



September 1, 2023

**ADDENDUM # 1**

Three (3) Pages

Attachment(s) – Thirty Two (32) pages

**RE: RFT 2023-15 – DRAYTON PUMPHOUSE UPGRADES**

Dear Sir / Madam:

Please find enclosed Addendum #1 for the above noted contract. Confirmation that this addendum has been received shall be indicated on your bid submission.

If you have submitted your bid online already it will be withdrawn, and you will be required to resubmit. You will be notified by the bid system that your submission has been withdrawn.

Please treat this as an original. No follow up copy will be provided.

Sincerely,

**CIMA Canada Inc.**

Adam Moore, P.Eng.  
Project Engineer, Infrastructure  
adam.moore@cima.ca

Encl.

cc: Stuart Winchester, CIMA+  
Jamie Morgan, Township of Mapleton

**TOWNSHIP OF MAPLETON  
DRAYTON PUMPHOUSE UPGRADES  
RFT 2023-15  
ADDENDUM NO. 1**

**ISSUE DATE: September 1, 2023**

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This addendum is issued for the purpose of clarifying, amending, or revising certain information contained in the Contract Documents. This Addendum No. 1 shall form an integral part of the Contract Documents. The closing date remains unchanged.

The following changes, clarifications, additions and/or substitutions shall be incorporated into the pertinent portions of the Contract Documents as follows:

**1     ATTACHMENTS**

- 1.1     Section 13100 – Control & Instrumentation
- 1.2     Section 13560 – Instrumentation General Requirements
- 1.3     Section 13563 – Pressure and Level Instruments

**2     SPECIFICATIONS**

- 2.1     From Section 16015, under Electrical Studies, remove Eramosa from electrical studies and training providers.
- 2.2     Remove IFT 2023-05 and replace with IFT 2023-15.

**3     FRONT-END DOCUMENTS**

- 3.1     Remove IFT 2023-05 and replace with IFT 2023-15.

**4     DRAWINGS**

- 4.1     Remove IFT 2023-05 and replace with IFT 2023-15.

**5     QUESTIONS AND ANSWERS**

- 5.1     **Question:** Drawing E603 there are 2 Level Transmitters. Please provide specification. Who is providing the Programming?

**Answer:** Please see the attached division 13 specifications for the level transmitters. Programming and integration is to be completed by Selog, to be retained by the general contractor.

- 5.2     **Question:** There does not appear to be any instrumentation and control spec.

**Answer:** Please see the attached division 13 specifications.



**Addendum No. 1**

The Bidder shall sign this Addendum in the space provided below, shall affix his seal hereto, and shall submit this Addendum in the same envelope as the tender.

Except as and to the extent that they are amended by the foregoing, all terms and conditions of the tender documents remain in full force and effect.

Signature of Tenderer

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Affix Corporate Seal Above

## **1 GENERAL**

### **1.1 Intent**

- 1.1.1 It is the intent of this section to provide the like-for-like replacement of existing I/Os and possible programming updates for the existing Control Panel CP-01 at the Drayton Pumphouse. The upgrades will include replacement of instrumentation to monitor and control process parameters and equipment to be supplied and installed under this contract, as shown on the drawings or specified.

### **1.2 Description**

- 1.2.1 Retain the services of the pre-approved Control System Integrator/Programmer (CSIP) for the scope described herein including overlooking the switchover of existing IO with like-for-like new, and installation, configuration and commissioning of the new level transmitter and transducers assembly to monitor the reservoir's level.
- 1.2.2 The work consists of the supply and installation of all instrumentation, controls, SCADA system automation components specified herein and shown on the drawings, and commissioning by the Contractor to suit the Pumphouse upgrades.
- 1.2.3 The CSIP and the Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in this Section. The word "provide" shall be defined to mean supply, install, start up, test and commission.

### **1.3 General Requirements**

- 1.3.1 The Contractor shall supply and Install all power, control, and communications wire interconnecting the control panels, and electrical and electronic pieces of the instrumentation equipment, under Division 16. Final wiring shall be as required by the reviewed shop drawings, (See Division 16).
- 1.3.2 At all times, ensure that work being carried out by the Engineer or the plant operations staff is properly coordinated with all ongoing construction activities and are unhampered by unnecessary delays or obstructions.
- 1.3.3 All functionality described in the Tender Documents and Process Narrative shall be fully implemented.
- 1.3.4 All control wiring shall be continuous and without splices. All control wiring is required to transition through or terminate to DIN rail mounted terminal blocks. No marret connections of control wiring is permitted.
- 1.3.5 All equipment performance requirements shall be based upon worst case scenarios and/or to the maximum capabilities of the equipment.
- 1.3.6 Provide documentation in a timely manner and as specified.
- 1.3.7 The Contractor shall prevent the following from occurring:
- .1 Scheduling of Commissioning & Site Inspection, prior to the completion of all site works including, loop checks, instrument calibration, wire or installation, resulting in delays and repeat site visits.

- .2 Lack of maintenance works to suit field equipment/devices including instruments, control hardware, motor starters, valve actuators, and all essential process systems required for the facility to run in a safe and fully automated fashion.

#### **1.4 Related Work Specified Elsewhere**

- 1.4.1 Section 13560 - Instrumentation General Requirements
- 1.4.2 Section 13563 – Pressure and Level Instruments
- 1.4.3 Section 16010 - Electrical General Requirements
- 1.4.4 Power and control wire interconnecting the control panel, and electrical and electronic pieces of the instrumentation equipment, under Division 11 and 16. Final wiring shall be as required by the reviewed shop drawings (See Division 16).

#### **1.5 Standards**

- 1.5.1 Equipment furnished under this section shall be designed, constructed, and tested in accordance with the latest edition and requirements of the followings:
  - .1 Canadian Standards Association (CSA)
  - .2 Canadian Electrical Manufacturers Association (CEMA)
  - .3 National Electrical Manufacturers Association (NEMA), and NEMA ICS-1-109.60
  - .4 The Instrumentation, Systems, and Automation Society (ISA)
  - .5 FCC Part 15 – Class A / Canadian's Interference-Causing Equipment Standards (ICESs)
  - .6 Institute of Electrical and Electronics Engineers IEEE-519
  - .7 ANSI C37.90

#### **1.6 Glossary**

- 1.6.1 FAT "Factory Acceptance Test": The purpose of FAT is to demonstrate that the system programming meets the plant operational requirements before being installed at site and to provide the Township with a level of confidence that the system, once on site, will perform as expected.
- 1.6.2 SAT "Site Acceptance Test": The purpose of SAT is to complete the full implementation of the system and to perform a final exhibit of the implemented control philosophies.

#### **1.7 Quality Assurance**

- 1.7.1 The materials, design, and workmanship employed in the manufacture of all equipment shall conform to the applicable standards established by the A.S.T.M. (American Society for Testing Materials), A.S.A. (American Standards Association), C.E.C. (Canadian Electrical Code) including the Ontario Supplement, C.G.S.B. (Canadian Government Specifications Board), C.S.A. (Canadian Standards Association), and the I.S.A. (The Instrumentation, Systems, and Automation Society). Canadian Standards shall take precedence over American Standards in the case of duplication or conflict.

