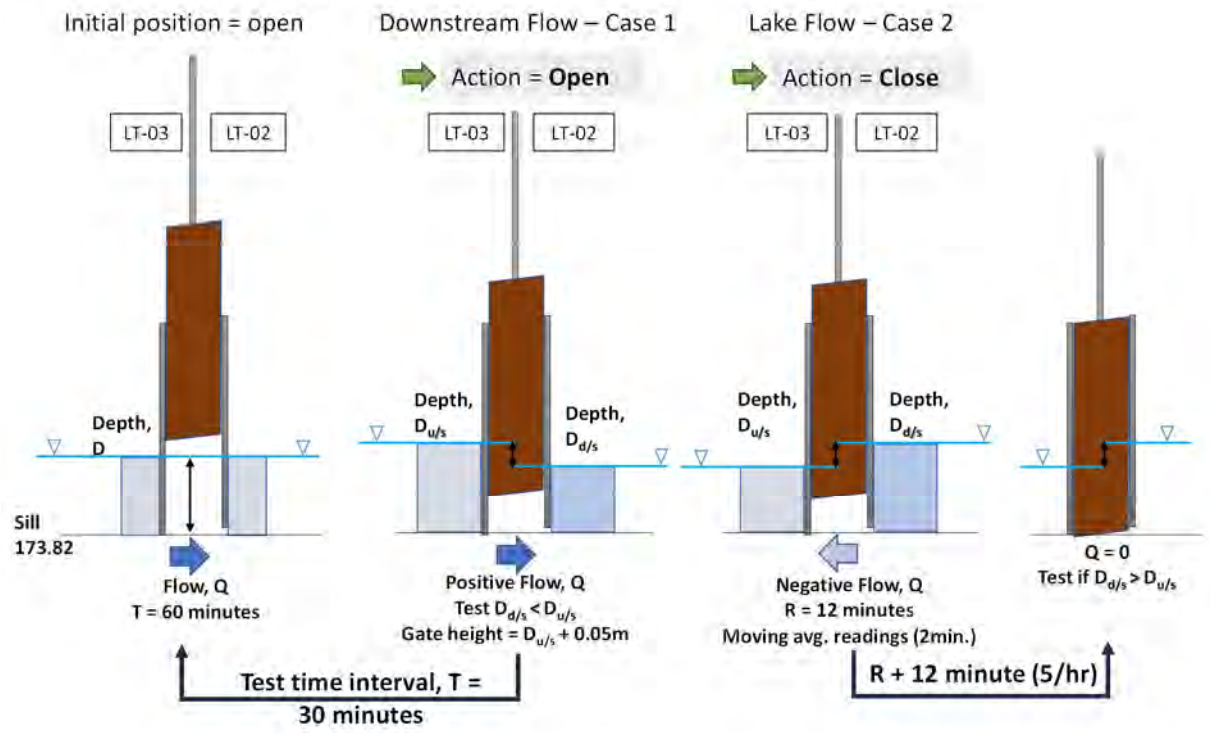


Figure 3 Level Transmitter Case Considerations

** where a singular gate word is used it is accepted that this means both gates working in sequence.*

Gate Control Startup

Default starting position on control start up is both gates to move to the fully open position from a closed position. Gate to cycle closed to open max height from a starting point. Alarm if fail on max. gate height is not reached as part of the start up or if gates do not fully close. This start up cycle is to confirm successful gate movement, or alarm to operator for response.

Gate startup option for alarm response during storm.

There is a specific start-up sequence that is to be operator selected on site for a special circumstance start-up condition. This anticipates that the operator has been called to site for some alarm and is responding to a failure notice from the gate system. In this specific circumstance, there is a storm, and the operator is at the site restarting the system.

In this case, the gates on startup for the storm sequence skip cycling between closed/open and instead go straight to closed and will remain closed until the operator tells the gate to go to automatic control and skip the open/closed sequence but testing levels and flow to confirm gate open/closed status.

Level Measurement Gate Control Sequence

1. If LT-03 reading upstream level and LT-02 reading downstream level is lower than the sill elevation (or minimum detection elevation) then pause all control for 3 hours. Existing Sill Elevation is 174.04 (proposed 173.82). Minimum detection elevation is determined by the LT-03 and LT-02 sensor selection and installation.
2. Test sequence is scheduled on a set time interval. Initial interval, T, is to be 30 minutes and then confirmed based on experience. However, the PCN requires that the test interval, T, be implemented as a parameter that can be adjusted by the operator.
3. Read upstream level (LT-03) and downstream level (LT-02) and confirm the existing starting difference is less than 6mm (1/4"). If greater than 6mm and negative (LT-03 minus LT-02), then a backflow may already exist and set gate to close and confirm using step 6.
4. Set gate height to half of the average height reported by LT-03 and LT-02.
5. After 5 minutes from gate movement to ½*D, calculate a differential comparing the upstream LT-03 subtracting the downstream LT-02 level reading.
    a. If positive, set gate height to D + 0.05m till test interval T is met.
    b. On detection of a negative result greater than 2.5mm difference, close Gate #1 and Gate #2 in sequence. Alarm using W-A1 prior to gate movement.
6. Read LT-03 and LT-02 on interval, reading interval R, and confirm negative or positive difference using a moving average calculation starting at + 2 readings (3 including the starting reading) to a max. of 5 readings. PCN requires that reading interval R be user configurable by the Operator.
7. Gates are to remain closed until there is a positive direction to flow out to the lake.
8. After test time R, and the gates are closed and the differential reading is greater than 6mm difference, from LT-03 minus LT-02, then open both gates to + 0.05 m above LT-03 elevation reading and flow direction is downstream, and go to Step 1.
9. Gates remain open on test interval T until a reverse flow is detected. If Flow is not detectable, essentially 0 lps and upstream LT-03 and LT-02 have no difference gates remain open.

Interval T is the test time between test reading of upstream and downstream levels. If R is short, then there is a risk that gate movement could be too frequent. If R is too long, there is a risk that flooding will start and the gates will not respond quickly enough. The default setting for R is to be 30 minutes.

Interval R is the test time between rolling average water level calculations. The rolling average is to be composed of water level measurements during a storm with a reading performed every 30 seconds. R, has a default setting of 12 minutes, which indicates a level check during a storm of 5 readings per hour to confirm flow direction.

At this location 300m from the water's edge, the dynamic impact of wave action is expected to be small but not zero. The control system is expected to avoid excess movement caused by wave impact on the sensors. The use of the moving average (MA) calculation on readings from sensors over the reading interval R is expected to reduce wave or other impacts.

Flow Measurement Gate Control Sequence

The following describes additional gate control sequence where the installation of a flow measurement sensor is installed along with the level transmitters. For the Wignell installation, the FT-01 is proposed for installation on the upstream side. For the description of gate control, the flow sensor is a supplemental measure compared to the required level measurements.

1. If FT-01 reading upstream flow is positive, identifying the flow is downstream to the lake, then no action is required if the gates are open. FT-01 is determined on the test time interval, T and is considered a valid reading if the gates are open. If the gates are closed, then the flow reading is presumed to be compromised and not used for analysis.
2. After time T, the FT-01 reading is negative by a margin greater than Q_D (the flow detection max limit), initial setting of -0.1 cms (-1.7 lpm), then go to step 4 of Level Measurement Gate Operation to confirm that the flow is moving upstream (negative). QD is to be user adjustable through the system interface.

A status reporting interface is to be always accessible from remote locations. Gate reporting interface to be accessible from HMI interface through computer and smart phone. Gate position, movement events, flow, and level readings to be stored for 1 month and monthly auto upload to City's server for historical archive.

The following are known conditions that are expected to be within the control system operation parameters.

1. No runoff/water upstream or water that is static and not moving through the outlet. (drought condition).
2. Low lake elevation with storm induced runoff, (typical condition).
3. High lake elevation with minor storm runoff, (seiche condition).
4. High lake elevation and high storm runoff, (significant precipitation event + surge).
5. Winter events consisting of ice, ice shelf, other ice impacts. The control system is to be winter resilient.
6. Lake seiche event with dynamic energy impacts including detritus and debris. Alarm issued to operator where gate operation is negatively impacted.
7. Runoff debris carried into the gates. Detection of gate obstruction with alarms issued to operator.

Diagnostic Testing:

1. Once a week exercise both gates from an open position to closed position and returning to open if not starting from a closed position on the trigger of 1 week timing.

Alarm indicators:

1) Gate movement, light and sound warning prior to movement (open or closed).
2) System fail – power loss, corrupt status, etc.
3) Gate obstructed – actuator status report, trigger notice event to operator and flash warning light.
4) Gate fail – trigger notice event.
5) Sensor fail – trigger notice event.
6) High Level warning – trigger notice and flashing light with U/S or D/S Level sensors report greater than 176.52m height.

B10.2 SENSOR & INSTRUMENT LIST

The following sensors and instruments are shown in drawing W.GS-05.

FT-01 is a flow sensor that includes the flow and flow direction.

FLT-02 is a level transducer to measure the downstream gate side water level.

FLT-03 is a level transducer to measure the upstream gate side water level.

W-G3-P-12 is a position sensor on Gate #3 to report gate open / closed status.

G-01 PI-01 is a transducer supported gate position indicator sensor.

G-02 PI-02 is a transducer supported gate position indicator sensor.

I&C	Label	TAG	Preferred Instrument
W-G1	Gate #1 (eastern gate)	W-G1	NA
W-G2	Gate #2 (middle gate)	W-G2	NA
W-G3	Gate #3 (western gate)	W-G3	NA
W-FG1	Flap Gate (on discharge pipe)	W-FG1	NA
FLT-01	Flow Transmitter	W-TR-01	Supplier submission +-1.7 lpm
FLT-02	Downstream Level Transmitter	W-TR-02	E+H Micropilot FMR20 Radar Level Transmitter or approved equivalent +-2mm
FLT-03	Upstream Level Transmitter	W-TR-03	E+H Micropilot FMR20 Radar Level Transmitter or approved equivalent +-2mm
FLT-04	Not used		
G-01	Gate #1 Actuator Close/Open	W-G1-A1	AUMA Model SA16.2-26A-AC01.2
PI-01	Gate #1 Position Indicator	W-G1-P1	With Position transmitter, 4-20mADC output, self powered
G-02	Gate #2 Actuator Close/Open	W-G2-A2	AUMA Model SA16.2-26A-AC01.2
PI-02	Gate #2 Position Indicator	W-G2-P2	With Position transmitter, 4-20mADC output, self powered
G-03	Gate #3 Manual Gate #3 Position Indicator	W-G3	NA
A-01	Gate Movement Warning Indicator	W-G-M01	Supplier submission

Sensor mounting hardware will depend on the type of sensor purchased and follow recommended manufacturer requirements.

B.11 WIGNELL DRAIN MECHANICAL ADDITIONS

The following are items of equipment to be added to the Wignell Gate Structure.

In all cases the Contractor is required to confirm all dimensions and fit for all equipment prior to commencing work or ordering parts and equipment to be supplied on the project.

B11.1 BLIND FLANGE

Blind flange dimensions are covered in ASME B16.5 but are to be adjusted to fit the existing pipe. The main material of the flange shall be formed from Carbon steel: ASTM A105 Class 150. The flange will be supplied as a flat face (FF) flange with a minimum of 4 SS bolts.

B11.2 CAMLOCK CONNECTION

Connection to the existing 400mm nominal steel pipe is to be made using a 150mm diameter threaded saddle connection to fit the pipe. Saddle to be Romac DI 202S or approved equivalent.

Contractor to confirm all sizes and general arrangement prior to commencement of work.

B11.3 GATE #3 EXTENSION

The existing gate is to be extended to match the height of gates 1 and 2 using the same materials as the existing gate. Contractor to weld extension to ensure that no gaps permit water to flow through the extension. Existing threaded rod connection to remain as is.

Contractor shall supply a welding diagram prior to commencement of the work.

B11.4 PE FLAP GATE

GENERAL SPECIFICATION

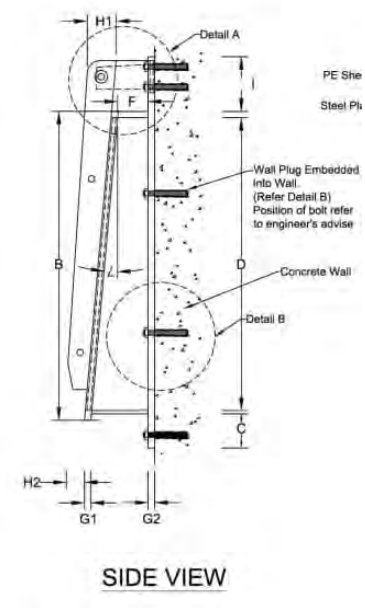
Material:PE100 Circular: ID 750mm nominal, contractor to confirm ID of existing pipe.

