Part 1 General

1.1 RELATED SECTIONS

.1 Section 01330 – Submittal Procedures

.2 Section 01780 – Closeout Submittals

.3 Section 13991 – Control Panels

.4 Section 16010 – Electrical General Requirements

.5 Section 16122 – Wires and Cables (0 to 1000V)

.6 Section 16133 – Conduits Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

.1 ANSI/ISA-S5.1-1984 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 SUMMARY

.1 Work includes: Engineering, furnishing, installing, set-up, calibrating, adjusting, testing, documenting, and starting up for a complete Process Instrumentation and Control System. Major components include:

.1 Process instrumentation and controls including primary elements, transmitters, control devices, control panels, standby power process and programmable controllers.

.2 Programming of PLCs and HMIs is not included in contract; programming will be by Owner.

.3 Allow for and provide support for programming during commissioning by the Engineer for a minimum of:

.1 Five (5) eight hour days at Laporte Sewage Pump Station.

1.4 INSTRUMENTATION SYSTEMS INTEGRATOR WORK SCOPE

.1 Perform system integration for instrumentation and control equipment and ancillaries required under Division 13 sections:

.1 Required Submittals.

.2 Equipment and ancillaries.

.3 Instructions, details, and recommendations to, and coordination with, Electrical Contractor for verification of proper installation.

.4 Verify readiness for operation.

.5 Verify the correctness of final power and signal connections (lugging and connecting).

.6 Adjusting and calibrating.

.7 Starting up.

.8 Testing and coordination of testing.

.9 Commissioning and coordination of commissioning.

.2 Verify that the following work not completed by the System Integrator has been provided:

.1 Correct type, size and number of signal wires with their raceways.

.2 Correct electrical power circuits and raceways.

.3 Correct size, type and number of instrumentation and control systems related pipes, valves, fittings, and tubes.

.4 Correct size, type materials, and connections of process mechanical piping for in-line primary elements.

.3 For equipment not provided under this section but directly connected to equipment required by this section:

.1 Obtain manufacturers' information on installation, interface, function, and adjustment.

.2 Co-ordinate to allow required interface and operation with instrumentation and control systems.

.3 For operation and control, verify that installations, interfacing signal terminations, and adjustments have been completed in accordance with manufacturer's recommendations.

.4 Test to demonstrate required interface and operation with instrumentation and control systems.

.5 Examples of items in this category, but not limited to:

.1 Pump motor starters in accordance with section 16225.

.2 Natural gas generator in accordance with section 16235.

.4 In addition to the above, provide the following services:

.1 During field construction, review final equipment installation.

.2 During field commissioning of the process equipment and the control and instrumentation equipment, work hand in hand with the other trades people, including the programmer, to facilitate hardware and software commissioning.

.3 Inspect the installation of equipment, which is connected to PLC I/O, supplied under this and other sections, and determine the source of problems, if any. Provide a written report with recommendations for remedial action if equipment is not operating satisfactory or not installed according to manufacturer's instructions.

.5 The System Integrator (SI) will develop a preliminary schedule showing a timeline listing all work components and submit with shop drawing package. The final schedule may be revised with the aid of Engineer. During the project works,

specific targets will be monitored by time/day acceptance by the SI's own project coordinator and major discrepancies must be reported to Engineer.

1.5 INSTRUMENTATION SYSTEM INTEGRATOR QUALIFICATIONS

.1 Perform work of this Section by one of the following:

.1 Capital Controls and Instrumentation Inc, Ottawa (613) 248-1999

.2 SUMMA Engineering Ltd., Mississauga (905) 678-3388

.3 ISI Controls Inc., Brockville (613) 345-1502

.4 Or approved Alternate

1.6 DESIGN REQUIREMENTS

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

.2 The Systems Integrator is responsible for gaining a comprehensive understanding of the process equipment and the control equipment. The Systems Integrator must coordinate with other trades to ensure all aspects of instrumentation and control wiring and hardware are compatible with the process itself, and associated equipment (after optimum tuning and adjusting of mechanical, electrical, and instrumentation equipment).

.3 General Design Requirements for Control Logic, Control Panels and Wiring Diagrams

.1 Design the Control Panels shown on the Tender Drawings and as per these specifications.

.2 Comply with manufacturers' instructions.

.4 Completion of Detailed Design

.1 Instrumentation and control systems design as shown and specified includes:

.1 Functional requirements, performance requirements, generalized component specifications.

.2 Typical drawings for installation details, control panel layouts, control panel schedules, PLC I/O module wiring, panel power, and control diagrams.

.3 System Integrator is to complete detailed design of instrumentation and control system components and detailed design of instrumentation and control system drawings.

1.7 SUBMITTALS

.1 Submit shop drawings in conformance with Section 01330.

.2 Prepare shop drawing submission to include the following information:

.1 Process instrumentation and controls including primary sensing elements, transmitters, control devices, control panels, and programmable controllers.

.3 Not later than eight (8) weeks before commencement of work, submit in accordance with Section 01330 the following:

.1 Instrument and control panel layout drawings

.4 Not later than 4 weeks prior commencement of work, submit in accordance with Section 01330 the following:

.1 Instrument data sheets for all instruments and equipment installed under this contract.

.2 Descriptive literature.

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

.5 Not later than 4 weeks prior to Site Acceptance Testing, submit detailed Instrumentation and Control Commissioning Plan, including:

.1 Proposed Input / Output loop test sheets.

.2 Updated wiring schedules based on Loop drawings all wiring and labeling for use by the Electrical Contractor.

.3 Detailed list of field determined ranges, set-points and logic states for all new and new equipment and sub-components interfacing with the new PLC.

.6 Prior to the Commissioning, submit in conformance with Section 01780:

.1 Final, as-constructed instrument loop diagrams.

.2 Final, as-constructed data sheets.

.3 Maintenance manuals.

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

.5 I/O Loop Test Report. A sample I/O Loop Test Report is included at the end of the Section.

.6 Instrument Calibration Sheets. A sample instrument calibration sheet is included at the end of this Section.

.7 Instrument Loop Check Sheets. A sample loop check sheet is included at the end of this Section

1.8 SITE CONDITIONS

.1 Available main power will be nominal 120 VAC, Utility supply.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Provide field and warehouse storage facilities for all instrumentation and control systems equipment.

.2 Prior to shipment, include corrosive-inhibitive vapour capsules in fabricated panels.

.3 Prior to installation, store items in dry indoor locations. Provide heating in storage areas for items subject to corrosion under damp conditions.

.4 Cover panels and other elements that are exposed to dusty construction environments.

1.10 MAINTENANCE SERVICES

.1 During the specified warranty period, supply service during normal working hours, 7 days per week. Respond to service calls within 4 hours or by 9:00 a.m. of the day following the call, whichever is sooner, and remain on-site until the problem has been defined, located and repaired.

.2 For each service call submit a report giving the following information:

.1 Part numbers, description and cost of items replaced.

.2 Name of Owner's technician present during service.

1.11 WARRANTY

.1 Warrant all supplied hardware and software from the date of substantial completion to one year following award of Contract Substantial completion. This is in addition to the manufacturer's supplied one year warranty

Part 2 Products

2.1 GENERAL

.1 Unless otherwise noted, supply instruments having linear, 4-20 mA, live-zero, isolated output signals. Where instruments do not have isolated outputs, provide DIN-rail mounted signal isolators.

.2 Unless otherwise noted, supply field-mounted instruments with CSA 4X housings.

.3 Supply field-mounted indicators calibrated in engineering units.

2.2 MANUFACTURED UNITS

.1 Ultrasonic Level Transmitters

.1 General: Integral temperature compensation

.2 Power: 100-230 VAC, 60 Hz power

.3 Performance:

.1 Range: 0.3 - 15 m

.2 Accuracy: 0.25% of maximum range

.3 Resolution: 0.15% of maximum range

.4 Single measuring point software

.5 CSA, General purpose

.4 Inputs/Outputs:

.1 Two isolated 4-20 mA analog output signals proportional to level

.2 Six 5A, 250 VAC rated relay outputs - 4 Form 'A', 2 Form 'C'

.3 Two 0-50 VDC Discrete inputs

.5 Transmitter:

.1 Wall mounted inside CP-01 panel, IP65 / CSA 4X Polycarbonate housing

.2 1/2" NPT cable entry

.3 Four line, back-lit LCD display

.6 Transducer:

.1 1" NPT mounting, Teflon facing, Kynar Enclosure suitable for CLASS 1, DIV. 1, Group C & D environment.

.2 Transducer cable: Per Manufacturer recommendations, minimum supplied length of 15 m.

.3 Mounting hardware: Refer to contract drawings for details.

.7 Manufacture:

.1 Siemens Model: MultiRanger 100 with Echomax XPS-15 Transducer, or approved alternate

.2 Additional Items to be supplied with each unit:

.3 Printed English Instruction Manuals

.4 Calibrator model: A5E36563512

.8 Schedule:

TAG	SERVICE
PSLIT01	Laporte Wet Well Primary Level Indication - Actual

.2 Laser Level Transmitter

.1 General:

.1 Function: measure water level and transmit current signal proportional to level.

.2 Type: continuous, non-contact, single point radar level measurement, four-wire HART transmitter, heated optics window with 24VDC power.

.3 Measurement range: 0.3 – 30m

.2 Service: liquid.

.3 Transducer:

.1 Integral to transmitter housing.

.2 Laser wavelength: 905nm, eye safe, class 1

.3 Laser beam divergence: < 0.3^0

.4 Tempered borosilicate glass with heated optics window.

.5 Process fitting – ASME DN 50 (2") flat-face flange.

.6 Wetted parts – flange 316L SST, borosilicate window, silicone O-ring (Type B).

.4 Transmitter:

.1 Power:

.1 15.5 to 30 V DC maximum (21 to 30 V DC for HART) for analog instrument loop.

.2 24 VDC, 3W power for lens heater

.2 Enclosure:

.1 316L stainless steel (SST) housing

.2 Remote mounted

.3 Degree of Protection: IP66/IP67/NEMA 4X

.4 15 mm (1/2") NPT cable entry

.5 Provide cable glands for cable entry

.5 Inputs/Outputs:

.1 Analog: 4 to 20 mA, NAMUR compliant

.2 Digital: HART 7 (multi-variable output)

.3 Communication: Local HMI, EDD/DTM, handheld

.6 Electronics & Display:

.1 Integrated 128 × 64 pixels LCD display with through-the-glass (TTG) interface

.2 Software features:

.1 Volume computation, damping, filtering, thresholds/alarms, user-defined display (with HMI)

.3 Menu guided, plain text operation

.7 Performance:

.1 Accuracy: 11 mm (0.4 in) (typical)

.2 Resolution: 5 mm (0.2 in)

.8 Approvals:

.1 cFM, Class 1, Division 1, Groups A, B, C, D, explosion proof.