## **1.8 Submittals**

- 1.8.1 Conform with requirements of Division 1.
- 1.8.2 Conform with Section 13560 - Instrumentation General Requirements.
- 1.8.3 Drawing Index: Prepare a clear, typed index listing the number and title of all proposed purpose-made drawings and submit for review within 20 days after award of contract.
- 1.8.4 Milestone Schedule: Prepare and submit a proposed schedule of instrumentation and control work per General Conditions, indicating the following major milestones as a minimum:
  - .1 Completed and signed Calibration Form for each field instrument, in accordance with Section 13560;
  - .2 Completed and signed Instrumentation Installation Checklist Form for each field instrument in accordance with Section 13560;
  - .3 Report on proper site installation, inspection, and loop check;
  - .4 Final submission and sign-off of Product Data Sheets as per this Section and 13560;
  - .5 Maintenance training sessions on field instruments.
- 1.8.5 Application Specific Drawings:
  - .1 Prepare application specific drawings neatly and accurately by means of the latest version of AutoCAD or as otherwise advised. Do not use external references or customized file extensions. Provide fully portable electronic file copies of all drawings.
  - .2 Make submission on reproducible material such as legal-size paper, complete with a title block containing the Project Contract number, your contract number and company logo, a drawing and Contract title as stated in the Contract drawings, and a referenced drawing number (related to a file name if applicable). Provide tabular columns to record the original submission date, a revision number, date and reason for subsequent revisions, and signature of authorized issuing staff member.
  - .3 Submit, as a minimum, the following application specific drawings:
    - .1 Scaled, reference, front of panel layouts, and general arrangements drawings;
    - .2 Scaled, referenced, internal panel layouts (may be combined with the above);
    - .3 Equipment or panel block wiring diagrams showing termination identification at each item of equipment, inter-wiring and cable numbering, all peripheral equipment, all PLC module DIP switch settings, pin assignments for D-shell connectors, plugs and jacks, and instrument/equipment tag numbers;
    - .4 Where issued, loop drawings are typical for guidance only. Submit itemized instrument wiring drawings for all analog process loops and discrete connections, generally in accordance with ISA S5.4 format and as a minimum incorporating the following details: PLC terminal numbers, PLC I/O Address, PLC Slot & Rack identification, Control Cabinet terminal numbers, field terminal numbers, wire numbers, contact orientation, power source identifications and equipment numbers. The "AutoCAD" files for these drawings are to be edited with "Record Drawing" detail and made accessible to the Engineer during the Contract. Include wiring by others that form part of the system or circuit.

- .5 List of expendable materials and quantities;
- .6 List of Instrument, Equipment and Panel Identification Nameplates, including all panel mounted component name plates.
- .7 Project name and job numbers.
- .8 Cable and wire requirements inclusive of specifications.
- .9 Input and output signal ranges and calibrated ranges.
- .10 Installation details including: material list, dimensions, process and electrical connection sizes and external wiring requirements.

1.8.6 Vendor Equipment Shop Drawings:

- .1 Submit Shop Drawings for all field and panel mounted instruments, controllers, gauges and similar products. Manufacturer documentation will be accepted only if the following information is clearly indicated and highlighted for the equipment proposed. Submit the following:
  - .1 An itemized listing of proposed instrument or equipment, including tag numbers, quantities, options being provided and a full description and performance data;
  - .2 Installation details depicting mounting assemblies, physical dimensions, process connection size (e.g. flange ratings & styles);
  - .3 Termination details clearly indicating the type and lengths of external wiring required and electrical connections;
  - .4 Power supply rating input and output signal ranges, maximum measured process range and calibrated scale, physical, electrical and environmental requirements;
  - .5 Exact catalogue model numbers of each piece of equipment and its accessory options, and clearly referenced by the respective instrument or equipment tag name given in this document (improperly tagged items shall be rejected);
  - .6 A separate sheet with manufacturer's recommended list of spare parts including individual pricing with the shop drawings;
- .2 The Contractor shall note compliance and variance in writing or the specification shall have precedence over approved vendor drawings. Stamp the shop drawings submitted as either "COMPLIES WITH SPECIFICATION" or "DEVIATES FROM SPECIFICATION" as appropriate. In the latter case, describe deviations exactly and indicate how they impact the specified duty of the component. The Engineer will assess acceptability of submission.

1.8.7 Product Data Sheets:

- .1 Provide Product Data Sheets for all instruments and equipment to suit shop drawing submissions in accordance with Section 13560 and as specified herein. Product data sheets to include the information noted below and all other data pertinent to the equipment and the application.
- .2 Initial submission for review to accompany Shop Drawings:
  - .1 The product manufacturer and the supplier or representative;

- .2 The complete model or catalogue numbers including all special options;
  - .3 The available adjustment ranges and the operating ranges.
  - .4 Supporting product documentation as indicated in Section 13560 and specified herein.
  - .3 Second submission during pre-commissioning, testing and calibration period:
    - .1 Serial numbers, part numbers, dates of installation and calibration;
    - .2 All special procedures required to duplicate calibration;
    - .3 This submission is for signature by the Contractor and the Engineer following acceptance of the operation of each instrument.
    - .4 The second submission shall include completed and signed Instrumentation Installation Checklist forms and Instrumentation
  - .4 Final Submission of signed-off Product Data Sheets included with Operating and Maintenance Instruction Manuals:
    - .1 All of the above information; and
    - .2 Phone and fax numbers of contact person for product support/service.
  - .5 Where there is any discrepancy, the description provided on the Product Data Sheet takes precedence over the model number given in the data sheet.
- 1.8.8 Record Copies of Purpose-made Drawings & Electronic Files:
- .1 Submit six white print “as-built” copies of each Purpose-made drawing and document specified above, as well as electronic copies (on CD or comparable media). Under certain circumstances during the course of the contract, instead of paper, drawing and document files may be exchanged with the Engineer to streamline coordination.
- 1.8.9 Submission Format:
- .1 A complete set of Purpose-made Drawings, Shop Drawings, and the initial submission of the Product Data Sheets shall be bound into one volume and issued for approval before the commencement of work.
  - .2 Comply with the instrumentation submission requirements identified in Section 13560.
  - .3 The Contractor shall prepare a product description sheet for each item or package submitted for shop drawing approval.
  - .4 Each shop drawing submission by the Contractor must be accompanied by a submission overview sheet that lists the individual items described in the respective individual product description sheets.
  - .5 The product description sheet shall conform with submission requirements identified in section 13560 and shall include the following information as a minimum:
    - .1 Submission date:      Project:
    - .2 Submission #:                      Prepared by:



- .3 Quantity: Instrumentation Tag:
- .4 Manufacturer: Model No.:
- .5 Description: Contractor ID No.:
- .6 Each shop drawing submission shall include a shop drawing overview submission sheet that identifies information related to the project. The shop drawing overview submission sheet shall include the following information:
  - .1 Date of submission:
  - .2 Project:
  - .3 Prepared by:
  - .4 Submission Number: (i.e. identify if it is first submission or resubmission)
  - .5 Equipment Tags: (summarize all Tags for equipment submitted for review)
- .7 Any deviation from the above noted submission requirements and Section 13560 will result in the rejection of the submission.

## **1.9 Operations and Maintenance Manuals**

1.9.1 Provide Operations and Maintenance (O&M) Manuals in accordance with Section 01780.

1.9.2 The following printed materials shall be provided a minimum:

- .1 Detailed (O&M) manuals shall be provided with complete information concerning the operation of the system and support necessary with diagnostics.
- .2 Data sheets shall be supplied for all equipment used in the system. The data shall include, as a minimum, the component name; manufacturer; model number, quantity and all special (O&M) characteristics.
- .3 Final as-built drawings of equipment shall be provided and as a minimum include:
  - .1 Overall dimensions details for each equipment and all door mounted operator devices including nameplate designations.
  - .2 Interconnecting wiring diagrams of all control equipment, communications networks, and remote switchgear control panels.

## **1.10 Work Included**

1.10.1 The Contractor shall be responsible for the:

- .1 Supply, installation and commissioning of all Controls & Instrumentation equipment and devices specified herein and/or shown on drawings.
- .2 Updates to the existing PLC automation system and existing SCADA HMI. This task is to be performed by the approved Control System Integrator/Programmer (CSIP).
- .3 Preparation of all descriptive data, schematic layout, interconnecting wiring diagrams, and communications architectures for submission and review as herein specified and in accordance with the requirements of the contract.