Colour: Carbon Black content of the raw material used must be not less than 2% in weight. The requirement of the carbon black is to give UV protection from sunlight.

PE Wall Mounted “Spiral" Flap Gate (Circular Type)

The flap door is designed to rest on the collar frame at an angle of 5° / 10° from the vertical plane.

https://www.spirolite.my/wp-content/uploads/2021/06/2021-PE-FLAP-GATE-BROCHURE.pdf



SIDE VIEW

Installation

Make sure the surface is clean and dry before grouting sealing between the concrete wall and the back plate. To ensure no leakages after install. Tighten nuts for studs or anchors evenly, don’t try to pull a gate frame tightly against an uneven wall surface. This, in most cases, will cause excessive leakage.

B11.5 Actuator for Open/ Close Service

AUMA Electric Actuator Model SA16.2-26A-AC01.2 with a Supply Voltage: 220/3/60 VAC or approved equivalent.

C1 COMPLETION

At the time of final inspection, all work in the contract shall have the full dimensions and cross-sections specified.

Payment is for all work complete on the basis of a measured linear distance inclusion of all items identified above. Where a culvert is removed and reinstalled, compensation shall be in the form of a per each payment. Where a tile is discovered and constructed as an outlet, compensation will be in the form of a per each payment for tile outlets repaired.

C2 AS-CONSTRUCTED DOCUMENTATION

For the 'as-constructed' works, the Contractor must provide the City of Port Colborne with an electronic version of the final drainage works as surveyed post construction, to be imported into AutoCAD or GIS. This copy must confirm that the design grade and cross-section details for all drainage work and the invert elevations and lengths for all culverts complies with the Engineer's Report. Survey spacing shall be to a minimum of 25m.

All work must be in an acceptable electronic format that the City of Port Colborne can use and all work must be completed using the verified geodetic benchmarks. The submission of the As-Constructed works will be in a common delimited format having the form as follows:

> Numeric key, Northing, Easting, Elevation, Coded identifier & optional description
>
> For the coded identifiers, the City of Port Colborne will provide a table for reference along with an example file from a past project for comparison. The City will certify the as-constructed files with respect to their completeness.

Failure to provide a certified as-built file will result in the delay of substantial completion and/or contract completion. In the event that the contractor asks the City to perform the AS CONSTRUCTED SURVEY, then payment for the lump sum item is negated.

A4 PAYMENT; Payment in full at the lump sum bid price for this item shall be made only upon completion and approval by the Contract Administrator.

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

.1 The General Contractor shall furnish all labour, material, tools, equipment, supervision and other services as may be required to execute the work described in the specification and on the accompanying drawings.

.2 Misinterpretation of any requirements of either the drawings or specifications will not relieve the General Contractor of responsibility to complete the work, if in doubt contact the Contract Administrator for written clarification prior to submitting tender price.

1.2 SITE EXAMINATION

.1 Before submitting tenders, carefully examine all drawings and all specifications having a bearing on the work, visit the site and thoroughly ascertain that the work can be carried out satisfactorily without any changes to the drawings or specifications. No extras will be allowed for anything, which would have been revealed in the course of such an examination.

1.3 CODES AND STANDARDS

.1 Electrical Equipment, controls equipment and instrumentation supplied and installed by the contractor shall comply with the latest versions of the following standards, codes and regulations:

.1 Ontario Electrical Safety Code (OESC)

.2 Canadian Standards Association (CSA)

.3 Canadian Electrical Code (CEC)

.4 Standards Council of Canada (SCC)

.5 Electrical and Electronic Manufacturers Association (EEMAC)

.6 Institute of Electrical and Electronic Engineers (IEEE)

.7 Insulated Power Cable Engineers Association (IPCEA)

.8 National Electrical Manufacturers Association (NEMA)

.9 National Fire Protection Association (NFPA)

.10 Workplace Safety and Insurance Board (WSIB)

.11 Measurements Canada

.2 Confirm area classifications prior to commencing work.

.3 Comply with Electrical Safety Authority Bulletins in force at time of tender submission. While not identified and specified by number in this Division, bulletins are to be considered as forming part of related standards.

.4 Comply with current regulations of the National Building Code, and the requirements of all applicable Municipal and Provincial Codes and regulations.

.5 Abbreviations for electrical terms: to CSA Z85-1983.

1.4 PERMITS AND FEES

.1 Obtain and pay for all permits and fees required for the execution and inspection of the electrical work and pay all charges incidental to such permits.

.2 Submit to the Inspection Department of Electrical Safety Authority a necessary number of drawings and specifications for examination and approval prior to commencement of work. In addition, if required by the Inspection Department of Electrical Safety Authority, prepare and submit any other drawing required for approval.

.3 Arrange and pay for all special inspections of equipment specified as required.

1.5 INSPECTIONS

.1 Furnish a Certificate of Acceptance from Inspection Department on completion of work. Correct installed work as directed by authorized inspector of authorities having jurisdiction. Notify the Contract Administrator prior to making changes.

1.6 COOPERATION OF TRADES

.1 Read complete specifications and drawings and conform with their requirements before proceeding with any work specified in this Division related to other Divisions.

.2 Co-operate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other trade.

.3 The General Contractor is responsible for sending all applicable contract documents to the vendors.

1.7 MATERIALS AND EQUIPMENT

.1 Use new materials and equipment unless otherwise specified.

.2 Provide material and equipment of specified design and quality, performing to published ratings and for which replacement parts are readily available.

.3 Use products of one manufacturer or equipment for material of same type of classification unless otherwise specified.

.4 Materials and equipment of manufacturer specified have been incorporated on the drawings with space and area required for the respective manufacturer’s equipment.

.5 Equipment and materials to be CSA certified. All electrical products shall be tested, certified and labelled in accordance with a certification program accredited by the Standards Council of Canada. Where there is no alternative to supplying non-CSA equipment, the General Contractor to obtain special approval from the appropriate inspection authorities.

1.8 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Division 16 for all major components including, but not limited to:

- .1 Outdoor Enclosure NEMA 4X Stainless steel
- .2 VFD Panels, VFD and associated equipment
- .3 Circuit Breakers and Disconnect Switches

.4 Distribution Panels

.5 Cabling

.6 Generator

.7 ATS

.8 SPD and Metering Devices

.9 Transformers and Distribution Equipment Bus splitter

.10 UPS

.11 Communication and Network Equipment

.12 Instrumentation, Transmitters and Other Field Devices.

.13 PLC, SCADA

.14 Integration Loop Drawings.

The above list shall not be considered finalized. Any major components not indicated on list will require shop drawings to be submitted to the Contract Administrator.

1.9 DRAWINGS

.1 Drawings, which accompany these Specifications, are diagrammatic and show the general location of the electrical and instrumentation equipment.

.2 Do not scale Drawings but use only dimensions that are shown. Where exact building dimensions and details are required, use only figured dimensions as shown on Drawings for jobsite dimensions.

.3 Make changes or additions to the electrical/instrumentation system as dictated by the civil, structural or mechanical conditions at no extra cost to the Owner.

1.10 LOCATION OF ELECTRICAL EQUIPMENT

.1 The location of any panel, equipment, outlet, raceway and wiring may be changed by the Contract Administrator if the new location is within a limit of 3,100 mm radius of the original location. Provide changes without extra cost if requested before installation in the original locations and provide the Contract Administrator at minimum two business days advanced notice before installation.

.2 Confirm the exact locations of all equipment and devices on site to ensure mounting heights, accessibility and ascertain location and elevations of connecting conduits, piping and other interferences.

.3 Confirm the location of all mechanical equipment, existing equipment and equipment supplied by others in reference to the connections, locations and connection requirements prior to the installation of conduit and wiring to the equipment.

1.11 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1,400 mm.

.2 Wall receptacles:

.1 General: 300 mm.
.2 Above top of continuous baseboard heater: 200 mm.
.3 Above top of counters or counter splash backs: 175 mm.
.4 In mechanical rooms: 1,400 mm.

.3 Panelboards: as required by Code or as indicated.

.4 Fire alarm stations: 1,500 mm.

.5 Fire alarm bells: 2,100 mm.

.6 Wall mounted telephone outlets: 1,500 mm.

.7 Individual safety switches: 1,300 mm.

.8 Thermostats: 1,500 mm.

1.12 LABELS AND SIGNS

.1 Unless otherwise specified, signs shall comply with CAN/CSA-Z321-96(R2006) Signs and Symbols for the Workplace.

.2 Manufacturer nameplates and CSA labels to be visible and legible after equipment is installed.

.3 Provide engraved lamacoid nameplates for all new, major electrical equipment such as disconnect switches, panelboards, control panels, etc. For instrumentation and field device where lamacoid nameplates are not practical, provide engraved stainless-steel hanging labels/tags.

.4 Lamacoid 3 mm thick plastic engraving sheet, black face, white core, mechanically attached with self-tapping screws.

Nameplate Sizes

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.5 Provide warning signs as specified or to meet requirements of Inspection Department and the Contract Administrator.

.6 Wording on nameplates and labels to be submitted as a Category 1 shop drawing submittal for review by the Contract Administrator prior to manufacture.

.7 Nameplates for junction boxes, terminal boxes, pullboxes, etc., larger than 100 mm square to indicate system and voltage characteristics.

.8 Field mounted control devices shall be identified by the equipment name, device control function and panel number that provides the source of power.

.9 Individual pilot devices on control stations, contactors and starters shall be identified with small lamacoid plates indicating the function that it provides.

.10 Transformers: nameplates to indicate designation, capacity, primary and secondary voltages.

.11 Panelboard nameplates to indicate designation, voltage and supply source.

.12 Control devices nameplate to indicate device tag, panel and PLC I/O number. Provide size 5 nameplate.

.13 Provide size 7 nameplate on all PLC panels indicating panel name, number, voltage, current, frequency.

.14 Submit list of nameplates indicating size, colour, description to the Contract Administrator as a Category 1 shop drawing submittal for review prior to ordering.

.15 Provide self-adhesive labels within the interior of all control panels and control stations to indicate the specific device (pushbutton, pilot light, etc.) reference number.

1.13 SLEEVES, INSERTS

.1 The General Contractor is responsible for supplying and setting of all sleeves and inserts for conduit.

.2 Floor sleeves, where required, shall extend 100 mm above floor. All sleeves to be made from schedule 40 steel pipe.

.3 Seal all sleeves with an approved fire stop material after installation of all conduits. Ensure all penetrations to hazardous location are sealed with EYS fittings to meet the requirements of the OESC.

1.14 CONCRETE BASES, CURBS, AND STEEL SUPPORTS

.1 The General Contractor shall furnish and install all structural steel supports, platforms, braces, tie rods, etc., required to support or hang all equipment installed under the electrical contract. All supports shall be attached to the building structure. Supporting electrical equipment, wiring, conduit, etc., from ductwork, piping, equipment, etc., will not be accepted.

1.15 CUTTING AND PATCHING

.1 All cutting of openings to walls, floors, foundations, footings, ceilings, plaster and drywall ceilings, roof or any other surfaces or finishes shall be performed by qualified tradesman specializing in that particular field.

.2 All patching, painting and making good of walls, floors, ceiling, partitions and roof shall be done by a qualified tradesman specializing in that particular field.

.3 Under no circumstances shall any cutting or burning of the structural parts of the building be undertaken without the written authority of the Contract Administrator.

.4 Provide patching and sealing of all new and existing openings for conduits passing through walls, floors, ceiling and roof.

.5 Maintain fire ratings around conduits/cables through floors, ceilings and fire rated walls.

1.16 WIRING TERMINATIONS

.1 Lugs, terminals and screws used for termination of wiring to be suitable for copper conductors.

.2 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.3 Maintain phase sequence and colour coding throughout. Colour code to CSA C22.1.

.4 Identify all control wiring with typed permanent indelible markings using vinyl self-laminating wrap on wire markers at all termination points of each conductor. Wire numbers shall be based on equipment identification numbers as per the schematic drawings unless otherwise indicated. Allow for up to 12 characters per tag. Final numbering scheme to be approved by the Contract Administrator on behalf of the Owner during construction.

.5 Identify all motor wiring with typed permanent indelible markings using vinyl self-laminating wrap on wire markers at all termination points of each conductor. Wire numbers shall be based on terminal identification numbers or motor numbers as indicated on the schematic drawings.