.9 Manufacturer:

.1 ABB, LLT100 series, or approved equal.

.10 Schedule:

TAG	SERVICE
PSLIT02	Laporte Wet Well Backup Level Indication - Actual

.3 Forcemain Pressure Transmitter

.1 General: In-line gage transmitter for detecting forcemain pressure

.2 Input voltage: 10.5 to 42.4 VDC, (24 VDC typical, 800 Ω load)

.3 Output: 4-20 mA with digital signal based on HART protocol.

.4 Minimum 250 Ω loop resistance for communication.

.5 Pressure range: 0 to 200kPa

.6 Reference accuracy: +/- 0.025% of span

.7 Isolating Diaphragm: SST

.8 Housing Material: SST

.9 Operating temperature range: -40 to 85 °C

.10 Electrical connection: ½-14 NPT (M)

.11 Process connections: ½-14 NPT female

.12 Electrical approvals: FM Class 1 Zone 1 Hazardous Location

.13 Intrinsically safe barrier as per RPU panel drawing.

.14 Manufacturer:

.1 SOR 815PT Pressure Transmitter, or approved alternate.

.15 Schedule:

TAG	SERVICE
PSPIT01	Laporte Forcemain Discharge Pressure Indication - Actual

.4 Temperature Transmitter

.1 General:

.1 Function: Measure the Station ambient air temperature and transmit analog signal proportional to temperature.

.2 Type: RTD.

.3 Parts: Element, thermowell, and transmitter.

.2 Sensing Element:

.1 Type: 1000ohm Platinum RTD

.2 Accuracy: +/- 0.1% of span

.3 Accuracy:

.4 PtRTD: =/- 0.1% @ 0°C

.5 Averaging: +/- 1°C @ 21.11°C

.6 Zero and span adjustment: Non-interacting

.7 Operating Temperature: -45 to 190°C, factory calibrated to a range of

.8 -40 to +40°C

.3 Transmitter:

.1 Ambient Operation Conditions:

.2 Temperature: 0 to 70 °C

.3 Relative Humidity: 0 to 100 percent, non-condensing.

.4 Electrical Safety: CSA

.5 Signal Interface: 4 to 20 mA DC

.6 Power: 24 VDC external power supply

.7 Enclosure: Wall Mounted

.4 Manufacture:

.1 TCS Basys Controls Model TCS/1000-T3R, or approved alternate.

.5 Schedule:

TAG	RANGE	DESCRIPTION/ SERVICE
PSTIT01	-10 – +40°C	Laporte CP-01 Panel Temperature Transmitter
PSTIT02	-10 – +40°C	Laporte UPS Panel Temperature Transmitter
PSTIT03	-10 – +40°C	Laporte Power Distribution Kiosk Temperature Transmitter

.5 Security Key Switch

.1 General:

.1 Function: Provide station legal entry indication when the key is inserted into the switch and turned.

.2 Type:

.1 Click-on/Click-off industrial type key-operated switch complete with a 24VDC rated normally open contact. SPDT N/O, N/C maintained.

.2 The lock barrel shall conform to the City of Ottawa Waste Water Division keying requirements. Girard’s Lock and Key, Ottawa, Ontario.

.3 Mounting: The key-operated switch is to be complete with NEMA 12 Enclosure, c/w visual 24VDC red LED state indication.

.3 Manufacturer:

.1 W.W.C. Alarm Box Key Switch System, no alternates.

.2 Camden CM-1030-7024 Switch Box.

TAG	DESCRIPTION/ SERVICE
PSKEY01	Laporte CP-01 Panel Legal Entry Key Switch

.6 Magnetic Door Contacts

.1 General:

.1 Function: Provide station Illegal entry indication when the Door contact unlatches.

.2 Type: Industrial Wide Gap surface Mount Magnetic door Contact c/w stainless steel armoured cable lead.

.2 Manufacturer: GE Model 2507A, or approved alternate.

.3 Schedule:

TAG	DESCRIPTION/ SERVICE
PSZS01	Laporte CP-01 Panel Door Contact
PSZS02	Laporte Generator Sound Enclosure
PSZS03	Laporte Power Distribution Kiosk
PSZS04	Laporte UPS Control Panel
PSZS05	Laporte PSRSP01 Soft Starter
PSZS06	Laporte PSRSP02 Soft Starter

.7 Uninterruptable Power Supply (UPS)

.1 General:

.1 True online, double conversion.

.2 Capable of performing a full system test on power up.

.3 Automatic restart after battery depletion.

.4 Bypass to utility on overload or UPS failure in less than 4 ms.

.5 Overload capacity to be 125 percent for 10 minutes.

.6 Relay interface for UPS alarm reporting to SCADA.

.7 Form factor: Tower

.2 Input power:

.1 Single phase, 120 VAC, 60 Hz

.2 Input voltage range: 100 – 138 V AC (full load)

.3 One (1) NEMA L5-20P input plug, c/w cord set

.4 Emergency supply: from internal and additional external batteries.

.5 Input protection to be fuse or circuit breaker

.3 Output power:

.1 Single phase, 120 V AC, grounded neutral, 60 Hz.

.2 Six (6) NEMA 5-20R output receptacles

.3 Full load output (see Schedule) at 0.9 power factor lagging

.4 Utility Voltage control to within 2 percent of nominal voltage.

.5 On battery output voltage control to within 3 percent of nominal voltage

.6 Output waveform to be sinusoidal

.7 Efficiency: Overall system efficiency not less than 85 percent

.4 Internal Battery:

.1 Type: Sealed, lead-acid; maintenance free

.2 Battery Replacement: Hot-swappable internal and external batteries

.3 Recharge Time: less than four (4) hours to 90 percent capacity

.5 External Battery(s):

.1 Standalone Extended Battery Modules (EBM)

.2 Form factor: Tower

.3 Type: Sealed, lead-acid; maintenance free

.4 Battery Replacement: Hot-swappable internal and external batteries

.5 Recharge Time: less than four (4) hours to 90 percent capacity

.6 Required Accessories

.1 Provide one industrial relay card for each UPS supplied.

.2 Relay card to provide the following dry contact signals for remote status monitoring:

.1 UPS Line Failure

.2 UPS Battery Low

.3 UPS General Alarm

.4 UPS on Bypass

.5 UPS on Battery

.3 Relay Contact type and rating: SPDT, 250 V AC / 30 V DC at 5 Amps (minimum).

.4 Provide all necessary adapters and cabling as required to connect UPS relay card signals to RPU.

.5 Provide all necessary accessories and cabling as required to connect EBMs to each UPS.

.7 Start Up and Commissioning:

.1 Provide start up and commissioning material and services, complete with a commissioning report, for all UPS monitoring equipment. This commissioning service must be performed by a qualified factory trained manufacturer's representative. This representative must also provide on-site training for owner/operator separate from the time of commissioning.

.8 Manufacturers:

.1 UPS:

.1 Eaton 9SX series, part number: 9SX2000

.2 Quantity: See Schedule

.2 Extended Battery Module (EBM):

.1 Eaton 9SX (2000 VA), part number: 9SXEBM48

.2 Quantity: See Schedule

.3 Relay Card:

.1 Eaton Industrial Relay Card-MS, part number: INDRELAY-MS

.2 Quantity: One (1) for each supplied UPS

.9 Schedule

TAG	DESCRIPTION/ SERVICE
PSUPS01	Laporte 2000VA UPS c/w 2 EBMs

.8 Wet Well Float Switch

.1 General:

.1 Function: Actuate contact at preset liquid level.

.2 Type: Direct-acting float with enclosed Mercury-free switch and integral cable.

.3 No splices in cable from float, except where otherwise indicated.

.4 Cable length and float levels to be determined by SI. Minimum length: 50 meter.

.5 Service: Liquid, as noted.

.2 Performance:

.1 Setpoint: As required.

.2 Differential: 100 mm maximum.

.3 Temperature: 0 to 60 °C.

.3 Features:

.1 Entire Assembly: Watertight and impact-resistant.

.2 Float Material and Size: Polypropylene body; 115 mm diameter and 150 mm length.

.4 Cable:

.1 Combination support and signal.

.2 Length required per mounting requirements.

.3 PVC Type STO, two No. 18 AWG conductors.

.4 Potted cable at float.

.5 Signal Interface:

.1 Switch Type: Mercury-free tilt.

.2 Switch Contacts: Isolated, rated 4.5 A continuous at 120 V AC.

.3 Form C-type contact (1 NC).

.6 Accessories:

.1 Provide a Type 4X junction box suitable for a minimum of four (4) level switches and ground lug for all switch installations. Junction box to be complete with water-proof splice connections (10 minimum) for level switch and outgoing cable termination.

.2 Anti-sway / tipping rings. Minimum 2 per float.

.3 Cable support and level adjustment bracket. Minimum 1 per float.

.7 Manufacturers and Products:

.1 Xylem ENM-10 Level Regulator

.8 Schedule:

TAG	DESCRIPTION / SERVICE
PSLS001	Wet Well Float Switch 1 / RSP01 Emergency Start
PSLS002	Wet Well Float Switch 2 / RSP02 Emergency Start

.9 Lamacoid Labels

.1 Provide lamacoid labels for each device listed under the loop diagram list.

.2 Lamacoids shall be black face, white lettering.

Part 3 Execution

3.1 GENERAL

.1 Locate field-mounted instruments, enclosures, panels and junction boxes as to avoid sources of leakage and spillage.

.2 Locate field-mounted indicators so that they are clearly visible from normal walkways.

.3 Protect each instrument circuit by means of a panel-mounted, terminal block-type, overcurrent-interrupting device.

.4 Field wiring requirements by Electrical Contractor in accordance with Section 16122 – Wires and Cables (0-1000V).

.5 Conduit requirements by Electrical Contractor in accordance with Section 16133 – Conduits Conduit Fastenings and Conduit Fittings.

.6 For each device, follow the manufacturer's instructions for installation and connection.

3.2 EXAMINATION

.1 Before proceeding with the work, report construction defects which will affect the work of this Section. Proceed only when defects have been corrected.

.2 Equipment furnished by System Integrator and installed by Contractor, requires System Integrator to observe and advise on installation to extent required to certify that equipment has been properly installed and will perform as required.

.3 For equipment not provided by System Integrator, but that directly interfaces with the instrumentation and control systems, verify the following conditions:

.1 Proper installation.

.2 Correct control action.