- .4 Installation of wiring and wiring terminations to suit connection of field devices as shown on contract drawings.
- .5 Testing, calibration, and commissioning of each signal loop.
- .6 Supply and installation of all Terminal Blocks, control wiring, and auxiliary relays as shown on the drawings.
- .7 The installation, wiring and point by point checkout of proposed field devices and instrumentation.
- .8 The installation and wiring of all control and instrumentation equipment supplied under this contract.
- .9 Provide complete record drawings. Drawings to be produced using the latest version of AutoCAD program and supplied to the customer on USB. Also provide one print set of reproducible record drawings (size A1). The Contractor shall also be responsible for providing detailed wiring diagrams, and equipment manual, upon satisfactory commissioning and certification of work.
- .10 Division 16 to provide power to all electrical equipment whether equipment supplied by this Division or by others, or pre-selected. Provide local disconnect switches (fused or un-fused) as required by code whether shown or not. Coordinate this equipment supply and wiring with the Electrical Contractor.
- .11 Commissioning of all equipment to be by the manufacturer's representative.
- .12 Detailed control loop wiring drawings for the proposed hardware in latest version of AutoCad as per contract drawings.

#### **1.11 Standards**

- 1.11.1 Comply with the requirements of the latest edition of the applicable CSA Standards, the requirements of the Authorities, Federal, Provincial and Municipal Codes, the applicable standards of the Underwriter's Association and all other authorities having jurisdiction. These codes and regulations constitute an integral part of these Specifications. In case of conflict, the codes take precedence over the Contract Drawings.

#### **1.12 Coordination**

- 1.12.1 It will be the responsibility of the Contractor to coordinate work to be wired under this division.
- 1.12.2 The Contractor will coordinate work with other Divisions where there is an impact or overlap of work with this Division.
- 1.12.3 Ensure that other Divisions provide all necessary material and work required by this Division for the installation of equipment and wire, which falls under the responsibility of this division.
- 1.12.4 Conform with Division 1.

#### **1.13 Control System Integrator/Programmer**

- 1.13.1 The Contractor shall retain the pre-approved Control System Integrator/Programmer (**CSIP**) to overlook the replacement of existing IO and ensure seamless transition from the old equipment to the new. Provide all PLC/SCADA programming updates (if required) and inclusive of the following:

- .1 Coordinating with the contractor and executing the verification of the SCADA system including all PLC control panels.
  - .2 Demonstrating the operation of the SCADA system and placing into service all SCADA equipment to the satisfaction of the Engineer.
  - .3 Develop an updated Automation and System Control Narrative (ASCN) based on existing documentation to reflect the upgrades under the scope of work of this project.
  - .4 Updating the existing programming of control panel CP-01 and SCADA Computers to suit the upgrade work, if required.
  - .5 Modify existing graphical user interface applications to suit the SCADA Computers and related custom HMI SCADA application, if required.
  - .6 Verification of all new I/O on site.
  - .7 Assist with start-up & commissioning of all PLC/SCADA controlled equipment.
  - .8 PLC/SCADA Programming documentation
  - .9 PLC/SCADA Manual
  - .10 PLC/SCADA Training – on site
- 1.13.2 The ASCN is to include but not be limited to the following information:
- .1 Describe each upgraded process to be monitored and/or controlled by the automation system.
  - .2 Provide a tag database for all real and virtual signals that will be included in the automation system. Identify the mode/type/units/range for each real or virtual signal.
  - .3 Identify all automation systems integrated into the existing main plant HMI/SCADA application. Produce custom graphical HMI applications to match the full functionality of the status/control/alarm features provided by the respective applications, where applicable.
  - .4 Identify detailed control logic required in the operation of each process including, interlock logic, delay logic, adjustable variables, high/low limits, modes of operation, failure modes, and base conditions
- 1.13.3 Develop a work plan with an itemized list of all deliverables.
- 1.13.4 The pre-approved Control System Integrator/Supplier for this project is:
- .1 Selog  
Peter Chung  
905-873-7373 ext. 203
- 1.13.5 The Contractor shall provide the following:
- .1 Verification and demonstration of all I/O on site.
  - .2 Start-up & commissioning of all PLC/SCADA controlled equipment.

## **1.14 Job Conditions**

- 1.14.1 Examine the site and contract documents in accordance with Instructions to Bidders.
- 1.14.2 Attend site visits during the tender period to verify the existing conditions to suit the required works shown on the drawings and specified herein.

## **2 PRODUCTS**

### **2.1 General Requirements**

- 2.1.1 All line voltage powered instruments are to be suitable for a 120VAC power supply. All line voltage AC powered instrument not CSA certified must bear an ESA Special Approvals Branch label.
- 2.1.2 Normal instrument and control power supply for the Contract is 120VAC. Emergency power supply is from associated UPS. Provide all line powered instruments suitable for use on these supplies with appropriate CSA approval. All UPS power feeds are to be sourced from the treatment plant existing emergency generator electrical distribution system.
- 2.1.3 As applicable, instrument control output is to be from 4 to 20 mA, linear, isolated capable of driving a maximum load of 750ohms, unless otherwise specified.
- 2.1.4 Provide all the necessary mounting hardware, electrical connections, transducer junction boxes, power supplies, and all accessory items or options required to satisfy each application.
- 2.1.5 Provide corrosion resistant stainless steel or epoxy coated screws, bolts, fasteners, etc. in all applications.
- 2.1.6 Provide all special instrumentation communication cables, transducer cables, power cables, process sensing/sampling lines and capillary tubing in field measured lengths without joins as required by manufacturer. Allow adequate cable/capillary etc. to allow removal of instrument/transducer from process. Agree instrument-mounting locations with Engineer to ensure accurate field measurements.
- 2.1.7 Provide mechanical protection for capillaries and transducer cables and adequately secure to eliminate sagging.
- 2.1.8 All instruments shall be provided with process isolation valves. Valves must be utilized on all instrument lines for easy removal without disruption to the process.
- 2.1.9 All readouts, indicators, recorders, etc., shall be in metric units, whether shown or not and in engineering scales. All final units, ranges, set points, colours, etc., will be finalized on the shop drawings.
- 2.1.10 The Contractor shall be responsible for supplying all required communications setup and/or wiring, etc., and all other appurtenances which may be required, in order for the entire control and instrumentation system to operate as intended by this specification and as designed. Unless specifically stated otherwise, all control and readout signals, etc., shall be linear.
- 2.1.11 For wiring, see Division 16.
- 2.1.12 Equipment specified includes automation hardware, communications hardware and control equipment (including panels/enclosures) as specified herein and shown on drawings.
- 2.1.13 Without limitation to the following sections of this item, the equipment supplied shall be complete with all accessory items, whether specifically mentioned or not, so as to provide completeness of installation, and operation as intended.

- 2.1.14 The equipment specified shall generally be an "all electronic" control system, with linear isolated outputs from all instruments, 4-20 mA DC unless otherwise noted, and suitable for 115 volts, 60Hz, single phase operation.
- 2.1.15 No instruments shall be included in the design which utilize mercury or all other highly toxic substances, which through error or otherwise may enter and endanger the water supply.
- 2.1.16 All instruments and control elements shall be fully pre-wired and pre-piped in the factory and shall be equipped complete with terminal, terminal blocks and taps suitable for direct connection in the field.
- 2.1.17 Mounting brackets, hooks, plates, screws, bolts, anchors, etc., shall be stainless steel or epoxy coated and of sufficient size to permanently mount the equipment.
- 2.1.18 All process controls and instrumentation shall be complete with all necessary appurtenances to perform the functions indicated on the control schematics and electrical drawings with respect to inputs, outputs, etc.
- 2.1.19 Equipment specified includes instrumentation (including appropriate mounting hardware) and control equipment (including panels/enclosures) as specified herein and shown on drawings. Primary devices, transmitters, receivers, signal protection, conditioning equipment, indicators, switches (pressure/flow/temp.) etc. is to be included.