1.17 GROUNDING

.1 Provide all equipment grounding as required regardless whether it has been shown on the drawings or called for in this specification as per the requirements of the Ontario Electrical Safety Code.

.2 Arrange grounds so that under normal operating conditions no injurious amount of current will flow in any grounding conductor.

.3 Include a separate ground wire to all devices, which are rewired and to all new devices. The conduit system is not to be used as the sole grounding path.

1.18 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure protective devices such as overcurrent trips and fuses are installed to required values and settings.

1.19 DISCONNECTION OF EXISTING EQUIPMENT

.1 Ensure the disconnection of any existing equipment and provided backup until the new equipment are installed.

1.20 PROTECTION

.1 Protect exposed live equipment during construction for personal safety.

.2 Arrange for the installation of temporary doors for rooms containing electrical distribution equipment. Keep doors locked except under direct supervision of an electrician.

1.21 CONTROL OF DEBRIS

.1 At all times keep the premise free from all accumulations of debris resulting from the electrical work.

1.22 CLEANING

.1 Do a final cleaning in accordance with Section 01710 – Cleaning.

1.23 CONTINUITY AND RESPONSIBILITY

.1 Schedule the electrical work so that disruption to the rest of the circuitry will be kept to a minimum. Co-ordinate with the Owner to schedule shutdowns required for system connection for equipment replacement.

.2 Obtain the Owner's authorization when a circuit is to be de-energized.

.3 Ensure service continuity to existing circuits not affected by the construction work. Make temporary connections if necessary.

.4 The General Contractor is responsible for any damage resulting from modifications to existing facilities such as underground cables, hard surface areas, watermains, and other utilities. The General Contractor to restore, replace or repair all such damage to the satisfaction of the Contract Administrator. Wherever possible obtain locates prior to commencing work.

1.24 LOAD BALANCE

.1 Measure phase current to panelboards with normal loads operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2 percent of rated voltage of equipment.

.3 Submit, at completion of work a report listing phase and neutral currents on panelboards, transformers and motor controls operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.25 FIELD QUALITY CONTROL

.1 All electrical work shall be carried out by qualified, licensed electricians or apprentices under direct supervision of a qualified electrician as per provincial rules and regulations.

.2 All work of this division shall be carried out by a contractor who holds a valid electrical contractor license.

.3 Test electrical equipment and systems for electrical or mechanical defects and rectify same prior to requesting inspection by the Owner's Representative.

.4 At completion of the work, test ground resistance and voltage in the presence of the Contract Administrator. Make corrections where necessary and as directed at no additional cost to the Owner. Give adequate notice to the Contract Administrator prior to the date of the test.

.1 Perform insulation tests for all equipment and wiring using a Megger insulation tester suitably rated for the equipment to be tested.

.2 Control wiring shall be Megger tested before conductors are terminated on the controller.

.3 Instrument and data transmission cables shall not be Megger tested but checked for continuity. All Ethernet cabling (copper/Fiber) to be tested to TIA/EIA standards for

Category 6 certification. Every Category 6 cable shall be qualified to meet the classification after termination to ensure the end to end link including connectors are qualified. The Contract Administrator reserves the right to requalify 10 percent of the cables at random. Provide a copy of the qualification reports to the Contract Administrator.

.4 Defective wiring shall be replaced prior to submission of final results.

.5 Record readings obtained for reference and deliver a set to the Contract Administrator.

.5 Under no circumstances is power to be applied to the equipment until the Owner's Representative and equipment manufacturer's representative are present on site to supervise the testing and start-up procedures.

.6 Under the direction of the Contract Administrator and manufacturer's representative, check all settings, wiring, grounding and motor rotation.

.7 Adjusting and start-up:

.1 The General Contractor shall conduct acceptance tests to demonstrate that the equipment and systems meet the specified requirements. Complete pre-start testing and provide results to the Contract Administrator prior to performing final tests. Preliminary tests may commence as soon as conditions permit. The General Contractor shall make all changes, adjustments, or replacements required as the preliminary tests may indicate prior to the final tests.

.2 Tests shall be as specified in various sections of this Specification.

.3 Carry out final tests in presence of the Contract Administrator. Submit test results to the Contract Administrator.

.4 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.

.8 The General Contractor shall be in charge of the system during tests. He shall assume responsibility for damages in the event of injury to the personnel, building, equipment, and shall bear all costs for liability, repairs, and restoration in this connection.

.9 Verify correct voltages on all transformer primary and secondary connections at No-Load. Adjust transformer tap changes as required in order to achieve nominal voltage required for equipment operation. Verify transformer voltages under operation with connected load applied.

.10 Submit directly to the Contract Administrator two (2) bound portfolio's containing all test reports, certified by the testing technician and the Contract Administrator’s representative authorized to witness the tests.

1.26 SAFETY

.1 The General Contractor shall be responsible for the safety of his workmen and the equipment on the project in accordance with all applicable safety legislation passed by Federal, Provincial, and local authorities governing construction safety. The more stringent regulations shall prevail.

1.27 WORKMANSHIP

.1 Only first-class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean

appearance on completion to the satisfaction of the Contract Administrator. Any unsatisfactory workmanship shall be replaced by the General Contractor at no extra cost.

.2 Conform to the best practices applicable for this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this Specification.

.3 Unless otherwise noted, all equipment shall be factory finished with a prime coat and two coats of good quality finish paint.

.4 Minor damages to finish on factory finished equipment shall be touched up to the Contract Administrator's satisfaction. Items suffering major damage to finish shall be replaced at the direction of the Contract Administrator.

.5 Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work. Work damaged or defaced due to failure in providing such protection shall be repaired or replaced at no cost to the Owner.

.6 Prevent overloading of any part of the building.

.7 Store all electrical equipment and materials in dry, non-corrosive locations and as per manufacturer's instructions.

.8 The General Contractor shall not employ an unqualified person and shall not employ anyone not skilled in the work assigned to them.

END OF SECTION

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

.1 This Section includes guidelines for the implementation of I&C system and overview of I&C System Integrator (SI) works and includes the For Construction Process Control Narrative as an attachment to this section.

.2 Produce the I&C screen shots based on the Process Control Narrative (PCN) for all new processes.

.3 Meet with the City's Operations and I&C staff, and consultant staff to obtain their approval of the screen shots and PCN. A minimum 2 meetings with City of Port Colborne staff shall be allocated for under this task.

.4 The Contractor shall only finalize the I&C programming after the screen shots and PCN have been approved by City staff.

.5 Software Programming of all field controller logic for the modified operation of the site/process area(s) based on the approved process control narratives (PCNs) developed as part of the project.

.6 Configuration of all network devices, including but not limited to workstations, switches, routers, servers, power monitoring devices, soft starters and modems as required to fully integrate the I&C system. The Contractor is to ensure that configuration of all networking devices and the I&C system is in compliance with the current City's I&C Standards.

.7 Configuration of the HMI using software, including but not limited to modifying existing screens, coordinating data collection and reporting to meet the City's requirements.

.8 Configuration of I&C paging software, for notification of City operations staff, is to use the City's existing system, Rayco.

.9 Complete I/O checks (existing and new), complete software SATs, train City staff, and I&C system integration and commissioning.

.10 I&C programming, integration and verification carried out in accordance with the City's I&C Standards, if applicable. On completion of the successful system verification and demonstration, Contractor shall submit two sets of all software programming (including any supporting program development documents), including a copy of the I&C HMI and PLC programs, to the Contract Administrator on CD-ROM. All CD-ROMs shall be properly identified by date of issue, version number, specific programs and City's project number or contract number.

1.2 REFERENCES

.1 Specification 16921 Software Factory Acceptance Testing.

.2 Specification 16933 Site Acceptance Testing.

1.3 SYSTEM DESCRIPTION

.1 The existing control system consists of an Allen-Bradley CompactLogix L35E Controller or approved equivalent.

.2 The I&C system shall perform control and monitoring, start-ups, shutdowns, interlocking, etc., of the equipment and processes provided under this contract for the system allowing operation as outlined in the For Construction Process Control Narrative.

.3 The For Construction Process Control Narrative provides an overview of the facility operation but may not provide details related to operating modes, alarm levels, configuration etc. that shall follow City of Port Colborne I&C standards.

.4 Refer to Division 13 and Division 16 Specifications for details on operation, control system requirements, FATs, commissioning, SATs, training, and other services to be provided under this Section.

1.4 SUBMITTALS

.1 Submit shop drawings in conformance with Section 01300.

.2 Produce the I&C screen shots based on the Process Control Narrative (PCN) for all new processes.

.3 Prepare and submit Software Plan, I&C Start-up and Commissioning Plan, and SAT plan for review in accordance with City of Port Colborne standards:

.1 Proposed timeline schedule and description of each task.

.2 Purpose of tasks, outline of tests to be performed, procedures.

.3 Evaluation of results, check lists and sign off sheets.

.4 Copies of completed products or work in progress (documents, software, programs, code, etc) shall be provided with each payment request or payment certificate.

.5 Software FAT/SAT checkout/verification forms. Submit all copies on CD ROMs.

.6 Program Code: Editable and compiled, electronic versions of program code (PLC, Operator Interface Terminal, I&C, and any other applicable code) on CD ROM for City backup purposes.

.1 Programming and Configuration Records

.2 Programming, integration, and configuration records.

.7 Short “Executive Summary” guide on how to operate the control system.

.8 Documentation of programming work under this contract upon completion of the work as specified in the Contract Documents.

.9 Information on used data structures, data organization, control system details, final I/O list including network points, data mapping, naming/tagging conventions, development and configuration, etc.

.10 Provide printouts of Operator Interface screen graphics layouts, colour conventions, graphics and symbols, interpretation, screen navigation, functional overview. Editable copy of source code is to be provided.

.11 Provide Event recording (alarms, warnings, status), storage, retrieval, and organization.

.12 Provide Trending and data logging, storage, retrieval, and organization.

.13 Provide system security consisting of both physical security and network security.

.14 Provide system start-up and shutdown procedural steps for review.

1.5 QUALIFICATIONS

.1 This Section includes guidelines for the implementation of the I&C system and an overview of I&C System Integrator (SI) works and includes the For Construction Process Control Narrative as an attachment to this section.

.2 The I&C System Integrator shall have expertise in managing large I&C projects in municipal/industrial water and wastewater systems including control system standard development and shall demonstrate expertise in implementation of I&C as it relates to the operation of such facilities.

.3 The I&C System Integrator (company) shall be one of the following I&C System Integrators:

.1 Eramosa Engineering

.2 NLS Engineering

.3 Summa Engineering Limited

.4 Fenstra Electric

.4 The I&C System Integrator sub-contractor shall be named in the Form of Tender.

1.6 SEQUENCING AND SCHEDULING

.1 Coordinate tests with Work under other Divisions.

.2 Schedule time required for this testing into the project construction schedule and include time for completion of functional testing, start-up, and commissioning of City systems (as outlined under other Divisions).

.3 In accordance with the Contract Documents provide sufficient time in the construction schedule for regular Site meetings and visits during construction. Administer and provide meeting notes related specifically to I&C System Integrator’s scope of Work.

1.7 SYSTEM START UP AND COMMISSIONING

.1 Section 13933 – Site Acceptance Testing (SAT).

.2 The Work shall be divided into multiple stages and include all of the City's systems.

.3 System verification is intended to demonstrate the complete operation of the I&C system under normal and failure operating conditions. Ensure that safety measures and fail safe interlocks are in place, and operate as designed and intended.

.4 I&C System Integrator shall proceed to the next stage of testing after the Consultant's approval of satisfactory system performance at the current stage. Rectify deficiencies, conduct troubleshooting and otherwise take corrective action with respect to the installed systems.

.5 Control and instrumentation work shall require completion and operational readiness of selected segments of Work prior to the beginning of the I&C system testing.

PART 2 PRODUCTS

2.1 PLC PROGRAMMING PRACTICES

.1 The following paragraphs outline general rules for programming of logic controllers. The intention of these paragraphs is to provide the I&C System Integrator with information on the project minimum requirements in regards to PLC programming practices.

.2 The program control logic and data files shall be documented in the program code:

.1 The level of documentation shall be sufficient to allow understanding of the program code by a third party.

.2 All program and data files shall have a name and a brief description.

.3 All spare, future, or reserved memory locations shall be properly described.

.3 All points interfacing I&C operator interface shall have a symbol that exactly matches the I&C operator interface database tag in addition to the standard address comment.

.4 When a rung or memory address is removed from the code, all relevant comments shall be removed from the database.

.5 Refer to the Process Control Narrative for additional details.