.3 Switch settings and dead bands.

.4 Opening and closing speeds, and travel stops.

.5 Input and output signals.

3.3 MANUFACTURER’S SERVICES

.1 Specialty Equipment: For following equipment provide the services of qualified personnel, on the staff of the manufacturer, during commissioning, for inspection, calibration, tuning. Provide original equipment manufacturer’s services for:

.1 Ultrasonic Level Transmitter.

.2 Laser Level Transmitter.

3.4 INSTALLATION

.1 Install instrumentation, control devices, and accessories necessary for the operation of the system.

.2 For each device, follow the manufacturers' instructions for installation and connection. Meet all grounding, power supply, and piping requirements.

.3 Provide identification tags with punched markings for each field-mounted device. Permanently attach the tags to the devices with stainless steel lightweight chain.

.4 Install per manufacturer's recommendations.

.5 All instrument AC supply circuits are to be fed from dedicated instrument breakers within the PLC Control panel at which the instruments control signals are also terminated. Size breaker in accordance with the manufacturer’s recommendations.

3.5 ULTRASONIC LEVEL TRANSDUCERS

.1 Mount transducers to avoid interference of ultrasonic beam with walls, pipes, conduits, ladders, floats, cables and objects other the liquid surface to be measured.

.2 Mount transducer face a minimum of 300 mm above the highest liquid level to be measured.

.3 Provide aluminum support arms and stiffeners for non-flange mounted transducers and non-pendant mounted transducers.

.4 Install in accordance with manufacturer’s installation instructions to comply with installations in Class 1, Zone 1, Gas Group IIA hazardous locations.

3.6 INSTALLATION OF PROCESS CONNECTIONS

.1 All direct measuring devices (transmitters, switches, indicators, etc.) shall be mounted as close as practicable to the measurement points unless indicated otherwise.

3.7 PLC I/O

.1 Refer to and comply with Section 13991 – Control Panels.

.2 For each device, follow the manufacturer's instruction for installation, calibration and connection. Wire all inputs and outputs via control panel terminal blocks.

.3 Provide “common” wire connections to suit particular I/O modules.

.4 City staff shall be present during modifications to existing PLC control panels, including drilling or cutting of enclosures, and termination of field wiring to an active PLC.

3.8 COMMISSIONING AND FIELD QUALITY CONTROL

.1 Tune the complete system as a whole.

.2 Coordinate and modify the system hardware and software components for continuous reliable operation of equipment and system features.

.3 Calibrate instruments on site. Follow the standards of calibration prescribed by the manufacturer of each instrument. Any values provided within the contract documents suggest factory calibrated process ranges for the transmitters, the indicators or indicating controllers, and adjustable ranges/setpoints for the switches etc. Final equipment calibration ranges, scales and setpoints etc. shall be field verified by the Contractor. Contractor is to recalibrate equipment on-site to suit required field installation conditions.

.4 Engage manufacturers' representatives to inspect equipment installation and to supervise the control system start-up.

.5 Test and adjust each device and verify its operation in conjunction with related equipment in the same control loop and in the overall system.

.6 Provide the necessary manpower and test equipment to perform tests and demonstrations.

.7 Perform tests and demonstrations as soon as possible after each section of the system is programmed and mechanically and electrically complete.

.8 Correct any deficiencies detected and schedule a new time for continuing the tests.

.9 Maintain in operation all equipment included in this Contract from the time they are installed and placed into operation.

.10 Calibrate instruments on site. Follow the standards of calibration prescribed by the manufacturer of each instrument.

.11 The Engineer may request to be present while recording calibration data on Instrument Calibration Sheets.

.12 The Engineer and Owner may request to be present while recording loop data on Instrument Loop Check Sheets.

.13 Supply and use calibration equipment at least three times as accurate as the instrument being calibrated. Submit certified calibration equipment test data for approval by the Engineer. Only test equipment certified in the calendar year of its use are acceptable.

.14 Test and adjust each device and verify its operation in conjunction with related equipment in the same control loop and in the overall system.

.15 Ensure that wires connecting field- and panel-mounted equipment to PLC to input and output modules are correctly terminated.

.1 For all input and output points, perform a complete continuity test including intermediate terminations.

.2 For digital input points, separately test the operation of each signal-generating device.

.3 For digital output points, separately test the operation of each signal-receiving device.

.4 For analog input points, separately test the operation of each signal-transmitting device.

.5 For analog output points, separately test the operation of each controlled device.

.6 For RTD input points, separately test the operation and temperature range of each RTD device

.7 Provide a detailed list of field determined ranges, setpoints and logic states for all new and modified equipment and sub-components interfacing with the various PLC's.

.16 At least four (4) weeks before Site Acceptance Testing, submit three copies of a formal I/O Loop Test Report to the Engineer to review. A sample form is included with this Section.

.17 Complete the first 3 columns of the I/O Loop Test Report using Microsoft Excel, Version 2010 or higher.

.18 Treat the submission of the I/O Loop Test Report as an assurance that wiring, connections and terminations have been thoroughly checked.

3.9 SITE ACCEPTANCE TESTS (SAT)

.1 Perform Site Acceptance tests for the following:

.1 Instrumentation and Control elements, as listed below.

.2 Test Instrumentation and Control Systems elements, both hardware and software, to demonstrate that instrumentation and control systems satisfies requirements. Demonstrate the accuracy and functional ability of each device, each monitoring and control loop, and the overall system.

.3 Test Format: Cause and Effect.

.1 Person conducting test initiates an input (cause).

.2 Specific test requirement is satisfied if correct result (effect), occurs.

.4 Procedures, Forms, and Checklists:

.1 Conduct tests in accordance with, and documented on, Engineer accepted procedures, forms and checklists.

.2 Describe each test item to be performed.

.3 Have space after each test item description for sign off by appropriate party after satisfactory completion.

.5 Conducting Tests:

.1 Special testing materials and equipment.

.2 Wherever possible, perform tests using actual process variables, equipment, and data.

.3 If not practical to test with real process variables, equipment, and data, provide suitable means of simulation.

.4 Define simulation techniques in test procedures.

.6 Test Requirements:

.1 Conduct the tests when the installation and calibration of instruments has been completed, and equipment has been thoroughly tested, and the I/O loop test reports have been submitted.

.2 Perform a witnessed SAT on the complete system to demonstrate that it is operating as required. Demonstrate each required function on a loop-by-loop basis.

.3 Perform local and manual tests for each loop before proceeding to remote and automatic modes.

.4 Demonstrate that the systems function as specified under each mode and set of conditions which are possible for the instrumentation, control equipment, process, process equipment and plant.

.5 If not practical to test with real process variables, equipment, and data, provide suitable means of simulation.

.6 Define simulation techniques in test procedures.

.7 For subsystems for which Engineer provides applications software, provide sufficient temporary software configuring to allow operational readiness testing of test subsystems.

.8 Where possible, verify results using visual confirmation of process equipment and actual process variable. Unless otherwise directed, exercise and observe devices supplied by others, as needed to verify correct signals to and from such devices and to confirm overall system functionality. Test verification by means of disconnecting wires or measuring signal levels is acceptable only where direct operation of plant equipment is not possible.

.9 Make updated versions of documentation required for SAT available Engineer at site, both before and during tests.

.10 Make one copy of O&M manuals available to Engineer at the site both before and during testing.

.7 Co-ordinate Instrumentation and Control systems site acceptance testing with Owner/Engineer, affected Subcontractors and any Owner's pre-purchased equipment suppliers.

.8 Owner and Engineer will actively participate in many of the tests.

.9 Engineer reserves right to test or retest all specified functions whether or not explicitly stated within test procedures. The Engineer's decision will be final regarding acceptability and completeness of all testing.

3.10 CLEANING

.1 Prior to closing system using tubing, clear all tubing of interior moisture and debris.

.2 Clean all interior and exterior surfaces of control panels and field enclosures.

.3 Clean all exterior surfaces and terminal compartment of instruments.

3.11 TRAINING & DEMONSTRATION

.1 Demonstrate the accuracy and functional ability of each device, each monitoring and control loop, and the overall system.

.2 Provide factory trained technicians to demonstrate the maintenance and trouble-shooting procedures developed and prescribed by the manufacturer of each type of device and instrument. Provide a minimum of 4 hours on-site training for each unique type and model of instrument, i.e., Level Transmitters, Temperature.

3.12 SUPPLEMENTS

.1 Supplements listed below, follow "End of Section" and are part of this section. This includes the following:

.1 Sample I/O Loop Test Report.

.2 Sample Instrument Calibration Sheet.

.3 Sample Instrument Loop Check Sheet.

END OF SECTION

SECTION 13000
SUPPLEMENT 1

I/O LOOP TEST REPORT

CONTRACTOR: CLIENT: City of Ottawa PROJECT:		PAGE: 1 OF X DATE: PANEL:		
		TEST RESULT		
ADDRESS	DESCRIPTION	PASS	FAIL	COMMENTS
0:02/00				
0:02/01				
0:02/02				
0:02/03				
0:02/04				
0:02/05				
0:02/06				
0:02/07				
0:02/08				
0:02/09				
0:02/10				
0:02/11				
0:02/12				
0:02/13				
0:02/14				
0:02/15				
0:02/16				
0:02/17				
0:02/18				
0:02/19				
0:02/20				
0:02/21				
0:02/22				
0:02/23				
0:02/24				
0:02/25				
0:02/26				
0:02/27				
0:02/28				
0:02/29				
0:02/30				
0:02/31				

CHECKED BY:_____ SIGNED:_____ DATE:_____

WITNESSED BY:_____ SIGNED:_____ DATE:_____

ACCEPTED BY:_____ SIGNED:_____ DATE:_____

SECTION 13000
SUPPLEMENT 2

INSTRUMENT CALIBRATION SHEET CONTRACT NO. _____

CLIENT _____

PROJECT _____

LOCATION: _____

TAG NUMBER: _____

MANUFACTURER: _____

MODEL NUMBER: _____

SERIAL NO. _____

PROCESS SERVICE: _____

INPUT	OUTPUT
0.0% _____	_____
25.0% _____	_____
50.0% _____	_____
75.0% _____	_____
100.0% _____	_____

CALIBRATION EQUIPMENT USED: _____

_____

NOTES: _____

_____

TECHNICIAN: _____ DATE: _____

COMPANY: _____

WITNESS: _____ DATE: _____

COMPANY: _____

SECTION 13000
SUPPLEMENT 3

INSTRUMENT LOOP CHECK SHEET CONTRACT NO. _____

CLIENT _____

PROJECT _____

LOCATION _____ DWG. _____

DESIGN AREA _____ LOOP _____

DATA SHEETS COMPLETED: YES [ ] NO [ ]

INSTALLATION APPROVED [ ] CONTINUITY TEST [ ]

POWER TEST [ ] LEAK TEST [ ] VALVE STROKED [ ]

CONTROLLER SET TO: _____ ACTION

_____ GAIN / P.B.

_____ INTEGRAL

_____ DERIVATIVE

INTERLOCKS: _____

_____

LOOP LEFT FUNCTIONAL: YES [ ] NO [ ]

NOTES: _____

_____

_____

TECHNICIAN: _____ DATE: _____

COMPANY: _____

WITNESS: _____ DATE: _____

COMPANY: _____

Part 1 General

1.1 GENERAL

.1 All conditions of the contract apply to the work of this section.