## **2.2 Service Conditions and Environmental Requirements**

- 2.2.1 The equipment provided for the control system shall be suitable for the service conditions specified in the equipment sections.
- 2.2.2 All equipment shall be designed and selected to operate without degradation in performance throughout the environmental extremes specified. Equipment shall be designed to prevent the generation of electromagnetic and radio frequency interference and shall be in compliance with FCC Rules and Regulations, Part 15, for Class A computing devices.
- 2.2.3 All control system equipment located in air conditioned rooms shall be suitable for operation in ambient temperatures from 10°C to 35°C and a relative humidity of 10 to 80 per cent, noncondensing. All equipment located in non air conditioned indoor areas shall be suitable for an ambient temperature range of 0°C to 50°C and a relative humidity of 10 to 95 per cent, noncondensing. All equipment located outdoors shall be suitable for operation in an ambient temperature range -20°C to 60°C and a relative humidity of 5 to 100 per cent. Heaters and air conditioning/cooling equipment shall be provided where essential to maintain equipment within its manufacturer-recommended operating ranges.
- 2.2.4 All input/output hardware shall meet or exceed, without false operation, all requirements of NEMA ICS-1-109.60, Electrical Noise Tests.

## **2.3 PLC & Automation Equipment**

- 2.3.1 The existing PLC within CP-01, is comprised of an Allen Bradley SLC 5/05 processor complete with associated I/O cards.

## **2.4 System Software Configuration**

- 2.4.1 The existing SCADA HMI and the system software will be configured by the CSIP to suit the new IO.

## **2.5 Instrumentation, Control, Communication, and Special Field Wiring**

2.5.1 Conform to the requirements of Division 16.

2.5.2 Run all wiring in conduit or duct (underground wire) unless otherwise specified. Refer to this division and to the drawings for additional information, requirements and details.

2.5.3 Provide minimum 20 per cent spare wiring or two conductors (one pair) whichever is greater for each control conduit. Spare control wire shall be tagged as spare at both ends.

2.5.4 All wires must be tagged with pre-numbered slip-on markers. Allow for up to 10 characters per individual wire. No wrap around markers will be accepted.

### **2.5.5 Control Wiring (Field)**

.1 All control wiring to be stranded, annealed copper conductors, 600V minimum rating 14 AWG, RW90 XLPE, 600V rated conductors to be provided.

.2 Where conductors to be buried in conduit 14 AWG, RWU90, XLPE, 600V rated conductors to be provided.

### **2.5.6 Instrumentation Cable (Field)**

.1 Cable to be 300 V rated and meet CSA, C22.2 No. 239 standard with the following features:

.1 Seven strand copper conductor with TW75 (-40°C) 105°C dry PVC insulation formed into pairs or triads.

.2 Aluminum/polyester tape shield over individual pairs or triads.

.3 Individual shield, seven strand tinned copper drain wire.

.4 Aluminum/polyester tape shield over cable.

.5 Overall shield, seven strand tinned copper drain wire.

.6 Ripcord.

.7 90°C (-40°C) FRPVC jacket.

.2 Cable to be as manufactured by SHAWFLEX LTD. or BELDEN LTD.

### **2.5.7 Communication and Special Wire and Cable (Field)**

.1 The Contractor shall provide all wiring and cable, including connectors, plugs and termination devices required for the wiring of the systems and equipment shown on the drawings, unless otherwise specified.

.2 Provide quantities and lengths of cable and wire type as recommended by the system equipment manufacturers. Do not de-rate any cabling and wire. No wire/cable to be sized less than 18 AWG unless approved by the Engineer or unless a specific requirement of the equipment manufacturer.

.3 Coordinate with the manufacturer and other sections of these specifications to ensure proper conduit type (i.e. metal) and sizes are provided.

.4 All cables and wire to be continuous runs.

- .5 Provide, as part of shop drawing submittal, cable and wire specifications and data for each system. Include written proof that cable and wire meets requirements of equipment supplier.
- .6 Any wire and cable installed that does not meet the wiring specifications of the equipment manufacturer shall be removed and replaced (including conduits, if necessary), at the Contractor's expense.

## **2.6 Field Devices and Control Equipment**

- 2.6.1 Unless specified otherwise, transmitters shall be four-wire, suitable for operation on 120 Vac, with 4-20 mA DC linear outputs, complete with direct reading local indicators in engineering scales.
- 2.6.2 Calibration and scale range data indicated may vary during shop drawing review.
- 2.6.3 Provide quantity and tagging to suit the drawings.
- 2.6.4 Acceptable manufacturers of control equipment transmitters shall be as specified for the respective field devices.
- 2.6.5 Level Measurement (LIT)
  - .1 To be supplied and installed in accordance with Section 13563
- 2.6.6 Level Primary Element: (LE)
  - .1 To be supplied and installed in accordance with Section 13563.
  - .2 Transducer cable to be installed in a dedicated conduit OR two cable in the same conduit provided the level indicator units are synchronized.
  - .3 Installation to suit manufactures specification (allow for ease of maintenance and cleaning).

## **3 EXECUTION**

### **3.1 Coordination**

- 3.1.1 Carefully examine and monitor for compatibility, any instrumentation and control work provided as part of the work of Sections of the specification, other than the Sections governed by this Section and ensure that all trades involved are aware of any coordination problems or details.
- 3.1.2 Incompatible work, such as instrument process connections, mounting of equipment, analog, discrete or communication wiring, voltages, or inconsistencies resulting from insufficient coordination of other related work, is to be satisfactorily resolved at no additional cost to the Contract.
- 3.1.3 When scheduling site inspection or commissioning with the Engineer, allow at least 10 working days advance notice.

### **3.2 Manufacturer's Services and Certification of Installation**

- 3.2.1 Comply with the requirement of Section 01000 – Clean Up, Commissioning, and Training.
- 3.2.2 Allow in the tender for all the necessary services and expenses of a trained, qualified manufacturer's representative for each device to ensure correctness of installation, testing, start-up commissioning and training. The qualified representative is to:

- .1 Provide onsite supervision of installation for the initial and critical stages of the work as agreed to with the manufacturer/supplier and as require by the Engineer.
  - .2 Supervise testing of equipment. Supervise retesting of equipment at no additional cost.
  - .3 Provide written certification stating that the work has been completed satisfactorily.
  - .4 Provide a complete Installation, Start-up Checklist and sign off on the start-up work completed.
  - .5 Provide operation and maintenance instruction to the Township operating staff.
- 3.2.3 Provide supervision of installation as required by the manufacturers for all equipment in this Division.
- 3.2.4 Provide all materials, labour and equipment to make any adjustments to the installation as required by the manufacturer or the Engineer to effect performance.
- 3.2.5 On completion of installation and testing, obtain certification from the manufacturers that the equipment is installed correctly, is in full operating condition, and is operating in accordance with its design rating. Submit the original certificate to the Engineer.
- 3.2.6 Include the service of the trained personnel to inspect and commission the equipment when ready for starting and to instruct the operating personnel in the operation and maintenance of the equipment. Time spent on site by the trained personnel must be witnessed by the Engineer.
- 3.2.7 Include above services for all equipment specified in relation to this Section and as a minimum provide commissioning and training as follows:
- .1 Major process equipment – See the list below. Split the specified time into three stages: inspection during installation, start up and commissioning, staff training.
    - .1 Level Instruments
  - .2 One four hour day for all other process instrument, where not specially mentioned
- 3.3 Identification and Tagging**
- 3.3.1 Identify systems and equipment in accordance with the provisions of this specification. Systems and equipment include:
- .1 All items furnished under this contract.
  - .2 Items defined in this contract that require identification;
    - .1 Identification of wiring and electrical equipment as specified and tagged in the PLC I/O list.
    - .2 Provide a Tag text list to Engineer for approval prior manufacturing.
  - .3 Provide tags of the following materials:
    - .1 Field instrument tags are 10 gauge, stainless steel with black lettering.
    - .2 Equipment tags are 10 gauge, stainless steel with green lettering.
    - .3 Control panels tags are to be Lamicoid, black background with white lettering.