2.2 I&C PROGRAMMING PRACTICES

.1 The existing City of Port Colborne Baseload Application shall be used, if available. Modifications of the standard I&C modules are not to be made without approval from the City's representative.

2.3 INTEGRATION WORK

.1 The I&C System Integrator (SI) shall lead, supervise, and support the overall I&C system implementation, requirements, and control aspects of the Contract.

.2 The overall programming of the control systems shall be the responsibility of the Contractor and its package suppliers; however, the I&C System Integrator shall provide details on the City's standards related to the I&C system. The Work in general includes:

.1 Publication and delivery of the I&C Standards to the suppliers in regards to the presentation of information, tagging, controls and monitoring, alarms, and events.

.2 Interface of the control system to the I&C system for monitoring, control, and data acquisition.

.3 The I&C System Integrator is fully responsible for the integration of the Contract I&C system, in its entirety including but not limited to the following:

.1 Maintain For Construction Process Control Narrative to meet the City's I&C Standards.

.2 Ensuring that proper interfacing is provided between the system, the application software and protocol layers.

.3 Support all aspects of automation including instrumentation, process equipment, control systems, wiring, panels, etc.

.4 Support all installation aspects of the Work including process, mechanical, instrumentation and control, electrical, environmental, health and safety and related services.

.5 Implementation of City-specific equipment/process control requirements.

.6 Review of documentation, shop drawings and submittals for all systems provided under the Contract for completeness and compliance with the City's I&C Standards, if applicable.

.7 Coordinate programming efforts, data exchange, interface with ancillary systems, reviews, and comments.

.8 Ensure that relevant information is available to all parties in a timely manner.

2.4 PROCESS CONTROL NARRATIVES

.1 Process Control Narratives are an integral part of the integration work.

.2 The Process Control Narrative outlines general rules for programming of logic controller(s), electronic operator interface(s) and the I&C systems. The intention of the Process Control Narrative is to provide the I&C System Integrator with the information on the control and monitoring of the process equipment and other facility systems that are directly or indirectly associated with the plant. It should be used as an aid in developing the control strategy and integration of the plant operation.

.3 Process Control Narrative shall be treated as a "work in progress", where all future mark ups and modifications including "as constructed" documentation Works shall be completed by the I&C System Integrator based on actual implementation.

.4 The I&C System Integrator shall be provided with an electronic version of the For Construction Process Narrative and relative materials.

.5 The I&C System Integrator shall incorporate control details provided by the equipment packaged systems vendors and other suppliers, which are related to equipment/process control requirements in the Process Control Narratives. Written description to include the detailed instrumentation and control system including the list of functions monitored, controlled, and alarmed. The SI shall provide documents in an editable file format for incorporation into the plant manual.

.6 The For Construction Process Control Narrative shall be reviewed and approved by the Consultant and the City before commencement of the I&C programming Work.

.7 The Consultant and the City reserve the right to review and modify the control concepts. The I&C System Integrator shall allow for such modifications including custom configurations to meet the City's control practices.

.8 The I&C System Integrator shall maintain and keep updated Process Control Narrative during development and construction.

.9 Make updated documents available upon the request by the Consultant or City. Documents shall be available in editable electronic and/or printed format when requested.

.10 Update, prepare and submit the final Process Control Narrative documents for the entire control system in accordance with the Contract requirements after successful completion of the software FAT, completion of the SAT, completion of the commissioning period and completion of the warranty period. Process Control Narratives are to be updated for any operational changes, setpoint value changes, control setpoint changes or alarm setpoint changes.

.11 The I&C System Integrator is responsible for integrating all vendor Process Control Narratives into the area Process Control Narrative.

.12 Provide administration services associated with the Process Control Narratives Works including organization and coordinating (including packaged supplier's narratives) and documents revisions, tracking, etc.

2.5 PLC PROGRAMS

.1 Provide programs with control and monitoring functions as outlined under the Process Control Narratives and meeting Contract requirements.

.2 The I&C System Integrator shall request or make minor modifications to the programs provided by the suppliers and required for I&C interface, control, and monitoring data exchange, etc.

.3 The Contractor shall allow for modifications to new or existing equipment or systems throughout the Contract to allow for the changeover of equipment.

.4 The PLC program becomes the sole property of the City of Port Colborne. The Contractor, System Integrator, and the programmer release all real and/or implied ownership and/or copyright and must turn over to the City the programs in their native formats free from any and all locks and/or restrictions.

2.6 I&C PROGRAMS

.1 Provide I&C programs for the facility processes with control and monitoring functions as outlined under the Process Control Narratives and meeting the requirements of the facility and the Contract.

2.7 OTHER PROGRAMMING AND CONFIGURATION

.1 I&C Configuration: The I&C System Integrator shall ensure the proper configuration, setup, and calibration of all computers (including I&C server) and control equipment including but not necessarily limited to all field instrumentation, programmable automation controllers, communications equipment, control devices, process equipment, etc. to ensure functional system. The general contractor, subcontractors and suppliers shall assist the I&C System Integrator as required to ensure a fully functional system.

2.8 SOFTWARE AND ACCESSORIES

.1 The I&C System Integrator shall have their own licensed copies of all programming software including I&C, PLC, OIT, I/O drivers, and data servers. Use of existing City-owned or Niagara Region-owned licenses is not permitted.

.2 Communication cables, wireless hubs, wiring accessories, etc. shall meet the Contract requirements.

.3 Data Backup Means: Hardware, software, and storage media.

PART 3 EXECUTION

3.1 DEMONSTRATION.

.1 Provide trained qualified "hands on" technical personnel to perform services herein specified including, but not necessarily limited to, troubleshooting of other overall I&C related facility systems (instrumentation, controls, etc.) and programming. Allow for

services of mechanical, electrical, instrumentation, and other Subcontractors to support start up and commissioning.

.2 Perform Software Factory Acceptance Test (FAT).

.3 Prior to the commencement of commissioning, review mechanical and electrical Works to ensure that the equipment is correctly installed, supported, connected, and wired. Immediately advise the Consultant in writing of any deficiencies or deviations from the installation instructions.

.4 The Consultant and facility operators shall provide support services during start up and commissioning, and shall observe events, but they shall not be an active participant or responsible for the operation during start-up and commissioning.

.5 Perform Site Acceptance Test (SAT). Inspect, operate, test, and adjust the equipment.

.6 Make any necessary changes and adjustments to the I&C system.

.7 Allow for sufficient time dedicated exclusively to the integration of vendors' packaged systems as indicated under individual Specification Sections. A manufacturer's representative for the equipment specified in the Contract Documents shall be present at the Site for pre-startup assistance, inspection and certification of the installation, and equipment commissioning testing.

.8 Contract Price shall include all disbursements including travel expenses, (accommodation, meals, transportation, etc.) to provide the services as listed.

.9 PLC or I&C programs or any other Work under I&C integration without proper documentation (even if fully operational and tested) will be considered Work not completed.

3.2 TRAINING

.1 Provide training services for the City's staff on the proper operating procedures after satisfactory start-up and commissioning.

.2 The operation and maintenance training shall include:

.3 Class training with overview of I&C operation, technology, and principles. Provide study and training materials and manuals.

.4 Hands on training. Provide presentation by the instructor with the City's staff following and physically performing control operations for the following (as minimum):

.1 System overview.

.2 How to navigate the system(s).

.3 Operation and operator interface.

.4 System security.

.5 How to monitor system.

.6 How to control system.

.7 Event management (alarms, warnings, statuses).

.8 Trending.

.9 Maintenance and I&C checks.

.10 Troubleshooting; simulate alarms and explain causes and procedures.

3.3 PROTECTION OF FINISHED WORK

.1 Back-up all existing software, programs, configuration files, etc. on external back-up media before proceeding with any modifications Work on the existing systems. Maintain a separate back-up copy off Site.

.2 Back-up programs, software, and codes on a daily basis during the commissioning and start-up period. Daily copies of all software programs are to be submitted to the City of Port Colborne.

END OF SECTION

PART 1 GENERAL

1.1 SURGE PROTECTION SCOPE

.1 Supply, install, test, and commission surge protection units, associated cabling and devices as specified in the contract documents and drawings.

.2 The SPD units and all components shall be designed, manufactured, and tested in accordance with latest applicable UL Listed standard (UL 1449, 4th Edition), UL 1283, and certified as per CSA 22.2.

1.2 REFERENCES

.1 SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards

.2 ANSI/UL 1449 4th Edition or later

.3 ANSI/UL 1283 5th Edition or later (Type 2 applications)

.4 IEEE C62.41.1

.5 IEEE C62.41.2

.6 IEEE C62.43-2005

.7 IEEE C62.45-2002

.8 IEEE C62.48-2005

.9 IEEE C62.62-2010

.10 UL 96A

.11 NFPA 780

1.3 QUALIFICATIONS

.1 The manufacturer of the assembly shall be the manufacturer of all the major components with the assembly.

.2 The manufacturer of this equipment shall have produced similar equipment for a minimum of five (5) years.

.3 The equipment shall be of maintenance free design and not require user intervention throughout its life.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with all of Division 16, Section 16010 – Electrical General Requirements

.2 Provide verification that the Surge Protection Device (SPD) device complies with the required UL 1449 4th Edition and CSA approvals.

.3 For retrofit mounting applications, electrical/mechanical drawings showing unit dimension, weights, installation instruction details, and wiring configurations.

.4 Provide documentation and/or test reports verifying the suppressor components can survive published surge current rating on both a per mode and per phase basis using IEEE C62.41, 8x20 microsecond current wave.

.5 Provide actual let-through voltage test data results for the ANSI/IEEE C62.41 Category C3 & C1 (combination wave) and B3 (ringwave) tested in accordance ANSI/IEEE C62.45.

1.5 VOLTAGE SURGE SUPRESSION – GENERAL

.1 Unit operating voltage – Refer to drawings for operating voltage and unit configuration.

.2 Maximum Continuous Operating Voltage (MCOV) shall be greater than 115% (125% for critical load filter application) of the nominal system operating voltage.

.3 Protection Modes - for a Wye configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).

.4 UL 1449 4th Edition VPR – The maximum UL 1449 4th Edition VPR for the device must not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N, L-G, N-G	400V	800V	1000V
L-L	700V	1500V	1800V

.5 ANSI/IEEE Category C3 Let Though Voltage – The let through voltage based on IEEE C62.41 and C62.45 recommended procedures for Category C3 surges (20kV, 10kV) shall be less than the following:

Modes	208Y/120	480Y/277	600Y/347
L-N	470V	900V	1300V

.6 ANSI/IEEE Category B3 Let Though Voltage – The let through voltage based on IEEE C62.41 and C62.45 recommended procedures for Category B3 ringwave (6kV, 5000A) shall be less than the following:

Modes	208Y/120	480Y/277	600Y/347
L-N	150V	200V	300V

.7 The SPD device shall distribute the surge current equally to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating SPD modules shall not be accepted unless specifically approved by the Engineer and owner.

.8 Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for the electrical line noise shall be 55dB at 100kHz using MIL-STD-220A insertion loss test method.

.9 No plug-in component modules or printed circuit boards shall be used as surge current conductors. All integral components shall be hardwired with connections utilizing low impedance conductors and compression fittings.

.10 For units providing safety and diagnostic monitoring, each unit shall be equipped with 200kAIC internal fuses. Diagnostics to provide the following minimum functions:

.1 Continuous monitoring of fusing system.

.2 Internal sensor system for monitoring individual MOVs (including N-G) and identification of open circuit failures.

.3 Thermal detection circuits to monitor overheating in all modes due to thermal runaway.

.4 LED status indicators on each phase, unit fault/damage LED.

.11 Provide minimum 15-year manufacturer warranty on SPD device components.

.12 Where remote indication of SPD unit status and/or alarms is specified (remote status monitor), the SPD must include a minimum of one (1) dry contact, preferably form C. The remote alarm contact shall change state if any of the monitoring systems detects a fault condition.

1.6 SYSTEM APPLICATION – GENERAL

.1 SPD device located in Branch Panels shall be tested and demonstrate compliance with ANSI/IEE C62.41 Category C1 environments.

.2 The minimum total surge current 8x20 microsecond waveform that the device is capable of withstanding shall be as shown in the following table, unless otherwise noted:

Application	Minimum Surge Current Per Phase	Minimum Surge Current Per Mode
Service Entrance (Switchboards, Switchgear, MCC Main Entrance)	250 kA	125 kA
Distribution Panelboards	160 kA	80 kA
High Exposure Roof Top Locations	160 kA	80 kA
Branch Locations (Panelboards, MCC's, Busway)	120 kA	60 kA

1.7 PANELBOARD AND BUS PLUG REQUIREMENTS

.1 SPD device shall be tested and demonstrate compliance with ANSI/IEEE C62.41 Category C1 environments.