.2 Section 13520 is a functional specification. The Contractor is to provide all the devices necessary to meet the intent of this specification and to ensure a fully functional wide area network that meets the performance requirements specified herein.

1.2 RELATED SECTIONS

.1 Section 01330 – Submittal Procedures.

.2 Section 01780 – Closeout Submittals.

.3 Section 01810 - Commissioning

.4 Section 13000 – Instrumentation and Control

.5 Section 13521 – Structure Communication System

.6 Section 16010 – Electrical General Requirements

1.3 TECHNICAL DEFINITIONS

.1 Cell: The area of radio range or coverage in which the wireless devices can communicate with the cell master. The size of the cell depends upon the speed of the transmission, the type of antenna used, and the physical environment, as well as other factors. Within this document a cell refers to a cell master linked with a number of subscriber sites in a spoke-and-hub configuration.

.2 Hub: The hub is the geographical and radio centre of the cell and that houses the cell master/s and is linked to the Pickard Centre via a backhaul.

.3 Cell Master: Also referred to as a base station, the cell master is located at the hub and is linked to multiple subscriber sites within a cell. Typically the cell master utilises an omni-directional antenna that radiates 360 degrees enabling it to see all subscriber sites within the cell. The cell master arbitrates access to media within the cell with a RTS/CTS handshake.

.4 Subscriber: A subscriber is a radio that is a member of the cell but is not the cell master. To transmit data a subscriber must request permission to transmit from the cell master.

.5 Backhaul: A backhaul is a network link connecting a cell master or masters with a central facility local area network. Typically a cell backhaul is a high bandwidth landline or wireless point-to-point link.

.6 Backbone: The backbone is the highest level of the network and links the geographically distributed cells with a centralised LAN.

.7 Repeater: A repeater site relays data between one or more subscriber sites and a cell master. Repeater sites are typically used when a subscriber site cannot directly reach a cell master. Repeater sites can have one or more antennas.

1.4 SCOPE OF WORK DEFINITIONS

.1 The following terms are used in this specification and related tender drawings to describe the scope of work associated with various devices. The terms shall have the following definitions in this context:

.1 Abandon: Abandon and make safe all process and electrical connections. Make pertaining process and electrical systems work safely after disconnection of abandoned item(s).

.2 Free-issue: Equipment or services supplied by the City for incorporation into the Contract by the Contractor.

.3 Reasonably to Scale (RTS): Dimensions shown are approximate only. Contractor is to field verify the dimensions prior to starting work.

.4 Provide: Supply the named device or equipment and all necessary appurtenances, install, test and commission. Unless otherwise noted, the device or equipment supplied and all appurtenances shall be new.

.5 Remove: Abandon and make safe all process and electrical connections, remove the item and mend the void space/process to its intended function.

.6 Replace: Verify that replacement material fits the replaced item and provide adapters as required, abandon and make safe all process and electrical connections, remove the item, supply and install new item with required adapters, make pertaining process and electrical systems work safely after replacing item(s).

.7 Re-wire: Abandon electrical connections to existing and install new wiring and conduit to new destination, as indicated.

.8 City: Refers to the designated City Staff or City Representative.

.9 Consultant: The term Consultant is used interchangeably with the term Contract Administrator and has the same meaning.

1.5 REFERENCES

.1 The Contractor is to conform to all references identified in this section where applicable. Unless otherwise specified, all references are the latest published editions as of the time of tender.

.1 Conform to all applicable sections of the Ontario Electrical Safety Code.

.2 Conform to CSA S37-01 Antennas, Towers and Antenna-Supporting Structures for tower manufacture and installation.

.3 Conform to TIA/EIA-195C, “Electrical and Mechanical Characteristics for Terrestrial Microwave Relay System Antennas and Passive Reflectors”.

.4 Conform to Ontario Provincial Standard Specification, Construction Specification for Pole Erection (OPSS 615).

.5 Conform to Ontario Electrical Safety Authority, Section 75-242 “Setting of Poles” and Specifications 6, 7, and 8.

.6 Conform to all sections of Industry Canada regulation RSS-210 “Low Power Licence-Exempt Radiocommunication Devices” that pertain to the outdoor application of the following unlicensed frequency ranges: 902 to 928 MHz and 2400 to 2483.5 MHz

.7 Conform to the IEEE 802.11b standard for all 2.4 GHz intra-cell radio links.

.8 Where copper or fibre optic Ethernet cabling is installed, conform to the following standards:

.1 TIA/EIA-568-B, Telecommunications Cabling Standard. All standards referenced within the TIA/EIA-568-B standard, where applicable, constitute standard provisions of this specification.

.2 TIA/EIA-526-14-A: Optical Power Loss Measurement, Multimode.

.3 Ontario Electrical Safety Code, Section 56 – Optical Fibre Cables.

.4 Ontario Electrical Safety Code, Section 60 – Communication.

.5 TIA/EIA-606: Administrative Standard for Telecommunications.

.6 TIA/EIA-607: Commercial Building Grouding and Bonding Requirements for Telecommunications – October 2002.

1.6 SITES

.1 2.4 GHz Subscriber Sites

.1 The following sites are existing 2.4 GHz Subscriber sites included in this scope of work:

No.	CELL	SITE	ADDRESS
1		Laporte PS	1056 Laporte Street Ottawa, ON K1J 7B4

.2 Backhaul Site

.1 The 10/100BASE-F backhauls (LAN extension service) programmed at the hub sites by the Telecom Service Provider terminate in the Computer Room within the Operations Building.

Robert O Pickard Environmental Centre	800 Green Creek Drive Gloucester, On, K1J 1A6

1.7 SCOPE OF WORK

.1 The work to be done under this Contract includes, but is not limited to, the supply of materials, labour, equipment, permits, etc. necessary for the complete construction of the works shown on the Tender drawings and as specified herein. The following is a general, but not necessarily complete, description of the work to be done:

.1 Existing utility pole for mounting the 2.4 GHz parabolic antenna, at the Laporte subscriber site, to remain.

.2 Existing 2.4 GHz parabolic antenna, antenna mount, and appurtenances at the Laporte subscriber site to remain.

.3 Existing communications equipment including 2.4GHz Wireless Bridge at the Laporte subscriber site, to remain and be relocated as per the contract drawings.

.4 Remove existing transmission cabling between the existing antenna and 2.4GHz Wireless Bridge at the Laporte subscriber site.

.5 Provide new transmission cabling between the existing antenna and 2.4GHz Wireless Bridge at the Laporte subscriber sites.

.6 Provide Radio Network Testing.

.2 The work to be done under this Section shall be completed by a City approved radio network installer.

.1 RCOMM Radio Inc.,

.2 or approved alternate.

1.8 RADIO LINK PERFORMANCE REQUIREMENTS

.1 The radio links provided by the Contractor will meet the following minimum radio link performance requirements:

.1 Provide a signal fade margin for each radio link that ensures one way annual availability of 99.995 percent or greater. At the City's discretion, lower link availability may be accepted. Under no circumstances will a one way annual availability or worst month availability be accepted that is less than 99.95 percent.

.2 The Effective Isotropic Radiated Power (EIRP) of all links will comply with Industry Canada, Radio Standard Specification RSS-210, for *Low Power License Exempt Radio Communication Devices* and all amendments.

.3 The minimum data rate for 2.4 GHz point-to-multipoint links will be 2 Mbps at a Bit Error Rate (BER) of 10^{-6}.

.4 For some radio links it may not be feasible to meet the performance requirements specified due to environmental constraints. The City places a higher priority on the reliability of the link than the data rate. Compliance with Industry Canada regulations is mandatory. The determination of feasibility with respect to meeting the performance requirements will be at the sole discretion of the City.

.5 The wireless Ethernet network constructed will comply with the IEEE 802.11b standard, unless otherwise noted or agreed.

.6 These standards utilise frequency bands that are regulated but not licensed by Industry Canada. It is understood by the City that at anytime during construction or after contract completion that interference from another radiation source, operating in the same frequencies, may effect the operation or performance of any wireless link in the network. If it was reasonable for the Contractor to have identified the interfering source during the pre-construction or construction phase of the contract, the Contractor will be required to take the necessary steps to eliminate or mitigate the interference.

1.9 SUBMITTALS

.1 Comply with the requirements of Section 01330 – Submittal Procedures. Section 13520 shall take precedence where there is a contradiction with Section 01330.

.2 All Shop and Record drawings submitted by the Contractor will comply with the City's CAD standards and shall be generated in AutoCAD 2014. All drawings will be formatted for and submitted on 279 mm (11") x 432 mm (17") paper.

.3 Submit the following documentation two (2) weeks prior Site Acceptance Testing: test plan, test sheets, Working Drawings, As-built drawings.

.4 Submit the Network Operations and Maintenance Manual, in compliance with Section 01780, within two (2) weeks following the completed Site Acceptance Test.

.5 Submit Link Acceptance Test (LAT) plan and test sheets two (2) weeks prior to Link Acceptance Testing. Include a description of any proposed network testing tools (software or hardware) required to meet the intent of the LAT.

.6 Submit Network Acceptance Test (NAT) plan and test sheets two (2) weeks prior to Network Acceptance Testing. Include a description of any proposed network testing tools (software or hardware) required to meet the intent of the NAT.

.7 Submit WAN construction schedule within seven (7) calendar days following the contract kick-off meeting.

.8 Supply the City with three (3) hardcopies and electronic versions on memory stick of each submittal. CAD files will be in Autocad v2014 format and configuration files will be in plain text. Pictures will be in jpeg format. All other electronic versions will be in PDF format.

Part 2 Products

2.1 ANTENNA MASTS

.1 Subscriber Site - Utility Pole

.1 Existing Utility Pole shall remain.

2.2 SURGE PROTECTORS

.1 General Characteristics

.1 All surge protectors shall be DC-blocked filters without gas tubes.