- .4 Size tags as 100 x 40 with maximum three lines, front height as 6.5mm.
- .5 Use text with the following characteristics:
  - .1 Lettering – Uppercase
  - .2 Font – Times New Roman
  - .3 Style – Regular
  - .4 Size – Maximum to fit label width, minimum 3mm
  - .5 Character spacing – Normal
  - .6 Justification – Center lettering on each line
- .6 Submit with the Shop Drawings, a typed list indicating all nameplates wording as well as proposed types, sizes and styles.
- .7 Prior to installation of new items, apply identification nameplates to each instrument, panel, telemetry device and controller. Where existing instruments are re-used, or connected into the new system/control panel, provide identification nameplates for these instruments also.
- .8 Lamacoid nameplates shall be provided for each piece of instrumentation equipment. (For interior or exterior panel mounted equipment).
- .9 Mount tags so that they are readily apparent and legible. Place tags within a height range of 1200mm to 1650mm if possible. Do not obscure or mount over other nameplates, labels or tags.
- .10 Nameplates shall be fastened with corrosion resistant screws.
- .11 Nameplates on field equipment and external to control panels to be black background with white lettering. Internal panel labels to be black background and white lettering.
- .12 Identify transducer and miscellaneous hardware with stainless steel labels denoting tag name only, permanently fastened to either the transducer housing or cable.
- .13 Wiring:
  - .1 Identify all PLC I/O signals on field terminal rails with appropriate tag.
  - .2 Identify all wiring at both ends with appropriate, permanent wire markers.

### **3.4 Controller Application Program Installation, Testing & Control System Commissioning**

- 3.4.1 Coordinate all commissioning activities. Supply all labour and materials required to coordinate instrument and controls commissioning with other trades.
- 3.4.2 Provide all labour and materials necessary to commission and operate the system for the duration of the run or period. During this time all equipment is expected to run in automatic mode.
- 3.4.3 Perform the commissioning activities associated with operation of the treatment plant process equipment under control by the software program, as directed by the programmer.
- 3.4.4 Take all necessary steps to ensure that all equipment or parts of the system successfully tested and deemed ready for their intended use stay in operation.

- 3.4.5 Provide clear signs/markings as to required status on the equipment that is to remain powered up, left in Auto, or remain Off, etc., during the commissioning period. Agree with the Engineer on the method for achieving this and ensure safe and compliant operation of the equipment at all times.
- 3.4.6 Adopt a recognized lock-out policy and agree to it with the Engineer. Coordinate the requirement for lock-out for safety reasons with the scheduled commissioning program so that all equipment needed to commission a process/area is available concurrently.
- 3.4.7 Make minor corrections/additions to wiring, terminations, instrument calibrations and settings as normally expected necessary to resolve operational problems during commissioning at no additional cost.

### **3.5 HMI & PLC Acceptance Testing**

#### **3.5.1 General**

- .1 The acceptance testing procedures must thoroughly exercise and demonstrate all system functions including HMI and PLC programs. Acceptance testing includes the SAT (Site Acceptance Testing).
- .2 The Site Acceptance Test (SAT) is intended to show the proper functioning of the new equipment connected to its final real-world process components.

### **3.6 FACTORY ACCEPTANCE TESTING**

- 3.6.1 Minimum adjustments are expected in the existing control system/equipment, if any, and therefore a FAT is not required.

### **3.7 Site Acceptance Testing (SAT)**

- 3.7.1 When initial site inspections and commissioning of the instrumentation and the control system is satisfactorily complete, schedule with the Engineer to demonstrate the entire system is ready to start control application program commissioning.
- 3.7.2 Include for the presence of qualified instrument technicians and equipment manufacturer's representatives to supervise the test if requested by the Engineer. Testing is to demonstrate the proper operation of all field physical input and output signals of the PLC system under actual operating conditions to the satisfaction of the Engineer. This includes proper operations between PLCs, and all peripheral devices. Supply all labour, instruments and materials to perform the testing.
- 3.7.3 The SAT must be satisfactorily complete prior to applying for a Certificate of Substantial Performance.
- 3.7.4 Deliver all testing software, panel keys etc. to the Engineer.
- 3.7.5 Provide test programming to suit all PLC applications and provide I/O and communications demonstration.
- 3.7.6 The purpose of SAT is to complete the full implementation of the upgraded system and to perform a final exhibit of the implemented control philosophies. The SAT demonstrates the operation of the actual plant equipment under SCADA control once the system has been installed and commissioned in the field. It provides a final opportunity for the CSIP to locate and correct any issues in the control logic. Additionally, the SAT is a final opportunity to fine-tune any programmed parameters within the control system. Also during the SAT the software is confirmed against the physical installation including the checking of interlocks, backup control, fault response, and power failure.

- 3.7.7 The SAT is performed on-site with the actual equipment. Individual alarm and virtual point testing for analogs and device control is not duplicated rather a focus on the interaction between the software and the field is tested. Generally, a team approach works best for SAT, since rarely does one individual have the breadth of knowledge required to oversee these tests. The SAT test team should be comprised of both Consultant, Township representatives, and the Installation Contractors.
- 3.7.8 A SAT test plan must be developed and submitted to the Township for approval no later than two weeks prior to the scheduled start of SAT. At minimum, the following items must be included in the SAT plan:
- .1 Roles and responsibilities of SAT team participants;
  - .2 SAT schedule;
  - .3 Any safety or process related considerations; and,
  - .4 Procedure for performing tests.
- 3.7.9 All present at the SAT will receive a copy of the approved SAT test plan and checklist for recording test results.
- 3.7.10 During the SAT, a designated Township representative shall witness the performing of each test case. Ideally, there should be no outstanding programming deficiencies at this point in the testing. Thus, all test cases are to be signed off at this point. If any defects are identified, they are to be logged on the deficiencies list. It should be noted that during the SAT items not specifically related to the PLC or SCADA system may be identified as deficiencies and requiring correction by the contractor.
- 3.7.11 No later than a week after the completion of SAT, a SAT test report shall be submitted to the Township. The SAT test report shall:
- .1 Describe any deviations from the SAT test plan;
  - .2 Summarize test results; and,
  - .3 Explain any discrepancies and plans for corrective action.
- 3.7.12 Once deficiencies are corrected and successfully retested the SAT signoff form shall be presented to the Township. The Township representative will sign that they have witnessed the system working as outlined in the SAT test plan and that they are prepared to perform the system handover.
- 3.7.13 The programmers shall update the process control narrative and submit it to the designers as the As-Programmed narrative so that any and all SCADA changes implemented during the course of the project are recorded.

### **3.8 Training**

- 3.8.1 Comply with the requirements of Section 01820 – Demonstration and Commissioning.
- 3.8.2 Supply a site training program for the plant operating personnel consisting of:
- .1 Maintenance Training (2 hours) by Instrument Supplier and/or appropriate equipment manufacturer's representatives.
  - .2 Operator training (2 hours) by Instrument Supplier.

- 3.8.3 Dates personnel receiving training shall be coordinated with the Township.
- 3.8.4 The training program is to be conducted by qualified instrument technicians and competent manufacturer's personnel experienced both with the product and with instruction, using system operation and maintenance manual data as the basis for demonstrations and instructions.
- 3.8.5 Training shall take place at the Pumphouse. Operation and maintenance manuals shall be submitted to the Township a minimum of 30 days prior to the training occurring.
- 3.8.6 The training program is to include routine maintenance of the equipment.
- 3.8.7 The site training program must be complete prior to application for a Certificate of Substantial Performance of the work.
- 3.8.8 Pay all costs associated with the training program, with the sole exception of salaries associated with the operating personnel being trained.

### **3.9 Process Performance Operation**

- 3.9.1 Provide all labour and materials necessary to support the process and the instrumentation and control system for the duration of the contract performance run. During this operation all equipment is expected to run in automatic mode.

### **3.10 Warranty and Guarantee Period Activities**

- 3.10.1 During the warranty period, hardware service should be provided by a factory trained service representative who shall be on-site within 24 hours of a service request, seven days/week, including weekends and holidays. The service representative shall be equipped with all necessary tools, testing equipment, spare parts, and expertise to perform the service in one visit.