.2 Distribution and panel suppressors shall be installed inside the panelboard or bus plugs at the manufacturer's factory.

.3 A direct bus bar connection shall be used to mount the SPD component to the panelboard bus bar or the bus plug disconnect to reduce the impedance of the shunt path.

.4 The SPD panelboard shall be constructed using a direct bus bar connection (cable connection between bus bar and SPD device is not acceptable).

.5 Suppression shall be included and mounted within the panelboard and bus plug by the manufacturer of the panelboard or bus way.

.6 For retrofit applications where suppressor is externally mounted, the maximum conductor lead length between breaker and suppressor shall not exceed 14 inches unless otherwise specified by the Engineer. Comply with manufacturer's recommended installation methods and practices.

1.8 SWITCHGEAR, SWITCHBOARD, AND MCC REQUIREMENTS

.1 SPD device shall be tested and demonstrate compliance with ANSI/IEEE C62.41 Category C1 environments.

.2 Service entrance suppressor shall be installed by manufacturer.

.3 Service entrance suppressor shall be in assembly.

.4 Locate suppressor on load side of main disconnect device, as close as possible to the phase conductors and ground/neutral bar.

.5 Provide 30A disconnect. The disconnect shall be directly integrated to the suppressor and assembly bus using bolted bus bar connections.

.6 The suppressor and integral disconnect shall be installed to the switchboard using a direct bus bar connection (no cable connection between the bus bar and TVSS SPD).

.7 All monitoring diagnostic features such as indicator lights, trouble alarms and surge counter(if specified) shall be mounted on the front of the switchboard.

1.9 SPD ENCLOSURE REQUIREMENTS

.1 All enclosed equipment shall have NEMA 12 general purpose enclosures or indoor applications unless otherwise noted.

.2 Provide NEMA 4 enclosures for SPD equipment where application may be exposed to water, splashing of liquid, moisture, or in any outdoor application.

1.10 APPLICATIONS FOR 20-100 AMP LOADS (1-3 PHASE LOADS)

.1 Total surge current per phase (based on 8x20 microsecond waveform) that the device is capable of surviving shall not be less than 80,000 A per phase.

.2 Balance surge plane construction. For each phase, all surge current shall be distributed equally to all MOV components to ensure equal stressing and maximum reliability.

.3 SPD to be flange mountable.

.4 Each conductor shall be rated to carry a high harmonic current. The actual current rating must be 150% or greater of the nominal phase current. The neutral conductor, if present, must be rated 250% or greater of the nominal phase current.

.5 Terminals to consist of copper alloy. Aluminum connectors rated Cu/Al mounted on the terminals is acceptable.

1.11 MAINTENANCE DATA

.1 Provide maintenance data for surge protection equipment for incorporation into manual specified in Division 1 and Section 16000 – Scope of Work.

PART 2 PRODUCTS

2.1 SURGE PROTECTION UNIT – 600V VOLT (INCOMING SUPPLY)

.1 Maximum continuous operating Voltage: 600 V (L-L, L-N, L-G, N-G).

.2 Peak surge current: 250 kA total per phase, 125 kA current mode per phase.

.3 Filter Attenuation at 100kHz: 55 dB

.4 Response time: 1 nanosecond maximum.

.5 Protection modes: line to line, line to neutral, neutral to ground, and line to ground.

.6 600V, three (3) phase.

.7 Provide 30 Amp breaker as per manufacturer's recommendations.

.8 Let-Through Rating for 600Y/347V (L-N/L-L): 1600/2200 C3 wave, 1200/2000 C1 wave, 900/1800 UL 1449.

.9 Contactor to supply and install surge protection device into MCC as shown on the drawings. Surge device to be connected directly to bus bar as per manufacturer's recommendations.

.10 Provide dry contact(s) for SPD Fault indication to SCADA (120V rated contacts)

.11 Approved Suppliers:

.1 Total Protection Solutions

PART 3 EXECUTION

3.1 INSTALLATION

.1 Supply, install, test, and commission incoming 600V surge protection in Panel as shown on the drawings. Incoming surge suppression unit to be connected directly to buss wherever possible. Incoming surge suppression unit display interface to be visible from Panel without opening Panel cell door.

.2 Mount surge protector so that the minimum practicable conductor length is achieved. Engineer will reject installation of surge protector if this condition is not met.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Supply and install required components as indicated on the drawings and as specified in the contract documents. Provide all new field wiring to the PLC cards as indicated on the contract drawings.

.2 Supply and install fiber optic cabling, CAT6 cabling, network devices, patch panels and media converters as shown on the drawings to provide a fully functional network.

1.2 SUBMITTALS

.1 Submit shop drawings within four (4) weeks of award of the contract in accordance with Section 16000 – Scope of Work.

.2 Include:

.1 Schematics.

.2 Wiring.

.3 Interconnection Diagrams.

.3 Additional Requirements:

.1 For devices containing dip switches, jumpers, or programming keypads.

.1 Functional description.
.2 Performance data.
.3 Physical, electrical, and environmental requirements.
.4 Location drawing.
.5 Equipment descriptive literature.
.6 Wiring details.

.2 For programmable equipment, communication links and networks, submit bill of materials. Include in bill of materials hardware description.

.1 For hardware items include and clearly identify: Description, make model, part number and serial number.
.2 For documentation include: Title and publisher for each item.

.3 For Programmable Equipment Hardware.

.1 Product descriptions for each item including:
.2 Wiring and installation instructions.
.3 Functional description.
.4 Performance data.
.5 Physical, electrical, and environmental requirements.
.6 Adapters and controllers.
.7 Equipment layout drawings showing location of hardware, boards, jacks, cables, and terminals.
.8 Related field tag numbers and wire numbers, module tag assignment, rack module assignment, terminal, and terminal strip numbers.
.9 Location and identifier and pin assignment of plugs, jacks, and cables.
.10 Switch settings and addresses, firmware.
.11 Interconnection Diagrams including wiring, cables, jacks between internal and external components, power supplies, processors, communications modules, racks, I/O modules, and peripherals. Label terminal jacks and pins. Show settings for jumpers and switches. Show address for each hardware module and point.

PART 2 PRODUCTS

2.1 PLC EQUIPMENT

.1 Provide fully functional Allen Bradley CompactLogix CPUs, I/O cards, and communication cards. The warranty for the Allen Bradley components to be honored by a local Canadian distributor in the Niagara Region Area.

.2 Provide all interconnecting cables between controllers and other networking components as required for a complete system as identified in the contract and on the drawings.

.3 Provide all RS-232, Optical Fibre and Ethernet cabling, Fibre and Ethernet jacks as required for a complete network.

.4 Provide uninterruptible power supplies (UPS) as specified in Section 16423 to provide power to the controller, instrumentation associated with the PLCs and all networking equipment within the PLC cabinets.

.5 Allen Bradley CompactLogix components (minimum quantities), and communication equipment. Contractor is responsible for verifying quantities contained in the following table, and for all additional components, cables, etc. required to complete the work as defined in the specifications and on the drawings.

Part #	Description	Quantities
5069-L310ER	CPU, 1 MB user memory	1
5069-IA16	16 pt. DI 24 VDC	4
5069-OW16	16 pt. DO Contact Output	1
5069-IF8	8 pt. AI	1
5069-OF4	4 pt. AO	1

.6 In addition to the quantities identified in the above table, provide a quantity of two (2) spares for each of the 5069-IA16, 5069-OW16, 5069-IF8, and 5069-OF4.

2.2 OPERATOR INTERFACE TERMINAL (OIT) PANEL

.1 Provide a fully functional OIT panel as per the Contract Drawings. Provide power wiring, communications cabling, or any other appurtenances for a complete and functional system according to the manufacturer's specifications.

.2 Mount OIT panel inside the cabinet as per Contract Drawings. Provide mounting as per manufacturer's specifications.

.3 OIT panel shall be the Allen-Bradley Panelview Plus 7 12-inch or approved equivalent.

2.3 COMMUNICATION SYSTEM

.1 All equipment for a fully functional system is to be supplied by the contractor unless otherwise specified.

.2 Supply, install, test and commission the following equipment as part of the communication network. Install as per the directions of the Engineer and Contract Drawings.

.1 Unmanaged fast Ethernet switch complete with minimum 4 RJ45 ports. Quantity as identified on the Contract Drawings.

.1 Weidmuller IE-SW-BL08T-8TX or approved equivalent.

.2 4G LTE Cellular Ethernet Bridge/Serial Gateway

.1 Microhard Systems – IPn4G

.3 Outdoor Omnidirectional Antenna

.1 SureCall – SC-288W

.2 Contractor shall provide all cabling, surge arrestor, grounding, and other appurtenances related to an outdoor antenna installation.

.3 Provide equipment mounting brackets as required.

.4 Supply, install and commission all hubs, switches, routers, transceivers, fiber optic patch panels, surge suppression equipment, radio coaxial cable, or any other communication equipment identified on the contract drawings unless otherwise noted.

.5 Supply, deliver, install, and test all network cabling including Ethernet Cat 6 10/100 Base-T, RS-232, optical fiber and any other network cabling required for a completely functional control system and network. All network components to be tested to TIA/EIA 568-A Category 6. Testing to conform to current TIA/ISO channel standards.

2.4 ISOLATED GROUND

.1 Provide a ground system for the instrumentation circuits, isolated from the main power system ground, to each RPU/PLC panel.

.2 Provide a #2/0 AWG insulated green with yellow tracer TWH conductor, connection from the electrical system ground grid to the isolated ground bus in each RPU/PLC panel.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Supply, install, test, program, and commission PLC components, OIT, communication equipment, and associated equipment to ensure functionality of complete network and control system. Report all construction defects, which will affect the progress of the work to the Owner and Engineer.

.2 The drawings have been developed on a conceptual basis. Provide devices, components, and accessory items necessary for the operation of the control system.

.3 Existing systems to remain functional at all times. Shut down of any of the existing equipment or system only to be performed under the direction of the Owner and Engineer.

.4 All replaced or extra equipment to be delivered to the Owner upon project completion.

.5 Communication system, OIT, and RPU panel modifications to be completed, tested, and operational prior to Site Acceptance Testing and commissioning.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Division 16.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at a time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

.5 Submit to Engineer one copy of test results.

.6 Provide a written list of all passwords, keywords, serial numbers, configurations, that are encountered during the installation of the operating system and application software.

.7 Assign all warranties, licenses and product registration to the City of Port Colborne.

.8 Turn over to the Owner all installation software, user manuals, accessory cables, calibration units, or any other material accompanying the installed equipment.

END OF SECTION

PART 1 GENERAL

1.1 DESCRIPTION

.1 This section specifies the supply, installation, field-testing, and placing into operation of flow and level instruments.

.2 Coordinate with other Divisions for instrumentation supplied under other Contract Documents.

1.2 REFERENCES

.1 ANSI/ISA-S5.1-1984 (R. 1992) Instrumentation Symbols and Identification.

.2 ANSI/ISA-S5.4-1976 (Revised 1989) Instrument Loop Diagrams.

.3 ISA-S20-1981 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

1.3 DESIGN REQUIREMENTS:

.1 The Drawings have been developed on a conceptual basis. Provide devices, components, and accessory items necessary for the operation of the control system.

.2 Provide all conduit and cabling necessary for installation of instruments including all new instruments to be integrated into the SCADA system as per the contract drawings. Use only new instruments where instruments are to be supplied under this contract. Instruments located in the areas classified as hazardous shall be rated for the specified classification.

1.4 SUBMITTALS

.1 Submit shop drawings in conformance with Section 01330.

.2 Not later than 4 weeks before commencement of work, submit the following:

.1 Instrument data sheets, conforming to ISA-S20.

.2 Descriptive literature.

.3 Manufacturer’s installation diagrams for field-mounted equipment.

.4 Drawings for field-mounted equipment.

.3 Not later than 6 weeks before commencement of work, submit the following:

.1 Loop wiring diagrams and control schematics conforming to ISA-S5.4 showing the connections at each device and wiring, pneumatic tubing, or cabling between devices. The diagrams are to be fully comprehensive so that every circuit loop can be followed completely. Indicate types of loads, switches, transducers and power supplies such as motors, relays, lights, indicators, float switches, hand switches, isolators, signal selectors, dedicated 24 VDC power supplies, etc. Number and identify each component circuit and terminal. Contain a loop on a maximum of two sheets, preferably one sheet. (This is required for modifications to existing facilities and new equipment).