.2 Throughput energy will not exceed 0.5 micro-joules for 3 kA at 8/20 micro-second waveform.

.3 Throughput voltage will not exceed +- 3V for 3 kA at 8/20 micro-second waveform.

.4 The protected side shall be a Type-N female connector and the surge side shall be a Type-N male connector.

.5 The operating temperature range shall be –40C to 85C.

.2 2400 MHz Surge Protector

.1 The 2400 MHz surge protector shall have a maximum insertion loss of 0.1 dB.

.2 The pass through frequency range shall be 1200 MHz to 2800 MHz with a maximum VSWR of 1.2:1.

.3 The 2400 MHz surge protector shall be Polyphaser, Model Number PSX-MA or approved alternate.

2.3 ANTENNA TRANSMISSION CABLE (50 OHM COAX)

.1 General Characteristics

.1 The coax cable will have a UV protected weatherproof, watertight, polyethylene jacket.

.2 The coax cable will have an operating temperature range of –40°C to +85°C.

.3 The coax cable will have a continuous copper shield to provide 100% coverage with a minimum RF shielding effectiveness of 90 dB.

.4 The coax cable will have a foam dielectric.

.2 2.4 Ghz Subscriber Antenna Transmission Cable

.1 The coax cable for the 2.4 GHz antenna shall have a maximum attenuation at 2300 MHz of 11.5 dB/100 m measured at 20C.

.2 The 2.4 GHz subscriber antenna cable shall be Andrew Corporation, Heliax Cable, Model Number LDF4.5-50 or approved alternate.

.3 When the transmission cable length will be greater than 50 metres use Andrew Corporation Heliax Cable, Model Number AVA5-50 or approved alternate.

2.4 COAX CABLE CONNECTORS

.1 General

.1 Where available, connectors shall be solderless connectors that are either clamped or crimped to the transmission cable.

.2 The connector centre contact shall be gold or silver plated.

.3 The entire connector shall be manufactured from corrosion resistant material.

.4 Connectors are to be supplied by the transmission cable manufacturer or recommended by the cable manufacturer.

.2 Type-N Connectors

.1 Type-N connectors shall be Andrew Corporation, Model numbers: BR600PNM-CC, BR600PNF-CC, L4.5PNM-RC, L4.5PNF-RC, AL5NF-PS, A5TNF-PS, 5TNM-PS, or Times Microwave Systems model numbers: EZ-600-NMH-D, EZ-400-TM-RP, EZ-400-NMH or approved alternates.

.3 RP-TNC Connectors (CISCO Aironet)

.1 RP-TNC connectors shall be Andrew Corporation, model numbers: BR600PTPM-CC, BR600PTPF-CC or approved alternate.

2.5 JUMPER CABLES

.1 Where available, jumper cables shall be manufacturer assembled, Andrew Corporation, SureFlex jumper cables or approved alternate.

.2 Custom fabricated jumper cables shall be assembled from a flexible 6 mm (1/4”) foam dielectric cable, Andrew Corporation model number FSJ1-50A, Times Microwave Systems, Model No. LMR-600 Ultraflex or approved alternate.

.3 Jumper cables shall not exceed 2 metres in length and shall include a service loop for re-termination and flexibility.

.4 Antenna-to-transmission cable jumpers shall be terminated at both ends with an N-type Male connector.

.5 Radio-to-transmission cable jumpers shall be terminated at the transmission cable end with an N-type male connector and at the other end with a connector that mates with the radio connector.

2.6 PATCH CORDS

.1 Provide three (3) ScTP CAT5e patch cords certified by the manufacturer.

.2 Patch cords will be three (3) metres in length.

Part 3 Execution

3.1 GENERAL

.1 The City of Ottawa, Remote Sewer Facilities, SCADA Wide Area Network (WAN) is a mission-critical network requiring a high-degree of reliability and robustness. The Contractor is responsible for constructing a wireless network that meets the

performance criteria specified in the *Radio Link Performance Requirements* of Section 1.0.

.2 This specification is a functional specification. Therefore, it is the responsibility of the Contractor to bring to the attention of the City any design, equipment or installations issues, which the Contractor believes may prevent the network from meeting any of the minimum performance requirements or comply with this specification. The Contractor will recommend solution/s, in writing to the City, including impact to scope, time and cost. The City will, in its sole discretion, make a determination if the identified issue/s will or will not negatively impact network performance.

3.2 MANDATORY WAN MEETINGS

.1 The Contractor's WAN representative (the person responsible for the construction of the WAN) and the Contractor's Project Manager shall attend these mandatory meetings. These meetings are in addition to routine construction meetings.

.2 Within one (1) week of contract award, a WAN meeting will be held to review this specification and Wide Area Network (WAN) Tender drawings in detail. Major WAN milestones will be identified with the Contractor to incorporate into their overall project schedule.

.3 Two (2) additional meetings will be called at the discretion of the Consultant to review issues relating to construction of the WAN. The Contractor will be provided three (3) calendar days notice of a meeting.

3.3 GHZ SUBSCRIBER SITES

.1 This section applies to the Pumping Station 2.4 GHz Subscriber Site listed in above Section 1 Sites.

.2 Antenna Transmission Cable

.1 Provide a transmission cable and all appurtenances to link the subscriber antenna with the radio in compliance with the subscriber site antenna installation drawings and this specification. Contractor is to verify length of cable run.

.2 Install the antenna transmission cable to comply with manufacturer's recommended installation practice.

.3 Any antenna transmission cable bend radius shall be greater than the minimum bend radius specified by the manufacturer.

.4 Antenna transmission cable is to be a continuous run, without splices or connections, from the top wiring-aperture to the surge protector mounted inside the control panel.

.5 Provide flexible, jumper cables for connection of transmission cable to antenna and to the radio.

.6 Antenna transmission cable is to be run within the utility pole raceway entering the raceway through the below-grade wiring-aperture.

.7 Provide cable support, as necessary, to meet manufacturer's recommended installation practice. As a minimum, anchor the antenna transmission cable at the top of pole using either, a compression fit, cushioned clamp or hoisting grip fixed securely to the pole.

.8 Wiring aperture covers shall be gasketed and watertight. All cable entry through the aperture cover shall be made watertight.

.9 The transmission cable will enter the utility pole through the below-grade, wiring aperture and exit the wiring aperture at the top of the pole.

.10 Connectors at both ends of the main transmission cable shall be type-N female connectors.

.11 All installed transmission cable connectors and grounding kits are to be watertight. Weatherproofing will be accomplished by wrapping two (2) layers of rubber slicing tape over the entire connection extending 300 mm beyond the end of the connector. Alternately, the Contractor may utilise a weatherproofing kit approved by the City. This weatherproofing will be in addition to any weatherproofing supplied by the manufacturer as part of the cable assembly or the connector kit.

.12 The antenna transmission cable will be run within 78 mm (3") PVC conduit from the below-grade aperture to the building. Conduit entry into the building and wiring aperture shall be watertight. Extend existing underground PVC conduit to the new control panel location.

.13 The antenna transmission cable is to enter the control panel near the bottom-side of the panel.

.3 Antenna System Grounding

.1 Provide an antenna grounding system in compliance with the subscriber site antenna installation drawings and this specification.

.2 Comply with Sections 10 and 54 of Ontario Electrical Safety Code.

.3 Provide two (2) grounding rod electrodes as per Ontario Electrical Safety Code, Section 10-702. Install grounding rods at one (1) metre and four (4) metres from the utility pole base. Bond grounding rod electrodes to the utility pole ground rod with No. 6 AWG copper conductor, within the below-grade wiring aperture.

.4 Provide ground bar, lug or splitter within the below-grade and top wiring apertures for the termination of ground leads.

.5 Bond the antenna system ground to the new building ground loop at a copper clad ground electrode. As a minimum, bond antenna system ground to the new building ground loop electrode with a No. 6 AWG copper wire that is as straight and short as possible.

.6 Bond the outer conductor of the antenna transmission cable to ground at a minimum of two (2) locations: pole top wiring aperture and below-grade wiring aperture. The ampacity of the ground conductor shall be equal to or greater than the ampacity of the outer conductor of the coax cable. Installed grounding kits are to be watertight and housed within the wiring apertures.

.7 Bond antenna mounting pipe and lightning rod (if present) to utility pole grounding rod utilising a No. 6 AWG ground conductor. Ground wire is to be clamped to the mounting pipe securely with a minimum of two (2) pipe clamps.

.8 At the time of installation, the site resistance relative to ground must be less than or equal to 5 ohms as per IEC61024.

.4 Surge Protection and Radio Jumper Cable

.1 Provide a surge protector, within the Control panel, to protect the 2.4 GHz wireless Ethernet Bridge.

.2 Surge protector is to be flange mounted. The flange is to be located in close proximity to the control panel ground bar to ensure ground lead is as short as possible.

.3 Connect antenna transmission cable to surge side of surge protector.

.4 Connect radio (radio) jumper cable to protected side of surge protector.

.5 Both ends of the jumper cable shall be fixed using self-adhesive cable ties to ensure the connectors do not flex when the panel door is opened.

.6 The radio jumper cable shall be looped to enable the panel door to open without straining the cable. Cover the jumper cable in spiral wrap to protect against damage.

.7 Surge protector is to be grounded to antenna system ground with ground lug and an insulated No. 6 AWG solid-copper ground wire.

.5 Patch Cords

.1 Provide three (3) ScTP CAT5e patch cords certified by the manufacturer.

.2 Patch cords will be three (3) metres in length.

.6 As-Built Drawings

.1 Utilising copies of the “Typical” drawings submitted with the tender, the Contractor will create and submit red-lined as-built drawings for each subscriber site. As a minimum, the Contractor shall annotate the drawings with the following details: all final dimensions, equipment location, approved design and material changes.

3.4 TESTING

.1 Site Acceptance Test (SAT) – Subscriber and Hub Sites

.1 The Subscriber and Hub sites will undergo a witnessed Site Acceptance Test (SAT).

.2 Site Acceptance Tests will evaluate the workmanship and verify installation against this specification, As-Built and Shop drawings.

.3 Prepare a checklist or test sheet using MICROSOFT Excel.

.4 The Contractor shall conduct the test when directed by the City.

.5 The SAT will be completed when all items in the checklist have been witnessed and initialled by the City as being in conformance with the design as specified.

.2 Link Acceptance Test (LAT) – Subscriber and Hub Sites

.1 The Subscriber and Hub sites will undergo a witnessed Link Acceptance Test (LAT). Perform all link acceptance tests where supported by the manufacturer’s radio and/or manufacturer supplied diagnostic tools.