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

- .1 Part numbers, description and prices for items replaced.
  - .2 Revised hard copy/soft copy listings of program changes.
  - .3 Hours worked by maintenance personnel.
  - .4 Reason for the service call, and whether preventative, unscheduled or corrective maintenance was carried out.
  - .5 Name of Township representative present during repairs. Explain the problem and solutions to the Township representatives.
  - .6 Description of problem as discovered on arrival at site and itemized report of activities performed to isolate and correct problem.
  - .7 Identification of any required actions to prevent similar future occurrence.
  - .8 Name of attending operations representative, time of call and time of arrival on site.
- .2 A single contact point shall be provided for all hardware such that the Township representative need only call a single phone number irrespective of which piece of hardware has failed.

### **3.11 Installation of Equipment**

- 3.11.1 Provide all necessary labour, equipment, tools, anchor bolts, etc., for the complete installation of all equipment specified under this Division.
- 3.11.2 Install all equipment in a workmanlike manner and in accordance with the manufacturer's drawings, instructions and/or under the direction of his qualified technical representative unless otherwise specified or instructed by the Engineer.
- 3.11.3 Existing PLC automation, SCADA HMI's and communications networks must remain in service for the duration of the contract. The Contractor must obtain written approval from the Engineer and owner prior to integrating the new I/O and communications links into the existing RPU control panels.
- 3.11.4 A representative from the Owner must be present during any interruption to the existing PLC, RPU and/or SCADA networks to suit the clarifier upgrades. The Contractor shall coordinate the attendance of the Owners representatives.

### **3.12 Supervision and Commissioning**

- 3.12.1 A supervision and commissioning period shall be allowed for by the Contractor for his supplier to thoroughly check the final installation and performance of each individual piece of equipment, to check each loop control, to start up the equipment and to instruct the Plant Operator on the operation and maintenance of the system. The work shall also include site supervision of the installations where necessary, repair and/or adjustments to the supplier's equipment, and co-ordinate the field supervision by other suppliers and the Contractor within their areas of responsibility.
- 3.12.2 The start-up procedures will not be carried out without the cooperation and presence of the Engineer. The Contractor shall be responsible for co-ordinating the work, and for making his supplier available to completely commission the entire control and instrumentation system so that it is in perfect running order. The cost of this supervision and commissioning by the supplier for the Contractor shall be total included for in the Contractor's tender. No extra accommodation or meal expenses will be paid. The Contractor remains responsible for a complete and working system, in full accordance with these documents, and at the price bid in his tender.
- 3.12.3 The Contractor shall obtain written approval from the Engineer, Owner, and Operator prior to modifying the existing system.
- 3.12.4 The commissioning will not be considered complete without a complete, final, and up-to-date test software listing being supplied.
- 3.12.5 The complete control system and instrumentation must be fully operational and without deviancies prior to implementation of the client supplied custom automation programming.
- 3.12.6 The Contractor shall provide the services of the installing electrician, on site for a period of not less than 15 non-consecutive days to assist in the testing of the client supplied custom automation applications. Any changes or adjustments to field wiring, setpoints, and system operation shall be at no cost.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- 1.1.1 Section 01330 – Submittal Procedures
- 1.1.2 Section 01820 – Demonstration and Training
- 1.1.3 Section 13563 – Level and Pressure Instruments
- 1.1.4 Section 16010 – Electrical General Requirements

### **1.2 Scope**

- 1.2.1 This section covers the furnishing of all instrumentation equipment required for the Control & Instrumentation System as indicated on the P&ID drawings and the sections herein.
- 1.2.2 Principal components of the instrumentation systems shall be as indicated on the Contract drawings. The contractor is required to provide all instruments including electronic/electrical and non-electronic/electrical instruments.
- 1.2.3 Provide product submittal data sheets for all instrumentation supplied under this project in the format identified in the sample forms included at the end of this section.
- 1.2.4 Section 13100 shall apply to all systems described in this section. All applicable requirements defined in Section 13100 shall apply to equipment and services provided under Section 13560.

### **1.3 General**

- 1.3.1 The Contractor shall select the equipment furnished under this section for its superior quality and the intended performance. The Contractor shall install all equipment in accordance with the manufacturer's instructions. Equipment and materials used shall be subject to review and shall comply with the following requirements.
- 1.3.2 Refer to Division 1 specifications for general equipment requirements which shall apply to all equipment furnished under this section.
- 1.3.3 Supplementing this section, the drawings indicate locations and arrangement of instruments and enclosures, provide mounting details, and may show device schedules and other information regarding the connection and interaction with other equipment.
- 1.3.4 Governing Standards for instruments shall be as indicated in Section 13100.
- 1.3.5 All parts, which are exposed to corrosive conditions, shall be made from corrosion resistant materials. Contractor shall submit certification that the instrument manufacturer approves the selection of materials of primary elements that are in contact with the specified process fluid to be inert to the effects of the process fluid.
- 1.3.6 Power and Instrument Signals. Unless otherwise indicated, electric power supply to the instrumentation equipment will be unregulated 120VAC and emergency electrical power will be from a diesel generator. All line powered instruments suitable for use on these supplies shall be provided with appropriate CSA approval. Line voltage ac powered instrument not CSA certified must bear an Electrical Safety Authority Approvals Branch label.
- 1.3.7 Unless otherwise indicated, all transmitted electronic analog instrument signals shall be 4-20 mA DC and shall be linear with the measured variable.

- 1.3.8 Appurtenances. Signal converters, intrinsically safe relays, signal boosters, amplifiers, special power supplies, special cable, special grounding, and isolation devices shall be furnished as needed for proper performance of the equipment.
- 1.3.9 Interchangeability and Appearance. To the extent possible, instruments used for similar types of functions and services shall be of the same brand and model line. Similar components of different instruments shall be the products of the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished.
- 1.3.10 Programming Devices. A programming or system-configuring device shall be provided for systems that contain equipment that requires such a device for routine calibration, maintenance, and troubleshooting.
- 1.3.11 Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with equipment drawings and shall be as close as practical to the tag numbers used on the project drawings and device schedules. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanel, and rack-mounted devices shall have laminated phenolic identification tags securely fastened to the device. Hand-lettered or tape labels will not be acceptable.
- 1.3.12 Indoor Installation. Unless otherwise shown or specified, enclosures for all instruments located indoors in dry hazardous areas shall be as a minimum EEMAC12.

#### **1.4 Submittals**

- 1.4.1 Submittals shall be as required in Section 13100 - Control and Instrumentation System and Section 01330 – Submittal.
- 1.4.2 Product Data Sheets. Provide completed product Data Sheets specifying instruments and equipment conforming to ISA specification sheet standards. Complete blank spaces on these sheets with the information noted below and other data pertinent to the equipment and the application.
- .1 Use the product data sheet for documenting installation and testing.
  - .2 Include the following upon initial submission (to accompany Shop Drawings):
    - .1 Project Name
    - .2 Tag number and description.
    - .3 Manufacturer, Model and Part Numbers.
    - .4 Identification Nameplate details.
    - .5 The product manufacturer and the supplier or representative.
    - .6 The complete model and catalogue numbers including special options.
    - .7 The available adjustment ranges and the project operating ranges.
    - .8 Web link for each product manufacturer.
    - .9 On each sheet, add the following information following field calibration:
      - .1 Serial numbers.

- .2 Date of installation.
- .3 Date, time and person who performed calibration.
- .4 Calibration data.
- .5 Input, output, and error at 0, 25, 50, 75, 100 per cent of span for analog instrument.
- .6 Switch setting, contact action, and dead band, if applicable, for discreet elements.
- .7 Certification by installer and acknowledgement by contractor.
- .8 Special procedures and equipment required to duplicate calibration.
- .9 Comments, including calibration changes, repair or replacement works performed.
- .10 Add the following upon final submission (immediately following site acceptance):
  - .1 Signature by the Contractor and the Engineer indicating acceptance.
  - .2 Phone and fax numbers of contact person for product support/service.
  - .3 Provide a completed Instrumentation Installation "Checklist" form for each instrument.