.2 Instrument panel layout drawings.

.3 Instrument panel wiring diagrams.

.4 Not later than 2 weeks prior to Site Acceptance Testing, submit the following:

.1 Completed Input/output test reports.

.5 Prior to the completion of the work, submit the following:

.1 Final, as-constructed instrument loop diagrams.

.2 Final, as-constructed data sheets.

.3 Maintenance manuals.

.6 A list of recommended spare parts including the make, model number, suggested quantity, cost, and required lead time of each part.

.7 Instrument calibration forms.

.8 Control Loop checkout/verification forms.

.9 Programmable Instrument and Equipment Configuration Summaries.

.10 CAT6 test report, including graphical representation of test data.

PART 2 PRODUCTS

2.1 INSTRUMENTS GENERAL

.1 Provide each instrument with mechanisms that are corrosion resistant.

.2 Provide all indicator and gauge dials finished in permanent white with black graduations and figures.

.3 Potentiometric signals shall have a “live” zero or positive minimum value in the signal range.

.4 Each component shall be carefully selected and designed for a long lifetime with ample margin to withstand transient and other surge Voltages which may occur in the circuits from any source in the power supply.

.5 Each component and composite instrument shall be suitable for the location and installation position at the attitude designated on the drawings (e.g.: horizontal, vertical or sloped position.)

.6 The Contractor shall provide all power supplies. Provide each instrument having a 120 VAC power supply with UPS power from local PLC panel.

.7 All instruments to have a locally mounted switch to isolate 120VAC power supply to the instrument.

.8 All control panel mounted instruments shall be suitable for flush mounting and shall be furnished with bezel.

.9 Unless otherwise indicated or specified, all signals shall be of the 4-20 mA DC type. This applies to both transmitting and receiving instruments.

.10 All materials shall conform to the standards of the Canadian Standards Association (CSA).

.11 Provide all instruments connected to process lines with isolation valve(s) and appropriate diaphragm seal for the application.

2.2 RADAR LEVEL METER (QTY: 2)

.1 Transmitter location: N/A – blind instrument.

.2 Transducer location: On mounting bracket on downstream and upstream drain. See Contract Drawings for details.

.3 Provide metal sunshade for level transducer.

.4 CSA-approved transducer.

.5 Transducer to be NEMA 4X, rated for outdoors installation.

.6 Accuracy: ≤ 2 mm

.7 Transmitter Power Supply: Loop-powered or 3-wire 24 VDC.

.8 Output: 4-20 mA output signal.

.9 Measuring range: minimum 10 m

.10 Approved manufacturers. Design is based on first named.

.1 VEGA VEGAPULS C22.

.2 Pulsar Measurement dBR radar series.

.3 Rosemount 1408 series.

.4 E+H Micropilot FMR20 Radar Level Transmitter

2.3 OPEN CHANNEL FLOW METER (QTY: 1)

.1 Flow Sensor: Ultrasonic.

.2 Sensor Mounting: Removable mounting bracket complete with sensor retrieval arm. See Contract Drawings for details.

.3 Enclosure: IP68 ingress protection.

.4 Cable: 23 m length.

.5 Transmitter location: Mounted facing upstream, centred on the Drain channel.

.6 Flow element location: Mounted on a bracket facing the upstream channel. See Contract Drawings for details.

.7 Speed Range: 0-3 m/s

.8 Display: Wall mount (with mounting bracket).

.9 Indication: Local LCD, Engineering units

.10 Power Supply: 120VAC, 60Hz

.11 Accuracy: up to 4% of span.

.12 Ambient Temperature: 0º to 35º C (Transmitter), -30º to 50º C (Sensor)

.13 Outputs:

.1 One 4-20mA for flow.

.2 One 4-20 mA level output.

.3 Minimum 2 SPDT relay.

.1 One for flow reverse signal.
.2 One for fault/error signal.

.14 Transmitter to have the ability to send a digital signal to indicate reverse flow.

.15 Approved Products. Design is based on the first named.

.1 Teledyne Isco Laserflow with Signature Flowmeter transmitter c/w TIENet modules as required to obtain the number of outputs specified above.

.2 Or approved equivalent based on contractor submission.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install all instruments in strict accordance with the manufacturer's requirements and recommendations.

.2 Use stainless steel hardware for all installations, except where manufacturer's recommendations state otherwise or otherwise specified in the Contract Documents or Contract Drawings. Ensure dissimilar metals are not combined. Ensure all supports are retractable to provide convenient access for maintenance and servicing of instrumentation.

.3 Contractor to wire all alarm points in a 'failsafe' configuration, such that the loss of power, opening of the contact or break in the control circuit wiring will activate an alarm.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 The Contractor is responsible for preparing a finalized Bill of Materials based on PLC panel circuits completed by the Contractor. Panel drawings are to be produced 'to-scale' for submission to the Contract Administrator for review. Submit to-scale panel lamacoids to the Contract Administrator for review.

.2 Comply with Division 1, Section 16000 – Scope of Work, Section 16010 – Electrical General Requirements.

.3 ESA certification is acceptable.

1.2 SUBMITTALS

.1 Submit Shop Drawings according to Section 01340 – Submittals indicating, but not limited to the following:

.1 Outline dimensions and assembly details.

.2 Dimensioned internal and external layout details.

.3 Schematic and wiring diagrams.

.4 Shipping splits interconnection wiring diagrams.

.5 Field interconnection wiring diagrams, including existing equipment, equipment supplied under this contract and equipment supplied by installation contractor.

.6 Terminal Block arrangement.

.7 Component details, specification sheets, data sheets, performance curve, calibration data, catalogue cuts, etc.

.8 Detailed Bills of Material.

.9 Materials of construction and construction details.

.10 PLC I/O point layout (as applicable).

.11 PLC I/O point loop drawings for each card. Typical loop drawings are not permitted.

.2 Submit installation, operation and maintenance manuals including, but not limited to the following:

.1 Complete parts list.

.2 Recommended spare parts list with current pricing.

.3 List of approved spare parts list with current pricing.

.4 Installation instructions.

.5 Operation instruction.

.6 Maintenance instructions.

.7 Component instruction booklets.

.8 Detailed troubleshooting procedures and fault correction schedules.

.9 Safety precautions.

.10 Data sheets and performance curves.

.11 Certified shop test results.

.12 Final record Drawings.

.13 Point-to-point wiring diagrams for all controls.

.14 Schematic and wiring diagrams.

.3 Enclose one copy of final record wiring diagrams (279 x 432 mm,) in a plastic envelope and place in each panel.

.4 Contract Administrator reserves the right to rearrange the component layout during Shop Drawing review.

.5 Submit, prior to panel delivery, complete wiring diagrams showing wiring between panel components and devices and panel terminal blocks, and between panel terminal blocks and remote equipment. Identify components, conductors and terminal blocks.

.6 Submit final record wiring diagrams at completion of Project. Include changes made during field installation and start-up.

1.3 QUALITY ASSURANCE

.1 Comply with Division 16.

.2 Test individual components, individual control panels and control panel assembly at manufacturer's plant.

.3 The Contract Administrator will witness tests and inspect completed assembly. Advise the Contract Administrator in writing ten (10) working days (two (2) week) minimum prior to carrying out tests.

.4 Shop tests to include, but not limited to:

.1 Standard production tests.

.2 Interchangeability of similar items of equal rating.

.3 Mechanical and electrical operation of switches, contactors, interlocks, draw-out mechanism, auxiliary devices, and manual devices.

.4 Functional tests on components and circuits. Where necessary, suitably simulate external devices.

.5 Testing and calibration of metering and protection devices.

.5 Test control panels as complete assembly. Separate testing of individual control panel components only is not acceptable.

.6 Prior to shipment, submit to the Contract Administrator six (6) copies of certified final test results.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

.1 Control panels: Complete working system with instruments, meters, indication lights, alarm annunciators, protection and control relays, programmable logic controllers, transducers, contactors, switches, auxiliary devices, and similar items.

.2 Arrangement of instruments and devices (face-mounted as well as rear-of-panel mounted): Allow sufficient access for maintenance.

.3 Mounting Height: Indicating devices, controls and instruments between 1,000 mm and 2,000 mm above finished floor. Allow for housekeeping pads, pedestals, and similar items.

.4 Side or back face mounted devices: On removable backplate. Direct mounted devices will not be accepted.

.5 Panel sideplate mounted devices are not acceptable with prior approval from the Contract Administrator.

.6 Nameplates: Removable, lamacoid-type, to identify panel and equipment function, letters minimum 6 mm, fasten with stainless steel screws. Grind screws flush on inside of panel so no sharp edges protrude.

.7 Supply panels complete with wiring and header piping connections.

2.2 ENCLOSURE

.1 Dry areas: Rigid, high-grade cold rolled sheet steel, 12 gauge/2.78 mm, NEMA/EEMAC 12, unless otherwise noted on Drawings.

.2 Wet, damp process areas, or outdoor installations: Rigid, dead front, 12 gauge / 2.78 mm, 316 stainless steel sheet, NEMA/EEMAC 4X, with stainless steel hardware. No holes or modifications to the panel are allowed that do not maintain the NEMA rating of the enclosure unless authorized by the Contract Administrator in writing.

.3 Corrosive areas: Rigid, dead front, molded fibreglass reinforced polyester, NEMA/EEMAC 4X.

.4 Hazardous areas: Assembly and components suitable for application in specific areas indicated.

.5 Visible welding seams: Not acceptable.

.6 Backplate: 2.7 mm powder painted white sheet mounted on four 10 mm collar studs minimum with stainless steel hardware.

.7 Doors: Removable, continuous piano type hinges, three-point latching, padlockable handle, keyed alike.

.8 Print pocket: On inside of door, rigid, for storing manual, layout Drawings and wiring diagrams.

.9 Finish: Steel sheet, phosphatize, zinc chromate prime, baked enamel epoxy coated inside and outside, matte white interior and ANSI 61 grey exterior.

.10 Acceptable Enclosure Manufacturers:

.1 Hammond,

.2 Ralston Metal,

.3 Rittal,

.4 Hoffman.

.5 Or approved equivalent

2.3 INTERNAL ASSEMBLY

.1 Internal component and equipment mounting: On hinged sub-chasses, racks and back plates, arranged for ease of access and removal.

.2 Pans and rails: For mounting terminal blocks, relays, contactors, wiring and similar devices.

.3 Luminaire: Refer to drawings. One light to be installed for single door panels, two for double door panels, etc. Fluorescent bulb to be included for each light.

.4 Simplex receptacle: Comply with Section 16423 – Control Devices.

.5 Duplex receptacle: Comply with Section 16423 – Control Devices.

.6 Power supply disconnecting devices: Molded case circuit breakers, 10,000 A symmetrical interrupting capacity for each instrument requiring 120 V supply.

.7 Instrument disconnecting devices: To disconnect incoming power supply sources and individual feeder circuit supplies, molded case circuit breakers.

.8 Identification: Identify switches, circuit breakers, components, terminal blocks, power supplies, relays, wiring and similar devices. Comply with Section 16010 – Electrical General Requirements.

.9 Warning signs: Identify sources of supply. Comply with Section 16010 – Electrical General Requirements.

.10 Wiring ducts: Maximum 50% fill, with snap-on cover, by Panduit Canada or Wieland Electric.

2.4 INSULATION

.1 Insulate the interior of all 6 sides of the enclosures with foil-facing insulation board or batting. Insulation is to be installed at the factory or site of panel assembly and delivered to the final installation site with insulation installed. Insulation may be patched or completed on site as required or directed by the Owner or Engineer.

.2 No penetrations into the enclosure walls are permitted to fix or install the insulation. Insulation shall be cut and customized to size and cover the maximum area of each side possible. The insulation is required not to interfere with the placement and/or performance of any installed component, conduit penetration, or wire runs.

.3 If a sun shield is not installed for the enclosure, insulation for the top side must be at least 40 mm (approximately 1.5”) thick.

.4 Minimum insulation thickness: 25 mm (or 1”)

.5 Minimum insulation R-value per inch: R-5 ($ft^2 \cdot {}^oF \cdot h/(BTU \cdot in)$)

.6 Contractor shall include locations, thicknesses, and method of affixing, in shop drawings. Catalog sheets for insulation shall also be included in control panel or junction box shop drawing submittals.

2.5 BREATHER-DRAIN

.1 Provide breather-drains for all outdoor enclosures (including all junction boxes and enclosures for instrumentation transmitters) and place them as per manufacturer's recommendations.

.2 Breather-drains shall maintain the NEMA rating of the enclosure.