.2 The measured Free Space Receive Signal Level (FSRSL) value must be within five percent of the calculations submitted by the Contractor and accepted by the City. Under no circumstances will a measured value for FRSL be accepted that results in link availability less than the specified performance requirement.

.3 Perform all radio link tests at both ends of the radio link.

.4 Measure and record the minimum, maximum and average Free Space Receive Signal Level (FSRSL) values over a four (4) hour period. The equipment utilised to measure FSRSL should have the ability to measure and record values at one (1) minute intervals. If not supported by the manufacturer utilise the radio’s standard link test and log the recorded results for a single link test.

.5 Measure and record the minimum, maximum and average signal-to-noise ratio values over a four (4) hour period. The measuring equipment should have the ability to measure and record values at one (1) minute intervals. If not supported by the manufacturer utilise the radio's standard link test and log the recorded results for a single link test.

.3 Network Acceptance Test (NAT)

.1 The witnessed Network Acceptance Test (NAT) will test Ethernet performance of overall network including the wireless Ethernet Bridges and their connections to the ROPEC local area network.

.2 Using laptops connected to the bridge at both ends of the link and suitable TCP/IP test software perform a "Ping" test. The latency of the ping test shall be less than 5 msec. Repeat the test ten (10) times and record the minimum, maximum and average latency.

.3 Using laptops connected to the bridge at both ends of the link and suitable TCP/IP test software perform a throughput test. Configure the test software to transmit 1000 Ethernet packets of a maximum size. The average latency of the ping test shall be less than 5 msec. Repeat the test ten (10) times and record the minimum, maximum and average latency.

.4 Using laptops connected to the subscriber bridge and to the ROPEC network core switch and utilising suitable TCP/IP test software perform a "Ping" test. Repeat the test ten (10) times and record the minimum, maximum and average latency.

END OF SECTION

Part 1 General

1.1 SECTION SCOPE

.1 The fabrication of custom control panels shall conform to the requirements of this Section. Custom control panels are those enclosed assemblies incorporating electrical, electronic, pneumatic and/or hydraulic devices constructed for the expressed purpose of monitoring and control of processes or equipment not belonging to packaged systems or equipment. Custom control panels include PLC and Remote Terminal Unit Control Panels.

.2 The requirements of this Section shall apply to modifications to manufacturer/vendor standard control panels belonging to packaged systems and equipment. Reference to this Section is made in the Section that specifies the packaged systems or equipment where modifications to the manufacturer's standard offering are required by this Contract.

.3 A tabulation of the control panels for which the requirements of this Section apply is provided in Supplements 1 and 2 that follow this Section.

.4 City staff shall be present during modifications to existing PLC control panels, including drilling or cutting of enclosures, and termination of field wiring to an active PLC.

1.2 RELATED SECTIONS

.1 Section 01330 - Submittal Procedures

.2 Section 01780 - Closeout Submittals

.3 Section 01810 - Commissioning

.4 Section 01820 - Demonstration and Training

.5 Section 16261 – SCADA Uninterruptible Power Supplies

1.3 SUBMITTALS

.1 Submit shop drawings in conformance with Section 01330, indicating, but not limited to the following:

.1 Outline dimensions and assembly details

.2 Dimensioned internal and external layout details

.3 Power distribution schematics and wiring diagrams

.4 Based on the Typical I/O Module Wiring Diagram drawings and the I/O lists for each RPU and remote PLC rack, submit wiring diagrams for every

PLC I/O module being supplied under this Contract, filling in all specific information such as point descriptions, SCADA tags, terminal block numbers, wire tags, and wire colours.

.5 Shipping splits interconnection wiring diagrams

.6 Field interconnection wiring diagrams, including equipment supplied under this contract and equipment supplied by installation Contractor.

.7 Terminal Block arrangement

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

.9 Detailed Bills of Materials

.10 Materials of construction and construction details

.11 Gross Weight

.12 Acquisition Value ($ CAD)

.2 Submit installation, operation and maintenance manuals in accordance with Section 01780, 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 suppliers

.4 Installation instructions

.5 Operation instructions

.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 including as-built wire tags, colours, and field device terminal block numbers.

.3 Enclose two paper copies of the final record wiring diagrams (A1 - Full size and 11 in. x17 in. - 50% reduced) in a plastic envelope and place in each panel. Also enclose one complete copy of record drawings in native AutoCAD 2014 (.DWG digital format on CD-ROM).

.4 The Consultant reserves the right to rearrange panel component layout during shop drawing review.

1.4 QUALITY ASSURANCE

.1 Comply with Division 1 and Division 16, all Sections.

.2 Test all individual components, individual control panels and complete control panels as assembled at the manufacturer's plant in accordance with applicable standards.

.3 The Consultant will witness tests and inspect completed assembly at the Factory. Supply complete shop drawings and advise Consultant in writing ten (10) working days minimum prior to carrying out tests.

.4 Test control panels as complete assembly. Separate testing of individual control panels is not acceptable.

.5 Factory Acceptance 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

.6 Testing of all PLC modules and associated I/O wiring

.7 Testing of all PLC based communications networks.

.6 Prior to shipment, submit to the Consultant certified final test result.

1.5 CUSTOM CONTROL PANEL BUILDER WORK SCOPE

.1 Custom control panels include all panels wholly or in part provide control functions within the Owner's SCADA system and are not part of a commercial standard equipment package. This includes, but is not limited to the following:

.1 RPU Control Panels which contain PLCs.

.2 Refer to Electrical Drawings and Instrumentation & Control Drawings for additional information.

.2 This section covers enclosure types; panel layout, sizing and mounting, panel power supply, lighting and cooling, internal wiring, terminations and labeling, panel mounted devices, selector switches and indicating lights and relays and signal converters.

.3 The Contractor is to provide all necessary labour, materials and equipment to fully install, test and commission equipment control panel. This work also includes the supply, installation, testing and commissioning of new interconnecting wiring, conduit and terminations for all contract PLC I/O, and instrumentation. Refer to the contract drawings for the schedule of new equipment control panels and associated wiring.

.4 Control Panels and Descriptions

.1 Laporte Pumping Station CP-01 PLC panel.

.2 Laporte Pumping Station CP-02 Communication Panel

.3 Laporte Pumping Station CP-03 UPS Control Panel

.4 Laporte Pumping Station CP-04 Document Panel

1.6 CUSTOM CONTROL PANEL BUILDER QUALIFICATIONS

.1 Perform work of this Section by one of the following:

.1 Capital Controls and Instrumentation Inc, Ottawa (613) 248-1999

.2 SUMMA Engineering Ltd., Mississauga (905) 678-3388

.3 ISI Controls Inc., Brockville (613) 345-1502

.4 Or approved Alternate.

Part 2 Products

2.1 GENERAL REQUIREMENTS

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

.2 All free standing Control Panels shall be a minimum size of 1800 mm x 1200 mm x 600mm. Wall mounted Control Panels shall be a minimum size of 1200 mm x 900 mm x 250mm. Panel construction materials shall be selected such that they are suitable for their installed environments.

.3 All new control panel enclosures shall have approximately 20% spare usable area for future devices.

.4 Power supply disconnecting devices: To disconnect incoming power supply sources and individual branch circuit and instrument supplies, moulded case circuit breakers.

2.2 ENCLOSURES

.1 Control Panel enclosure types shall be compatible with, and suitable for, the environment in which they are installed, and they shall protect all instruments and equipment enclosed. The choice of location for Control Panel enclosures should attempt to minimize exposure to ambient temperature extremes, moisture, dirt and gaseous contaminants. Control Panel enclosures shall be designed, manufactured and tested in accordance with the latest applicable standards of CSA, NEMA, IEEE and ANSI.

.2 Only the following NEMA types are approved for installation in the Owner's facilities:

.1 NEMA Type 12, non-metallic or painted/coated metallic

.2 NEMA Type 4, non-metallic or painted/coated metallic

.3 NEMA Type 4X, non-metallic or painted/coated metallic

.3 Use of other enclosure types must be approved by the Consultant.

.4 Steel and Stainless Steel panel enclosures shall be constructed of 12-gauge minimum.

.5 All Control Panel enclosures shall have sufficient structural reinforcements to ensure a plane surface, limit vibration and to provide rigidity during shipment, installation and operation without distortion or damage to the Control Panel enclosure or injury to any mounted instruments.

.6 All enclosure seams shall be continuously welded and ground smooth to be undetectable after painting.

.7 Removable "eye" bolts shall be provided to facilitate sling handling of each panel. Eyebolt mounting shall be a part of the structural support bracing to distribute stresses and enclosure weight while sling handling enclosures during installation.

.8 All control panel cabinets should have a total depth not less than 50 mm from back plate mounted devices and door mounted devices.

.9 A 60 mm gap shall be provided between the rear of the panel and the wall for all new, free standing Control Panel enclosures.

.10 All Control Panel enclosures containing PLCs or HMIs shall be supplied with print pockets. The minimum pocket size shall be 500mm wide x 300mm high x 30mm deep, located in the inside left corner of the Control Panel enclosure door or as shown on the Contract Drawings. The colour of the print pocket shall be the same as the Control Panel enclosure interior.

.11 All Control Panel doors shall open through 180^0 without restriction.

.12 All enclosures shall be provided with flush hinges and a vault-type latch capable of accepting a 10mm shackle padlock. Enclosure doors 914 mm high and larger shall also have three point latch assemblies.

.13 Control Panel enclosures shall be supplied with a flip-out shelf for laptop computers where the panel contains a PLC or remote rack. The shelf shall be installed on the interior surface of the Control Panel door, at approximately 1100 mm above finished floor elevation and shall be easily accessible without obstructing the main PLC or panel mounted HMIs.

.14 Internal panel backplate is to be removable type, mounted 100 mm clear from rear of the panel. Refer to drawings.

.15 Insulate panel interior with 1” rigid insulation.

.16 Finishes

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.2 Paint enclosures exterior green. Submit RAL color number for final approval during the shop drawing review stage.

.3 The control panel enclosure interior, including door interior, shelf and print pocket to be to be factory finished, Epoxy Powder coated White.

.4 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.5 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

2.3 CONTROL PANEL COMPONENT LAYOUT

.1 General

.1 Control Panel enclosures shall be constructed to accommodate all necessary accessories such as instrument air, power supplies, mounting hardware, terminal blocks and any signal conditioning or conversion equipment that may be necessary to make operational all monitored and controlled equipment mounted in the enclosure.

.2 Control Panel enclosure layout and equipment spacing shall be constructed to allow for device removal, calibration and maintenance without disassembly of adjacent devices.