## **1.5 Delivery, Storage, and Shipping**

- 1.5.1 Delivery, storage and shipping shall be as required in Division 1 and Section 13100.

## **1.6 Spare Parts**

- 1.6.1 Spare parts shall be provided as following: duplicated full set of lamps for indicating lights, terminal blocks, fuses, breakers, relays and timers.
- 1.6.2 Supply spare parts required to commission instruments. Include five spare fuses of each type for each instrument panel.

# **2 PRODUCTS**

## **2.1 Individual Device Specifications**

- 2.1.1 Section 13563 – Pressure and Level Instruments

# **3 EXECUTION**

## **3.1 Instrumentation Installation Requirements**

- 3.1.1 Additional instrumentation installation requirements are specified in Section 13100.
- 3.1.2 Instrumentation field wiring shall be continuous, no splices.
- 3.1.3 Complete an Instrumentation Installation Checklist Form and Instrumentation Calibration Form for each instrument that is tested and commissioned. Testing and commissioning of the instruments will be considered incomplete unless the respective instrument is provided with an Instrumentation Calibration Form, with all fields completed. The contractor shall provide a typed version of the completed calibration forms to be included in the maintenance manual.



- 3.1.4 Field Calibration. After each instrument has been installed, a technical representative shall calibrate each instrument and shall provide a written calibration report for each instrument, indicating the results and final settings. The adjustments of calibrated instruments shall be sealed or marked, insofar as possible, to discourage tampering. Instrument calibration shall be done before checkout of the system operation. A typical instrument calibration form and Instrumentation Installation Checklist form is attached to the end of each section.
- 3.1.5 Systems Check. A technical representative shall participate in the checkout of instrumentation systems. Systems check requirements shall be as specified in Section 13100.
- 3.1.6 Installation Test Equipment. Unless specified otherwise, all test equipment for the calibration and checking of system components shall be provided by Contractor for the duration of the testing work and this test equipment will remain the property of the Contractor.
- 3.1.7 Mounting of Field Instruments. Instruments shall be mounted so that they can be easily read and serviced and so that all appurtenant devices can be easily operated. Installation details for some instruments are indicated on the drawings. Where installation details are not indicated, the installation performed shall conform to the manufacturer's instructions and/or API RP 550 recommendations.
- .1 Unless otherwise shown or specified, all required mounting hardware, enclosures, termination's, junction boxes, etc., shall be provided. Refer to the tender drawings and the manufacturer's documentation to confirm the necessary hardware and construction for specific mounting assemblies where such details are not specified herein.
  - .2 No instruments shall be mounted on vibrating structures (e.g. handrails), or on piping or near equipment that induces vibration. No instruments shall be mounted below or directly adjacent to lines conveying corrosive chemicals or near sources of leakage or spillage.
  - .3 Metal surfaces shall be prepared and supports or frames shall be painted the same color as the member of the complete assembly is mounted on.
  - .4 Unless otherwise shown or specified, instruments shall be mounted 1.4m above finished floors, grade or platforms. Allow for cabinet plinth/floor-pad heights when locating panel instruments. Instruments that are not easily accessible for operation or maintenance, or indicator that is not easily and readily visible must be relocated as directed by the Engineer at no cost to the contract.
  - .5 When drilling or installing conduit entry points in instruments, protect internally mounted equipment from vibration, shock and metal filings. Conduit entries must maintain the equipment or panel EEMAC rating.
  - .6 Lengths for transducer cables and similar items shall be field measured prior to ordering. Cables shall be mechanically protected and adequately secured in place without sagging.
  - .7 All instruments shall be provided with isolation valves.
  - .8 All instrument cables shall be protected with capillaries throughout their length without sagging by using painted/galvanized angle iron and clips. Avoid sharp bends in capillary and coil excess close to the sensor end. Protect the coiled capillary by clipping to a steel plate or other safe method.
  - .9 Instruments shall be positioned so that they do not block or obstruct walkways or access points and adequate space shall be provided around installation for removal of covers, etc.
  - .10 Instrument support brackets shall not be welded to process piping or equipment but should generally be pedestal or wall mounted.

- .11 Field cables for analogue signals shall be run in separate conduit from 120V AC/24VDC control or 120VAC power supply cables.
- .12 Field junction boxes suitable for the area classification to “marshal” groups of signals of the same type in an area and cable back to buildings and local control panel with multi-core cables shall be used.
- .13 Junction boxes may be FRP (fiberglass reinforced plastic) or similar material suitable for the area and rust and weather resistant. Terminals inside field junction boxes are to be DIN rail mounted.
- .14 Once an instrument has been inspected by the Engineer and initially calibrated, it is to remain powered up at all times unless servicing the instrument itself.
- .15 Instrument calibration, setpoints and other programmable parameters are to be confirmed with the Engineer during on-site inspection as soon as site conditions are sufficiently ready. Final calibration values may be adjusted to values different than the nominal values specified in the Product Data Sheets at no extra cost to the contract.
- .16 Provide the necessary mechanical shields, mounting plates to properly secure and protect transducers. Provide stilling wells wherever turbulence can adversely affect measurement.

### **3.2 Customer Training**

- 3.2.1 Provide Instrumentation training in accordance with Section 13100 and Section 01820 Demonstration and Training.

### **3.3 Forms**

- 3.3.1 Provide the calibration report from the vendor as a pre-SAT activity and have this available prior to commissioning.
- 3.3.2 Complete an Instrumentation Installation Checklist Form and Instrumentation Calibration Form for each instrument that is tested and commissioned.

### Instrumentation Installation Checklist

Project Name:	Project Number:	
Contractor:	Contract Number:	

<b>EQUIPMENT:</b>		<b>DATE INSTALLATION</b>	
		<b>COMPLETE:</b>	
<b>SERIAL NO.:</b>		<b>MAKE AND MODEL NO.:</b>	
<b>PRE-START-UP</b>	<b>CHECKED BY</b>	<b>DATE</b>	<b>REMARKS</b>
Installation/Mounting Sensor/Transmitter			
Wiring/Conduit Termination and Seals			
Check Fuse Ratings (Supply and Internal)			
Tagging/Nameplate			
Compliance Section 16			
Test (Ground Loop, Continuity, Installation)			
Power Supply			
Check Instrument Air/Adjust Filter/Regulator			
Check Temp. Control (Internal/Heat Tracing)			
Configure Calibration			
Tailback lights			
<u>START-UP</u>			

Verify Operation Under Max Process Conditions			
Correct Quantities of Expandable Material			
* Indicates (N/A) if not applicable			
Comments:			
Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection

\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Supplier

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

\_\_\_\_\_  
Consultant

\_\_\_\_\_  
Region/Operator

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

### Instrumentation Calibration Form

Project Name:	Project Number:	
Contractor:	Contract Number:	

Equipment:			
Tag/Instrument Number:			
PLC:			
Input Point:			
Manufacturer:			
Model Number:			
Serial Number:			
Calibration Range:			
Service			
Temperature		Chlorine Residual	
Pressure		pH	
Differential Pressure		Density	
Flow		Dissolved Oxygen	
Level		Gas monitoring	
Weight		Others	
Type			
4-20 mA		0-100 VDC	
0-20 mA		Digital Input	
1-5 VDC			
Power Source			

120 VAC		Dry Contact	
24 VDC			
Alarms – Hardwired			
HIHI		LO	
HI		LOLO	
Failure			
Alarms – Software			
HIHI		LO	
HI		LOLO	
Failure			
Test Full Range			
0 %		75 %	
25%		100 %	
50 %		On/Off (Digital)	
Verification			
Contractor			
Consultant			
Region			
Date			
Comments			

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	
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\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Supplier

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

\_\_\_\_\_  
Consultant

\_\_\_\_\_  
Region/Operator

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- 1.1.1 Section 13100 – Control & Instrumentation
- 1.1.2 Section 13560 – Instrumentation General Requirements
- 1.1.3 Section 16010 – General Electrical Requirements

### **1.2 Scope**

- 1.2.1 This section covers the furnishing of all pressure and level instruments and accessories required for the Control and Instrumentation System as indicated on the drawings or on the Instrument Device Schedule.
- 1.2.2 Equipment and services provided under this section shall be subject to the General Instrumentation Requirements specified in Section 13560. This section shall be used and referenced only in conjunction with Section 13560. Supplementing Section 13560, instrument data, special requirements, and options are indicated on the drawings or the Instrument Device Schedule.
- 1.2.3 The Contractor shall install the instruments on the locations as shown on the Contract Drawings and provide all signal and power cables. If the cables are not presented on the Contract Drawings, the Contractor shall coordinate with the Engineer, the installation location, but no extra cost of the installation is allowed.