.3 Breather-drains must be appropriate for the area classification.

.4 The interior assembly, including insulation must allow for water to collect and drain through the breather drain.

.5 Approved manufacturers:

.1 Eaton Crouse Hinds, Appleton (Emerson), Hubbell, or acceptable equal.

2.6 DATA ENTRY PORTS

.1 NEMA 5-15 power receptacle and RJ45 copper port to connect to an external laptop.

.2 RJ45 port to communicate with the PLC and connected as per the Contract Drawings.

.3 Data entry port assembly shall not change the NEMA rating of the enclosure.

.4 Acceptable manufacturers:

.1 Panduit

2.7 SWING-OUT PANELS

.1 Swing-out panels shall be placed at a depth where the most protruding component installed on the swing-out panel is at least 50 mm from any part of the front door, including any insulation.

.2 The swing-out panel must come complete with quarter-turn latches. Contractor shall confirm with Engineer the depth of installation of the swing-out panel. Install all lights, buttons, switches, and disconnect handles on swing-out panel as shown on the drawings.

2.8 PANEL-MOUNTED LAPTOP TRAY

.1 Provide drop down type Laptop Shelf where indicated on the Contract drawings. Shelf shall be of the same manufacturer as panel enclosure.

.2 Panel-mounted laptop tray shall not interfere with any panel insulation. Insulation may be thinner underneath the tray in its folded-down configuration. Confirm with Engineer during shop drawing review phase for placement of laptop tray and thickness of insulation.

2.9 PANEL HEATING, VENTILATION, AND AIR CONDITIONING

.1 Provide and install heating and air conditioning units for the enclosure as per manufacturers' recommendation. Size heating and cooling power according to panel surface area, insulation, and radiant heat generated by internal components. Heating and air conditioning components listed in the drawings are assumed to be correct for the size of the enclosure, which is the minimum size allowed by the Owner for this application. Any resizing of the enclosure will require re-evaluation of the heating and air conditioning units by the Contractor and the Engineer.

.2 The heater unit shall be mounted on the backplate, with a clearance above the heater of at least 60 mm or a distance recommended by the manufacturer, whichever is greater. The heater shall come complete with a built-in fan and thermostat.

.3 The air conditioner unit shall have a NEMA 4X enclosure, and if possible, with a finish resembling the exterior of the enclosure. The air conditioner unit must not compromise the NEMA rating of the enclosure. The air conditioner must come complete with built-in thermostat.

.4 The heating and air conditioning system shall maintain a temperature inside the enclosure of not lower than 19º C and not more than 25º C. The system shall be designed for an outdoor, free-standing installation with temperatures of up to 36º C and down to -35º C, with moderate wind load.

.5 Submittals:

.1 Heating system calculations

.2 Air conditioning calculations

.6 Acceptable manufacturers:

.1 Heaters:

.1 Hammond SCR or FLH series with continuously running fan
.2 Rittal SK heater series with fan
.3 Hoffman

.2 Air conditioners:

.1 Hammond DTS series, NEMA 4X
.2 Hoffman T-series or Spectracool Series
.3 Rittal Blue e series, NEMA 4X

2.10 TERMINAL BLOCKS

.1 Comply with Section 16423 – Control Devices.

2.11 INSTRUMENT GROUNDING

.1 Ground: Full-length tin-plated copper ground bus or ground stud with tin plated copper lugs at ends, suitable for minimum #4 AWG ground wire.

.2 Instrument cable shields and equipment ground conductor connections: With screws and clamp washers.

2.12 OPERATOR DEVICES

.1 Comply with Section 16423 – Control Devices.

2.13 GENERAL PURPOSE CONTROL RELAYS

.1 Comply with Section 16423 – Control Devices.

2.14 INSULATING BARRIERS

.1 Barriers: Covering exposed terminals and terminal blocks against inadvertent contact.

.2 Warning labels: Lamacoid with 3 mm white letters on red background, on front of compartments where multiple power sources are present.

2.15 INTERNAL WIRING

.1 Comply with Section 16122 – Wires and Cables.

.2 To control or eliminate electrical noise in wiring systems, group wires of compatible signal or power levels together and run separately or electromagnetically isolated from wires of incompatible signal or power level as much as possible.

.3 Install low level analogue signals, 50 V DC maximum or 4-20 mA, and digital signal operating at 50 V AC or DC maximum, in raceways that do not contain as little higher power wiring as possible. Comply with wiring separation and isolation guidelines recommended by instrument and PLC equipment manufacturers.

.4 Wiring type: except shielded instrumentation wiring, copper, 600 V, single conductor, sixteen strand minimum, heat and flame-retardant type insulation. TEW #16 AWG minimum for control circuits, TEW #14 AWG minimum for power circuits and TEW #10 AWG minimum for current transformer circuits.

.5 Wiring devices on hinged doors or panels: Extra flexible, forty-nine strands minimum, harnessed nylon cable ties, encased in spiral wrap.

.6 Instrumentation Wiring:

.1 Comply with Section 16122 – Wires and Cables.

.7 Wiring ducts: Maximum 50% fill, narrow slot, with snap-on cover, Type F by Panduit Canada or Ty-Duct by Thomas & Betts.

.8 Identify each conductor, including spares, with a unique alphanumeric designation to facilitate troubleshooting and maintenance. All wire tagging is to be approved by the Contract Administrator prior to tagging wiring.

.9 Identify PLC wiring at terminal blocks and connection points with PLC terminal (I/O) address numbers, as shown on drawings.

.10 Wire markers: Identify wiring at both ends with heat shrink type, indelible machine printed wire markers. Brady PermaSleeve. This wire marker style is to be used for both internal PLC panel wiring and field/external wiring for all wires connecting to the PLC panel(s).

.11 Wiring terminations: On terminal blocks only.

.12 Spare I/O points: Terminate on terminal blocks.

.13 Spare terminal blocks: Minimum 20% spare terminals for each signal class.

.14 Maximum number of conductors under one terminals for each signal class.

.15 Insulating barriers: Cover exposed terminals and terminal blocks against inadvertent contact.

.16 Isolated DC Ground:

.1 The analog DC and digital DC power supply "-" connection (0 VDC) shall be connected to a single star ground point referred to as the "Isolated DC Ground" located within the PLC panel. This is typically implemented using a copper bus bar on insulated stand-offs located near the bottom of the controller cabinet. This bus bar shall be identified as the "Isolated DC Ground." This bus shall be tied by only one 8 AWG ground wire, which runs directly from the bus bar to the lowest potential

building or system ground available (typically the building frame or buried grounding grid). Simply tying this ground via the AC System Ground bus bar should be avoided. The grounding cable from the Isolated Ground DC bus bar to this ground point shall not serve any other purpose.

.2 Field device enclosures must not be bonded to the Isolated DC Ground.

.3 Instrument shields shall not be bonded to the AC ground at the instrument.

.4 Instrument shields shall be connected to the “Isolated DC Ground.”

.17 AC System Ground:

.1 The AC System ground is the principal ground for the SCADA system. It originates from the supply transformer neutral.

.2 This AC System ground is typically implemented using a copper bus bar on non-insulated stand-offs located near the bottom of the controller cabinet.

.3 All cabinets and bonding shall be grounded to the AC system ground.

.4 Wiring conductors connected to the AC System Ground shall be labeled and coloured in accordance with their loop function (i.e., with a "G" suffix as described below), or shall be light green in colour and labeled as "AC GND."

.5 No UPS system shall interrupt the ground.

.18 AC Isolated Ground:

.1 Use of an AC Isolated Ground should be avoided unless the UPS or power conditioner manufacturer installation instructions require it.

PART 3 EXECUTION

3.1 INSTALLATION

.1 After installation, wrap panels in heavy duty plastic until construction is complete. Protect against damage and moisture.

.2 Provide control panels where indicated.

.3 Assemble and erect floor mounted panels on channel bases. Install on 50 mm high concrete housekeeping pads.

.4 Provide wall mounted panels with 6 mm nylon or lead spacers.

.5 Install channel mounted panels on aluminum channels and fasten with stainless steel hardware. Use stainless steel anchor bolts for fastening channels to floor or parapet.

3.2 SHIPPING AND HANDLING

.1 Design control panels to allow lifting without racking or distortion. Provide removable lifting rings to allow rigging and lifting of the panel during transportation and installation. Provide water tight plugs to fill the lifting ring holes after installation.

.2 Provide suitable wooden crating to transport control panels to the construction site.

.3 Wrap control panels in industrial shrink-wrap to prevent dust and water from entering the control panel during shipping and during storage at the construction site.

3.3 SPARE PARTS

.1 Provide consumables and spare parts to allow commissioning and start up of the control panel.

.2 Provide a zip lock bag with spare fuses of each kind and spare incandescent pilot light lamps of each kind. Tape to the inside of the panel.

3.4 SITE INSPECTION, COMMISSIONING AND TESTING

.1 Provide services of manufacturer's representative to inspect test and commission control panel installation.

.2 Carry out functional tests with the Contract Administrator to confirm field wiring, interlocks, and PLC functionality.

.3 Submit certified inspection and test reports.

END OF SECTION

PART 1 GENERAL

1.1 INTRODUCTION

.1 The Software Factory Acceptance Test (FAT) demonstrates that all I&C and controller software are working properly and that all software configurations match the requirements identified in the detailed process control narrative.

.2 Test the software under all possible process conditions in order to ensure the software contains no defects. Include a wide range of operating scenarios, with all process setpoints, interlocks and alarm limits.

.3 Test the software under abnormal process conditions to confirm fault response operation of the software.

.4 FAT testing is to be carried out for all I&C and controller software including packaged and vendor supplied products as a whole system.

1.2 OBJECTIVES

.1 The overall objectives of the Software Factory Acceptance Test are to:

.1 Confirm and document that the PLC I/O matches the type and quantity identified in the control schematics.

.2 Confirm and document that the individual device logic operates all field equipment correctly and safely, as described in the detailed process narrative, logic flow charts and HMI functionality

1.3 SUBMITTALS

.1 Submit shop drawings in conformance with Section 01330.

.2 In addition, submit the test plan: testing forms, procedures, and schedules of work, not less than four (4) weeks prior to the scheduled test date.

.3 Separate test plans to be submitted for Hardware testing and Software testing.

.4 Submit copies of the PLC program, OIT and HMI graphics software to the City of Port Colborne. Source code of the PLC program is to be provided; printed copies are not permitted.

.5 The test plan must be approved in writing by the Consultant, prior to commencement and should show the schedule of work to include dates.

.6 Submit the Software Factory Acceptance Test Report within one (1) week after completion of Software FAT.

.7 Additional submission prior to site installation identifying that FAT deficiencies have been corrected. Must be submitted two (2) weeks prior to going to site.

1.4 TESTING PROCESS

.1 The I&C System Integrator shall conduct the tests with the Consultant and the City's Representative present. The City's representative will actively participate in the tests. The Consultant reserves the right to test any specified hardware/software function whether or not explicitly stated in the test submittal.

.2 Meet the following criteria prior to the start of the tests:

.1 Complete submittals and resolve disputes.

.2 Make hardware and software fully operational.

.3 Have the Consultant review and approve the test procedure.

.4 Set a test date, which is agreeable within the contract schedule.

.3 At the discretion of the City, conduct factory acceptance tests at a City facility. Otherwise testing will be conducted at the I&C System Integrator's facility. All necessary computers, network equipment and PLC hardware necessary to conduct the test is to be provided by the I&C System Integrator.

.4 Hold a meeting at the end of each day to review the day's test results and to review or revise the next day's test schedule.

.5 At the end of the test, meet to review the list of deficiencies. All deficiency items must be corrected prior to onsite installation.

.6 Following the completion of the successful FAT and correction of all deficiencies, the I&C application is to be created for all local I&C terminals and servers.

.7 I&C System Integrator is to provide their own developers licenses for PLC programming software, OIT programming software, I&C software and the I/O drivers and I/O servers. Use of City-owned licenses is not permitted.

.8 All devices are to be set up with correct IP addresses prior to site installation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 TEST DOCUMENTATION

.1 Prepare "Software Factory Acceptance Test Plan" and submit for Consultant and the City's review.

.2 Complete the "Software Factory Acceptance Test and Site Acceptance Test Check Sheet" and operational test forms.

.1 Software Action Log will be developed and maintained until all deficiencies from the FAT are resolved.

.2 Test Sign-Off Form, to document the completion of a test; note any issues/concerns.

3.2 SOFTWARE TESTING TOOLS

.1 Prepare automated test programs using internal simulation logic with the PLC program.

.2 Software to be developed with the existing City of Port Colborne Baseload Application, if available.