.3 PLCs or remote racks shall be installed on the backplate of the Control Panel enclosure. Refer to drawings.

.4 Power supply equipment such as power supplies, transformers, power fuses or disconnects shall be installed at the left or top of the backplate, as per drawing layout.

.5 The PLC and field instruments shall be supplied from a 120 VAC UPS supply circuit of a plant UPS distribution panel.

.6 Every circuit entering a control panel for distribution shall have a main disconnect switch installed.

.7 All terminal blocks, relays and other wiring and devices shall be installed on the backplate below the PLC rack as per drawings.

.8 Separately mounted and clearly identified terminal strips shall be used for power, analog inputs, analog outputs, digital inputs and digital outputs. The order of terminal block sections (one for each card) will match the ordering of the cards as they appear in the rack. Each terminal block section will match the numbering convention of the card. Terminal strips must be clearly labeled as per the drawings with an approved marker consisting of white background with black machine produced lettering.

.9 Terminal blocks shall be supplied and installed for all used and spare I/O cards.

.10 Co-ordinated breaker protection required from a control panel main breaker, to downstream distribution breakers.

.11 Digital, analog and power devices such as relays, terminals and wire must be separated and clearly labeled as per the drawings with an

approved marker consisting of white background with black machine produced lettering.

.12 There shall be no devices installed on the side plates of the Control Panel enclosure.

.13 For all new installations, all external wiring shall enter the Control Panel enclosure through side entry conduits or cable trenches from the underside of the Control Panel enclosure. Top entry may only be used upon authorization from the Consultant. Top entry conduits must be sealed with a non-shrink, waterproof mastic putty.

.14 All field wiring entering panel shall run through ducts, or side entry.

.15 Supply, install test and commission all modifications to existing control panels.

2.4 GROUNDING

.1 Control panels shall be considered the same as distribution panels and grounded to the electrical system.

.2 The system ground bus shall be a 6mm thick x 50 mm wide copper bus wall mounted and centrally located to all system components. Dimensions shall be such that the plate will have enough tapped holes to accommodate all the grounds that need to be connected.

.3 Use of conduit, cable raceways, or building steel to distribute the ground from point to point will not be permitted. Distribution should be through a well-insulated, dedicated wire of appropriate size.

.4 The conductor connecting the earth grounding system to the system ground shall be stranded copper wire, #2/0 AWG. This conductor shall follow the most direct path between the ground points. Sharp turns decrease the conductor's ability to carry high currents, such as those encountered when lightning strikes nearby, and shall be avoided.

.5 Control panels shall be connected to the externally mounted system ground bus, each via a separate conductor.

.6 Grounding of PLC Control Panels containing analog and digital signals to include the following:

.1 Each panel shall have an internal copper panel ground bus. The bus shall have tapped holes to accommodate ground connections from various devices in the rack. The internal panel ground bus shall be connect to the low impedance system ground bus at only one point, via a stranded, insulated copper wire of #6 AWG or larger.

.2 The rack frame shall be connected to the internal panel ground bus.

.3 Each chassis in the panel shall have a bonding jumper to the panel ground bus. Connections shall be via ring tongue connectors that bolt to the bus. If the chassis has several types of signals that need to be grounded, such as low level sensor signals, high-level output modules, or noisy switching circuits-each shall have a separate line to the signal ground bus. Only circuits of the same voltage level shall share the same ground return line.

.4 Manufacturer's recommendations shall also be followed.

2.5 SHIELDING

.1 The shielding on a twisted pair cable must be connected to ground at one end only. The grounded shield drain wires shall be connected to a dedicated rail mounted instrument ground terminals. Special attention to the shield in relationship to other conductors must be taken. Neither the shield drain wire nor the aluminized mylar of braided copper shield material may touch anything connected to another grounding system. Install an insulated sleeve over each of the drain wires and removing the shield material back to the point where the cable assembly is split to allow the individual conductors to be separated from the cable. The cable assembly shall be heat shrunk at the point where it is split to ensure that the loose pieces of shield material do not contact the panel that the cable assembly enters.

.2 The drain wire shall terminate on rail mounted grounding terminals contained within the panel.

2.6 CONTROL PANEL WIRING, TERMINATIONS AND LABELING

.1 General

.1 Wiring shall not be spliced. Wire shall be run in continuous lengths from screw terminal to screw terminal. Wire service loops in ducts shall be provided to permit device removal.

.2 Wire colour coding shall be supplied following the colour convention provided later within this section.

.3 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. These groups are defined as levels.

.4 Install low level analog signals, 50 V DC maximum or 4-20 mA, and digital signal operating at 50 V AC or DC maximum, in raceway electromagnetically isolated from higher power or signal wiring. Comply

with wiring separation and isolation guidelines recommended by instrument and PLC equipment manufacturers.

.5 All field wires and cable terminated within Control Panels and termination cabinets shall be identified at each termination with a marking that corresponds with the drawings and support documentation.

.6 All spare external wire shall be labeled and terminated on terminal blocks.

.7 Solderless ring lug connectors with insulating sleeves shall be used for connecting wires to screw-type terminal blocks.

.2 Internal Wiring

.1 All internal Control Panel wiring and terminations shall be installed in accordance with the latest, locally applicable standards and codes.

.2 Internal wiring from PLC digital I/O module to the terminal blocks shall be 7 or more stranded copper #18 AWG-type Belden 8501 or approved equivalent, of the appropriate colour and bundled together in a harness.

.3 Wiring to each PLC I/O card shall have a separate harness. Each harness shall run from the card behind the back panel and into the nearest wire duct through to the appropriate terminal strip. All other wiring in the control cabinets shall be contained in wire ducts.

.4 The wiring duct material shall not be combustible. It shall be made of insulating material and shall not contain exposed metal parts except mounting screws.

.5 A clear Plexiglas cover shall protect all PLC output card terminal blocks with multiple sources of power, a label stating "Caution: Multiple Sources of Power" is to be provided and put in place.

.6 Wires to devices on the Control Panel door shall not interfere with the devices on the door, or operation of the door. Wiring to be extra flexible, forty-nine strands minimum, harnessed with nylon cable ties.

.7 Wires shall have sufficient length and support and be secured to minimize stress on the wires and terminals.

.8 Plastic wiring wraps shall be used to fasten wires, except within wiring ducts. The bundles shall be securely fastened to the steel structure at suitable intervals, not exceeding 300mm.

.9 Flexible stranded wiring shall be used throughout. No solid conductor wire shall be permitted.

.10 Power wiring insulation shall be rated at 600 volts at 90°C and be type RW 90. Conductors shall be stranded copper. No wire smaller than 12 AWG shall be used for power wiring, 14 AWG minimum for AC control circuits, and 10 AWG minimum for current transformer circuits.

.11 Wiring ducts: Maximum 50% fill, with snap-on cover, by Panduit Canada.

.12 Identify each conductor, including spares, as per the drawings with a unique alphanumeric designation to facilitate troubleshooting and maintenance.

.13 Wire Markers: Identify wiring at both ends as per the drawings with rap around, indelible machine printed wire markers. Brady type TLS2200, or equal. Labels shall be font size 14 Bold.

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

.3 Analog Signal Wiring

.1 Signal wiring shall be segregated from control power wiring, grouped functionally and arranged neatly to facilitate circuit tracing. Low level analog signals of 100 mV or less shall not be combined with digital input or control output wiring nor shall they be intermixed within the same bundle.

.2 Where shielding is required, shields shall be continuous foil or metalized plastic providing 100% coverage. A drain wire in continuous contact with the shield shall be included. The drain wire shall not be used as a control signal conductor.

.3 Analog signal cable shall be shielded pair or otherwise approved by the Consultant.

.4 All DC signal wiring shall be segregated from wire conducting AC signals.

.5 All analog circuits are to be protected using 1/16 amp fuses.

.6 Analog Signal Instrument Wiring

.1 Panel: 18 AWG, 7 strand minimum, tinned copper, unless otherwise indicated, 300 V minimum insulation.

.2 Construction: Twisted pair, triplet and quad grouping with nominal 50 mm staggered lay and 100% aluminum-mylar tape shield with minimum 25% overlap.

.3 Drain wire: Over each group, bare, 20 AWG minimum, tinned copper, in direct continuous contact with shield. The drain and shield shall not be used as a control signal conductor.

.4 Jacket: PVC (-40°C) low acid gas, low flame spread.

.5 Panel, general purpose instrumentation cable: Belden 9318

.6 Termination fittings: Type, configuration and gender required to connect cable directly to equipment without additional adapters or fittings.

.4 Terminal Blocks

.1 Terminal blocks shall be provided for interconnections with field devices and within termination cabinets.

.2 All field wiring shall be terminated on the left side of the terminal strip. Internal panel and PLC I/O wiring to be terminated on the right side of the terminal strip.

.1 The acceptable manufacturer for terminal blocks is indicated on drawings.

.2 Provide general use, single and double layer terminal blocks.

.3 Secondary circuit breakers sized to suit application.

.4 35x7.5 slotted steel DIN rail.

.5 Terminal block numbers to be white background with black lettering oriented for the mounting plane of the terminals.

.6 Terminal block section marker shall be used to identify groupings by PLC I/O card and/or equipment.

.3 Design of the terminal layout shall include a grounded barrier to segregate those terminals devoted to current type signals from others. The terminal blocks are to be factory assembled on a mounting channel and the channel bolted to the inside of the Control Panel on 40 mm standoffs.

.4 Terminal blocks shall be rated at least 300 volts for NEMA general industrial control devices and 600 volts for NEMA limited power circuits. No miniature terminal blocks shall be permitted. The terminals shall have a continuous marking strip.

.5 One 6 mm thick by 50 mm wide copper ground bus, minimum of 450 mm long, to be provided at the bottom of each Control Panel for

instrumentation ground connections. All holes will be tapped with a proper size screw, either 10-32 or 3-40 screw size. There shall be no more than one wire termination per screw.

.6 Terminals shall be plainly and permanently marked to correspond with the wire identification shown on the drawings.

.7 Terminal blocks shall be wired and mounted, and wiring shall be routed so that internal and external wiring does not cross over the terminals.

.8 One wire only shall be placed under each termination screw, with the exception of allowing 2 wires per termination screw, only when absolutely necessary.

.5 Internal Wire Numbers

.1 Identification / labeling of wires that are run from the PLC I/O to the terminal blocks shall incorporate the following formatting:

WW: X/YY/ZZ, where

WW = I/O type (DI, DO, AI, AO)

X = Rack No.

YY = Slot No.

ZZ = Channel No. (or point)

.2 The Consultant and City of Ottawa reserve the right to modify the wire identification / labeling numbers during shop drawing review stage, without additional cost to the Contract.