### **1.3 Design Criteria**

- 1.3.1 Instrumentation is to be wired in the manner shown in the Instrumentation Loop Drawings in the Contract Drawings set and Specs. In the event of a wiring discrepancy between the instrumentation and the Contract Drawings, the Contractor is to ask the Engineer for Direction.
- 1.3.2 Each device shall be a pre-assembled, packaged unit. Upon delivery to the work site, each device or system shall be ready for installation with only minor piping and electrical connections required by the Contractor.
- 1.3.3 Primary elements shall derive any required power from the transmitter, unless otherwise indicated.
- 1.3.4 The instruments shall be installed to measure, monitor, or display the specified process at the ranges and service conditions indicated on the drawings or as indicated in the Instrument Device Schedule. The instruments shall be installed at the locations indicated on the drawings or in the Instrument Device Schedule.
- 1.3.5 Where possible, each instrument shall be factory calibrated to the calibration ranges indicated in the drawings or in the Instrument Device Schedule. Transmitters or similar measurement instruments shall be calibrated using National Institute of Standards and Technology (NIST) approved bench calibration procedures, when such procedures exist for the instrument type. For "smart" devices, calibration data shall be stored digitally in each device, including the instrument tag designation indicated on the drawings and/or Instrument Device Schedule.



## **1.4 Submittals**

- 1.4.1 Submittals shall be made in accordance with the requirements of Section 13100.

## **1.5 Shipment, Protection, and Storage**

- 1.5.1 Equipment provided under this section shall be shipped, protected, and stored in accordance with the requirements of Section 13560. Identification of packaging shall be as described in Section 13560.
- 1.5.2 Cleaning. Instruments indicated to be utilized in oxygen, ozone, or similar service shall be cleaned for oxygen service, labeled appropriately, and bagged or packaged as necessary to ensure the instrument will remain suitable for insertion in the process during installation. Any special mounting or installation requirements associated with such instruments shall be detailed on tags attached to the instrument.

# **2 PRODUCTS**

## **2.1 General**

- 2.1.1 The following paragraphs provide minimum device requirements. The drawings or Instrument Device Schedule shall be used to determine any additional instrument options, requirements, or service conditions.
- 2.1.2 Interconnecting Cable. For systems where the primary element and transmitter are physically separated, interconnecting cable from the element to the transmitter shall be provided. The cable shall be the type approved by the instrument manufacturer for the intended purpose of interfacing the element to the transmitter. Length of cable shall be a minimum of three meters or as indicated in the drawings or Instrument Device Schedule.
- 2.1.3 Programming Device. For systems that require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided for the City facility. The programming device shall include appropriate operation manuals and shall be included in the training requirements. For systems that allow the programming device functions to be implemented in software, running on a laptop computer, the software shall be provided instead of the programming device.
- 2.1.4 The programming device shall be complete, newly purchased for this project, and shall be in like-new condition when turned over to the City at completion of startup.
- 2.1.5 Configuration Software/Serial Interface. Devices indicated as requiring a serial interface shall be provided with all accessories required to properly communicate over the serial link. As a minimum, an appropriate cable shall be provided to allow the transmitter serial interface to be connected to a personal computer. One licensed copy of the diagnostic/interface software shall be provided for the City facility. Software shall be capable of running under Microsoft's Windows 8, Windows 7, and Windows XP operating system.

## **2.2 Pressure Transmitters**

- .1 Not used.

## 2.3 Level Transmitters

2.3.1 Ultrasonic Level Transmitters: Each ultrasonic level transmitter shall be a microprocessor based electronic unit consisting of a sensor assembly, a signal converter/transmitter, and an interconnecting cable if necessary and if suitable for the application. The sensor shall be encapsulated in a chemical and corrosion resistant material such as kynar or CPVC, and shall be suitable for operation over a temperature range of -45° to 90°C and a relative humidity of 100 percent condensing. The sensor shall be compatible with the process media being measured.

- .1 The supplier shall coordinate the sensor mounting requirements and furnish drawings complete with dimensions and elevations. General installation requirements are indicated on the drawings.
- .2 The ultrasonic level transmitter shall have automatic compensation for changes in air temperature at the sensor location. If separate temperature sensing probes are provided, they shall be mounted with or adjacent to the ultrasonic sensor, as recommended by the manufacturer. The transmitter shall have a local backlit LCD, which displays level in engineering units, with additional indicators for alarms and status conditions. Digit height shall be approximately 12 mm. The transmitter shall be designed to ignore momentary level spikes, false targets, or momentary loss of echo. A loss of echo condition shall be indicated on the transmitter unit and shall be available as an alarm contact output. The loss-of-echo alarm shall fail to "Hold Last State" position after five (5) minutes. The transmitter output shall be an isolated 4 to 20 mA dc signal linearly proportional to the measured level range. Calibration parameters shall be entered through a keypad on the unit and shall be stored in non-volatile EEPROM memory. Transmitters shall have Microsoft windows based graphical programming software and RS-485 interface. Accuracy of the transmitted signal shall be +/- 0.25 % of full scale with repeatability of +/-0.5% of full scale and linearity of +/-0.5% of full scale.
- .3 Transmitters shall contain six (6) independently adjustable level alarm contact outputs (6 relay outputs). Contacts shall be rated not less than 5 amperes at 120VAC. All contacts must provide at least a NO contact, with at least two being Form C contacts
- .4 A sufficient length of sensor to transmitter signal cable shall be furnished with the instrument to locate the sensor 7.6 to 61 m from the signal converter.
- .5 Transmitters shall at minimum be enclosed in a NEMA Type 4X housing. Where transmitters are installed in Class 1, Division 1 environments, the transmitter shall be certified for such areas. When ultrasonic level instruments are comprised of separate transmitters and sensor units, the transmitter enclosures shall be suitable for wall or pipe stand mounting.
- .6 Ultrasonic level instruments to be installed outdoors shall be capable of operating at temperatures of -26° to +51°C and a relative humidity of 10 to 100 percent. A thermostatically controlled strip heater shall be provided in the signal converter enclosure.

2.3.2 Level Transmitters shall be installed in the following locations and sized as follows:

Location	Tag Number	Liquid type	Type	Number of units	Acceptable Product
Reservoirs - Cell 1 - Cell 2	LIT-101	Well water	Ultrasonic	1	Siemens Multiranger 200 with two Siemens

Location	Tag Number	Liquid type	Type	Number of units	Acceptable Product
					XPS-10 transducers (one for each cell)

- .1 If the installation location is not shown on the Contract Drawings, the Contractor shall coordinate with the Engineer, the location of transducer and monitor / controller, but no extra cost of installation is allowed.

### **3 EXECUTION**

#### **3.1 Field Services**

- 3.1.1 Manufacturer's field services shall be provided for installation, field calibration, startup, and training as specified in Sections 13100 and 13560.
- 3.1.2 Instruments shall not be shipped to the Work Site until two weeks prior to the scheduled installation. CSS shall be responsible for coordinating the installation schedule with the Installation Contractor. Each shipment shall contain a listing of protective measures required to maintain sensor operation, including a listing of any common construction or cleaning chemicals that may affect instrument operation.

**END OF SECTION**