.3 Run test programs to demonstrate all functions in control logic and functions of operator interface screens.

.4 All software licenses are to be provided by the I&C System Integrator.

3.3 DEFECT HANDLING AND MANAGEMENT CHANGE REQUESTS

.1 For test failures, report the defect using Software Action Log.

.2 Document all defects and submit to the Consultant for review.

3.4 CHANGE REQUEST MANAGEMENT

.1 During testing, identify the need for changes to the system.

END OF SECTION

PART 1 GENERAL

1.1 INTRODUCTION

.1 This section is part of overall Facility Commissioning.

.2 The Site Acceptance Test (SAT) is focused on ensuring that all instrumentation, equipment, I&C and controller hardware and software is working properly and that all software configurations match the requirements identified in the Detailed Software Design, including the detailed process narratives. Successful completion of the SAT is considered to be a critical project milestone. All participants will test the software under all possible process conditions in order to ensure the robustness of the software.

.3 In general, the SAT consists of repeating the FAT using the actual field inputs/outputs once all field equipment has been installed and successfully tested. This also includes all the inputs/outputs, derived and calculated data points transmitted via Ethernet/IP between the plant PLC and the vendor packaged systems. Hence many of the procedures are identical to the activities identified in the other test procedures.

.4 SAT testing is to be carried out for all I&C and controller software including packaged and vendor supplied products as a whole system.

1.2 PRE-REQUISITES

.1 Equipment start-ups completed with manufacturer representatives including all mechanical equipment required to fully test the operation of the software.

.2 All instrumentation to be installed, calibrated, and tested prior to starting SAT.

.3 All network equipment to be installed and tested prior to starting SAT.

.4 The final SAT & Start-Up Test plan is to be prepared and submitted by the contractor and approved by the Consultant and the City no later than four (4) weeks in advance of the SAT.

.5 All panel I/O must be wired up, tested, and signed off 100% prior to commencing SAT unless otherwise approved by the Consultant. If any I/O are not available, the Contractor must submit a request to defer I/O testing until after the SAT for review and approval at the same time when the SAT & Start Up test plan is submitted for review. The request must identify the reason for deferring I/O testing along with a proposed date when the I/O will be tested.

1.3 START-UP TEAM

.1 The Start Up Team consisting of individuals from the Consultant, Contractor, System Integrator, and the City will jointly develop the testing plan, SAT & Start Up Plan.

.2 The Start Up Team is to review the testing plan, SAT & Start Up Plan and revise, if necessary, at a pre-SAT & Start Up meeting to be scheduled no later than six (6) weeks in advance of the proposed SAT period. The Contractor will be responsible for expanding and providing details for the SAT & Start Up Plan to clearly identify the proposed test procedure for the equipment and software.

.3 The SAT testing is to be conducted/witnessed by the facility Start Up Team.

.4 Members of the Start Up Team are to be identified at the pre-SAT & Start Up meeting. These team members will be involved throughout the process and are to be changed only with the approval of the Consultant and the City.

1.4 PURPOSE AND SCOPE

.1 The goal of software testing is to ensure that the system released for use by users meets their requirements and is error-free. Software installed or modified under the project must not adversely affect the operation of other systems currently in operation at the facility. All functionality that is currently available within the system must remain available at the completion of the testing.

.2 All software installed on the project is to be tested to confirm that the software developed, tested, and installed under the project conforms to the approved process control narratives.

.3 All software is to meet the requirements of the project specifications including all operational control, monitoring, and alarming, as well as integrates all vendor packaged systems as defined within the contract documents.

.4 Testing is intended to demonstrate that all software developed not only works locally at the facility but that it is fully functional on the City of Port Colborne I&C system. All City-wide testing is to be conducted concurrently with the local testing to confirm operation throughout the City-wide system.

1.5 OBJECTIVES

.1 The following identifies the overall objectives of the Site Acceptance Test.

.1 Confirm and document that the PLC I/O (Ethernet I/P and hardwired) matches the panel shop drawings in terms of input/output configuration, tagging and function;

.2 Confirm and document that the individual device logic operates all field equipment correctly and safely, as described in the detailed process control narrative;

.3 Confirm and document that the process and control logic operate the system correctly and safely, as reviewed at the FAT and also described in the detailed process control narrative;

.4 Confirm and document that the data integration with the City I&C, historian software, and other third-party software operates correctly as tested in the FAT and described in the detailed process control narrative;

.5 SAT testing is to be conducted for both plant PLCs and vendor PLCs.

1.6 APPROACH

.1 As part of the testing process regression testing is to be incorporated into all test plans to demonstrate that any changes made to the software do not impact other areas of the logic. This approach will ensure that corrections/modifications have not adversely affected the previously tested (and debugged) systems and system components.

.2 Testing is to be both progressive and regressive. Progressive testing introduces and tests new functions and uncovers problems in the newly added or modified modules and in their interfaces. Regressive testing concerns the effects of newly introduced changes or system components on all previously integrated (tested) code.

.3 The goal of software testing is to ensure that the system released for use by users meets their requirements, is error-free and does not adversely affect other systems.

1.7 TEST SUCCESS CRITERIA

.1 Test success shall be based on the number of defects and the defect severity levels encountered during the testing period. The City/Consultant at their discretion shall determine to restart a new SAT.

.2 Refer to Section 3 for additional details on defects and their impacts on the testing period.

1.8 COMPLETION CRITERIA

.1 Testing of software is deemed to be complete when all features, functions and information required in accordance with the Process Control Narratives, Process and Instrumentation Drawings, and the complete functionality as described in the contract documents has been verified as present and functioning and documented as accurate within the anticipated operating range for the process being monitored and controlled.

1.9 PARTICIPANTS AND RESPONSIBILITIES

.1 The roles and responsibilities for test planning and testing are summarized below.

.2 SAT & Start-Up Test Planner (Contractor):

.1 Develops the complete SAT & Start-Up test plan

.2 Develops the schedule.

.3 Coordinates all meetings identified in the contract documents to develop and implement the test plan.

.4 Coordinates the involvement of all team members and equipment manufacturers required to be present during testing.

.5 Develops/compiles the test data.

.6 Oversees the test planning and test plan execution of the process control system.

.7 Obtains approval for test plan and schedule from Consultant and City.

.3 Consultant:

.1 Reviews and approves test plan.

.2 Documents test results and classifies defect severity.

.3 Identifies system “design” defects (where the design does not match the specification) and coding defects (where the system does not behave as specified).

.4 Reviews test results.

.5 Assigns Level 1, 2 and 3 faults. Logs action required and taken in the Software Action Log.

.6 Assigns Level 4, 5 and 6 faults. Logs action required and taken in the Software Action Log.

.7 Maintains Software Action Log.

.8 Maintains Deficiency Log related to other trades: electrical, instrumentation, vendor packages, and others.

.9 Presents Change Requests to the City for prioritization.

.10 Schedules approved change request work.

.11 Maintains Change Request Log.

.4 System Integrator:

.1 Responsible for defining the procedure required to complete the SAT & Start-Up tests.

.2 Responsible for directing the SAT and start-up testing and for providing input to the Contractor as to which trades are required to complete the tests identified within the test plan.

.3 Installs and tests all software for functionality as per the detailed process control narrative.

.4 Fixes critical defects.

.5 Documents test results and forwards to the Contractor.

.5 City of Port Colborne's Project Manager:

.1 Coordinate with the City operations staff and Niagara Region (if applicable) to avoid conflicts and minimize impact to operations of construction activities.

.6 City of Port Colborne's Representative:

.1 Participate and assist in the acceptance testing.

.2 Responsible for signing-off on the acceptance testing, on behalf of the City, that the system is fully functional as defined within the detailed process control narrative.

.3 Oversee the integration of the software into the City-wide I&C system.

.4 Responsible for the configuration of the historian.

PART 2 DOCUMENTATION

2.1 GENERAL

.1 Site Acceptance Plan to be developed based on standard City of Port Colborne's SAT templates, if available.

2.2 TESTING SCHEDULE

.1 Testing procedures and schedules of work shall be submitted for review and final approval no less than four (4) weeks prior to the projected test date or as specified elsewhere in the contract documents. This will include specific dates for when the various test procedures are to be carried out, and when City staff assistance is required.

.2 This schedule must be approved in writing by the Consultant and the City's representative prior to commencement.

.3 The Contractor must allow flexibility in their schedule to allow for emergency requests on plant staff as operation of the facility takes precedence over testing.

.4 The completed Site Acceptance Test Report must be presented one (1) week after completion of the SAT in order to identify and resolve all critical issues which affect scope, cost or schedule in a timely manner.

PART 3 EXECUTION

3.1 GENERAL

.1 This part provides an outline of the works to be carried out by the Contractor/Consultant/System Integrator/City of Port Colborne's Project Manager, I&C Group and Operations team as part of the Site Acceptance Test(s).

3.2 TEST SUB-PHASE

.1 The types of software tests (referred to here as test sub-phases) are:

.1 Individual instruments, equipment, and process units: these sub-phases test/verify that devices and their larger system parts (e.g. process units and duty tables) perform as specified.

.2 Intra-system Integration: tests/verifies the interfaces between units and the associated process logic related to multiple units, treatment processes, facility areas, and/or liquids, solids and plant-wide operating strategies.

.3 Function: tests/verifies the functions the program is to perform as set out in the detailed process control narratives.

.4 Performance/Operational: tests/verifies the system's performance under a variety of conditions (normal/abnormal) and verifies these results against the detailed process control narratives. Includes testing of the system's configuration, security, backup/recovery, and reliability in the planned network architecture.

.5 System Wide Integration: tests/verifies the operation of the facility with other sites that are integral to the facility that is being upgraded under this contract. Testing is to include integration and testing on the City-wide I&C system.

3.3 DEFECT HANDLING AND MANAGEMENT CHANGE REQUESTS

.1 During testing, the need for changes to the system will be identified. This will be as a result of a test failure or as a result of an incorrectly specified requirement (test did not fail, but the requirement is incorrectly specified).

.2 For test failures, the defect must be recorded in the SAT test document.

.3 All defects are documented by the System Integrator and Consultant. All defects are to be immediately reviewed and resolved during the SAT period.

.4 The following "Fault Severity Index" is to be used for handling defects.

Defect Severity Level	Defect Description
1.	Fault causes system to crash. System rendered unusable/non-functional.
2.	Fault occurs in a critical function. Function is rendered unusable. A critical function is defined as a function that is required to maintain operation of the facility without manual intervention by the operations team.
3.	Fault occurs in a critical function. A portion of the function is rendered unusable.
4.	Fault occurs in a non-critical function. Function is rendered unusable.
5.	Fault occurs in a non-critical function. A portion of the function is rendered unusable.
6.	Cosmetic (e.g. typo) and would be unlikely to result in loss of confidence by users.

3.4 TESTING CUT-OFF POINTS

.1 Testing cut-off points also need to be established in the test plan and reflected in the testing schedule. Level 1, level 2 and level 3 faults must be corrected as a first priority and testing should not proceed to the next sub-phase until all level 1, 2 and 3 faults are corrected.

3.5 CHANGE REQUEST MANAGEMENT

.1 The Consultant determines the priority for correcting Level 4, 5 and 6 faults in conjunction with the City and prioritizes all Change Requests.

.2 Change Requests are prepared by the Consultant for review with the City. Possible implications of not proceeding should also be identified. The City authorizes the work to be done under any change request. The Contractor schedules change request work based on the project priorities.

3.6 SUCCESSFUL COMPLETION

.1 The SAT is deemed successful when the following items have been completed:

.1 SAT Test plan has been completed and signed-off.

.2 All Level 1, 2 and 3 faults identified during the SAT have been corrected and verified for correct operation.

.2 The completed SAT plan has been reviewed and signed off by the Contractor, System Integrator, Consultant, and the City's Representative.

3.7 FACILITY START-UP PERIOD

.1 Following successful completion of the SAT testing, the facility startup period may commence. Contractor, Consultant, System Integrator and City Operations, as a minimum are to be present during the facility startup period.

.2 Consultant to maintain a log of faults/deficiencies encountered during the facility startup period. The Contractor/System Integrator/Programmer is to immediately correct faults/deficiencies at the request of the Consultant. If any Level 1, 2 or 3 fault occurs during the facility startup period, the test period will be restarted from Day 1 after completion of the software modifications and testing by the System Integrator.

.3 Following completion of the facility startup period, the fault/deficiency log is submitted to the City for review. Sign-off by Contractor, System Integrator, Consultant, and the City are required at the completion of the facility startup period.

END OF SECTION