.3 In all cases, the Consultant and City of Ottawa must review and approve the assigned labeling a minimum of ten (10) working days prior to commencement of work.

.4 Wire labels shall be font size 14 bold.

.6 Colour Conventions

.1 The following colours will be used on all supplied and/or installed components with the general concept that red indicates energy in motion and green indicates no energy.

.2 Pilot Devices

Condition	**Colour**
Indicating Lights	
a. Trouble Malfunction	Amber
b. Breaker Closed	Red
c. Device Running	Red
d. Valve Closed	Green
e. Breaker Open	Green
f. Device Stopped	Green
g. General Purpose (Owner defined)	White
Push Buttons	
a. Emergency Stop/Lock out stop	Red
b. Reset	Black
c. Start/Open	Green
d. Stop/Close	Red

.3 Control Panel Enclosure Wiring

Use of Wire	**Wiring Colour**
1. Utility Power circuits, AC or DC power	Black
2. Utility Power Control Circuits	Red
3. DC Control Circuits(+)	Blue
4. DC Control Circuits(-)	Blue/white
5. PLC Digital Output Card to Terminal Block	Yellow
6. PLC Digital Input Card to Terminal Block	Red
7. Equipment Grounding Conductors	Green
8. Hydro Neutral	White
9. UPS Line and Load	Orange
10. UPS Neutral	Gray
11. Autodialer inputs	Brown

2.7 PROGRAMMABLE LOGIC CONTROLLERS (PLC)

.1 The PLC products shall be of the CompactLogix series, manufactured by Allen-Bradley, as shown on the Contract Drawings. Provide incidental hardware and devices as necessary for a complete operable system.

2.8 PROGRAMMING SOFTWARE

.1 Provide one (1) license of RSLogix5000 Professional Edition c/w one (1) USB Dongle.

.1 Order No. 9324-RLD700NXENE, as supplied by Westburne Ruddy Electric

.2 Order No. 9509-USB-DONG2, as supplied by Westburne Ruddy Electric

.2 All software licenses shall be registered to:

Sam Dhaliwal, P. Eng.
Control Systems Engineer
City Of Ottawa
800 Green Creek Drive, Gloucester, Ontario, K1J 1A6
Phone: (613) 580-2424 Ext. 16640

Fax: (613) 913-0133
Email: sam.dhaliwal@ottawa.ca

2.9 MEDIA CONVERTER

.1 Industrial 10/100BaseT(X)-to-100BaseFX media converter

.2 Multi-mode with SC fiber connector

.3 Link Fault Pass-Through (LFPT)

.4 -40 to 75°C operating temperature range

.5 DIP switches to select FDX/HDX/10/100/Auto/Force

.6 Model IMC-21A-M-SC-T, by Moxa, or approved alternate.

2.10 INTERFACES

.1 Relays

.1 Control logic relays shall be heavy duty, machine tool industrial type. Relay coils shall be moulded construction and operate on 24V DC or 115V AC 60 Hz +10% as required. Contacts shall be rated for a minimum mechanical life of ten million operations.

.2 Loss of Power relay shall be general purpose relay: Electrically held, enclosed, three 5 A, 120 V AC, form C contacts minimum, screw terminal socket mount, with hold down clips, pilot light and push-to-test button.

.3 I/O auxiliary interposing relays shall be DIN rail mounted and supplied by the same manufacturer to ensure similar appearance and uniform operating characteristics. Relays shall operate on 24 V DC or 115 V AC +10% as required and have internal LED status indicator to show if the relay is energized. Contacts shall be SPDT, rated 6 Amperes continuous; maximum voltage 250 V.

.4 Relay contacts shall not be used in excess of their rating and shall not be connected in parallel to increase effective ampacity.

.5 Relays required to interface with equipment such as starter contactor coils, motorized valves, circuit breaker trip coils, etc. must be supplied with and mounted within that equipment if at all possible and only mounted in the control panel containing the PLC/RTU output when space is not available in the controlled equipment and only when explicitly approved by the Owner/Consultant.

.6 All relays shall be CSA recognized.

2.11 POWER DISTRIBUTION

.1 General

.1 Electric power serving the SCADA system and its subcomponents shall be "clean", stable, and reliable. The system shall be protected against power outages, voltage fluctuations, distortions, transients, surges, and spikes.

.2 Electrically powered equipment, from computers to instrumentation, must be properly grounded to reduce noise and interference, protect personnel and equipment, and provide a "quiet" environment for electronic instrumentation.

.3 When surge suppressers are used to minimize electrical noise, they shall be of diode, MOV or RC type.

.4 Typical control power distribution diagrams are shown in Drawings.

.2 Power Requirements

.1 Electrical power requirements for SCADA systems are 120 VAC, +/-5%, measured at the equipment connections

.2 The following rules shall be followed when setting up a power source for a control panel:

.1 Power feed to the control panel shall be from a 15 A, 120VAC branch circuit in the nearest available power distribution panel.

The panel shall be the only equipment that the branch circuit services.

.2 The feeder shall not be routed close to other lines that generate noise. If feeders must run close together, parallel paths shall be as short as possible.

.3 Primary power for the panel's control circuit as shown on the Contract Drawings shall come from the closest available UPS distribution panel.

.4 The source of the supply for the control circuit shall be taken from the load side of the main disconnecting means.

.3 Analog and digital loops shall have separate power circuits.

.4 Each individual field device or input group greater than 24 Volts shall have a circuit breaker to minimize impact on the control system in the event of a device failure.

2.12 DC LOOP POWER SUPPLIES

.1 Control panels shall house a regulated DC power supply for field analog signal transmitters and to power LEDs.

.2 All DC power supplies shall be switching power supplies and manufactured by Phoenix Contact, sized to supply 125% of all known associated 24 V DC loads.

.3 24 VDC power supplies will be powered by the UPS supply.

2.13 CONTROL PANEL MOUNTED DEVICES

.1 General

.1 Instruments or devices furnished for mounting on the front of Control Panels shall be suitable for the intended application and selected to match each other and present a coordinated aesthetically pleasing functional arrangement. The arrangement of devices on the Control Panel shall be as symmetrical as possible and shall functionally group devices to enable operators to easily locate groups of devices or individual devices to control the process.

.2 A detailed schedule of all device labels shall be submitted to the Consultant for review a minimum of 10 working days prior to label fabrication and installation.

.2 Pilot Devices

.1 All selector switches, pushbuttons and indicating lights shall be oil tight NEMA 4X as a minimum.

.2 All pushbuttons, indicating lights and selector switches shall be supplied by one manufacturer; shall be of the same series or model; shall be heavy duty oil tight type, manufactured by Allen-Bradley.

.3 Selector switches and pushbuttons shall be supplied with the operator mechanisms, appropriate number of contact blocks and any necessary inserts. Contact block terminals shall be labeled for identification purposes and contain not less than one single pole, double throw contact. Contact blocks shall be of heavy-duty type rated 10 amperes at 120 VAC breaking current. In the case where the contact blocks are handling low-level signal currents, the contacts shall be rated for electronic duty and shall provide mechanical self-cleaning action for reliable operation on electronic loads where thermal cleaning action is not present. The contacts shall be rated at 1 amp at 28 VDC and shall be gold or gold flashing over silver.

.4 Operator devices: Heavy duty, industrial, oil-tight, rated 120 VAC, Type 800T by Allen-Bradley Canada Ltd., or approved equal.

.5 Emergency stop pushbuttons: Push-to-stop, pull-to-reset, pad lockable, Large diameter red mushroom head, heavy duty, corrosion resistant. All areas: Type 800H devices by Allen-Bradley Canada Ltd. Pushbuttons to have isolated, auxiliary NO contacts for monitoring switch position by the PLC.

.6 Local/Remote type selector switches shall be of early-make, late-break type contacts (make before break) in control circuits for bumpless transfer of device control mode. Switch operation shall be maintained position. Switches to have isolated, auxiliary NO contacts for monitoring switch position by the PLC. Hand-Off-Auto type switches for control purposes are not to be used without the prior approval of the Consultant and only on a case-by case basis.

.7 Spring return selector switches shall only be used where approved by the Owner/Consultant.

.8 Pushbutton operation shall be momentary.

.9 All indicating lights shall be oil tight type operating from either 24 V DC or 120 V AC, 60 Hz power source. Indicating lights operating on 120 VAC shall be transformer type with the indicating lamps operating on 6 to 8 V AC. Indicating lights operating on 24 V DC shall have lamps rated for 28 V DC for longer life. Removal and bulb replacement shall be accessible

through the front of the Control Panel. A push-to-test-LED feature shall be employed to provide a positive test of lamp condition.

.3 Indicators

.1 Display devices can consist of rectangular Control Panel meters, edgewise Control Panel indicators, recorders, annunciators and graphic displays.

.2 All display devices shall have scales, which indicate the actual process value with the measured variable reading in engineering units (i.e., 0 to 100 ML/D). It is unacceptable for display devices to indicate the measured value as a percent of maximum (i.e., 0 to 100% full scale) except for those devices displaying position (i.e., percent valve open/ closed, etc.).

.3 Analog indicating instruments and meters: Front door, semi-flush mount, magnetically shielded, dust tight, 114 mm face, 250° movement, 1% accuracy, external zero adjustment.

Part 3 Execution

3.1 DELIVERABLES

.1 Control Panels

.1 Control Panels shall be provided in complete compliance with this Specification. Where necessary, for example a retrofit of existing equipment, deviations from this standard must be approved by the Owner/Consultant during the design stage.

.2 Drawings

.1 Drawings showing the layout of Control Panels complete with schedules for all panel-mounted devices shall be provided during design, marked-up to incorporate changes during construction and issued with the final 'as-constructed' drawing set.

.2 Control Panel Wiring Diagrams shall be submitted for approval as shop drawings prior to manufacture. These drawings shall be marked-up by the Contractor to reflect changes during construction, updated by the Control Panel manufacturer electronically, and issued with the final "as-constructed" drawing set.

3.2 SUPPLEMENTS

.1 Supplements include the following:

.1 Laporte Pump Station Control Panel List

SECTION 13991 – SUPPLEMENT 2
PUMPING STATION
CONTROL PANELS

Panel ID	Service	Location Description	Layout Sheet	EEMAC Type
CP-01 RPU-LPRT	PLC Control Panel	Laporte PS	I110	4
CP-02	Communication Panel	Laporte PS	I108	4X
CP-03	UPS Control Panel	Laporte PS	I105	4
CP-04	Document Control Panel	Laporte PS	I109	4

END OF SECTION