

Part 1 General

1.1 REQUIREMENTS OF WORK

- .1 Supply, install, commission, provide warranty and fully document a complete instrumentation and control (I&C) system as shown on the Drawings and as specified herein. The I&C system contains vendor component subsystems specified in this and other Sections of the Specification.
- .2 Component subsystems of the I&C system will include, but are not limited to, the following:
 - .1 Primary elements and transmitters
 - .2 Final control elements
 - .3 I&C field devices
 - .4 I&C junction boxes and marshalling panels
 - .5 Instrumentation cabling
 - .6 Instrumentation power supplies
 - .7 Conduit and cable tray
- .3 The Contractor's responsibility also includes receiving, uncrating, examining for shortages or damage, assembling, field fitting, installing, mounting, wiring and testing of vendor supplied component subsystems.
- .4 Where packaged, stand-alone control systems are supplied under other Divisions of this Specification, provide cabling to connect to the required remote monitoring and/or control functions. Provide end-to-end Commissioning of all required remote monitoring and/or control functions. Ensure the correct functionality of any equipment supplied under other Divisions of this Specification.
- .5 Documentation referred to in 1.1.1 to include as a minimum:
 - .1 Equipment descriptive data
 - .2 Equipment installation, service manuals, O&M Manuals and recommended spare parts lists
 - .3 Schematics and interconnection wiring diagrams sealed by a Professional Engineer registered in the Province of Manitoba.
 - .4 Records of conductor identification, field terminals, changes, etc.
 - .5 Instrumentation and control panel Shop Drawings, face layouts, schematics and point-to-point wiring diagrams sealed by a Professional Engineer registered in the Province of Manitoba.
 - .6 Submit individual loop drawings based on the provide typicals
 - .7 Records of as-built information for the complete instrumentation system.
- .6 Documentation provided is formatted as follows:
 - .1 *Piping & Instrumentation Diagrams (P & IDS)* – depict the general intent of the control systems and are to be used as the governing document for the scope of Work.

- .2 *Instrument Index* – an index of the detailed information for the devices shown on the P & IDs. The index lists the appropriate support documentation for the devices' supply and installation. The instrument index is the controlling document for the supply of materials.
 - .3 *Input/Output (I/O) Index* – an index of the control system I/O points shown on the P & IDs, giving the supporting documentation as per the instrument index.
 - .4 *Instrument Specification Sheet* – detail the relevant data for the supply of devices.
 - .5 *Instrument Loop Diagrams (ILDs)* – show typical interconnections and hook-up of devices. The Contractor is to reproduce an ILD for each device and record all relevant as-built information on each sheet for submission at the completion of the Work. Fill in all terminal and wiring numbers etc. from the Shop Drawings as they become available. A set of 'B' size (11 x 17) ACAD Drawings and associated files will be made available to the successful Contractor.
 - .6 *Location Drawings* – indicate in plan and/or elevation views where the instrument elements are physically located. These Drawings are provided to assist the Contractor in estimating the amount of cable and ducting required.
 - .7 *Standard Details* – provide a reference for installation, operation and other instructions pertinent to a particular device.
 - .8 *Detailed Specification* – lists qualifications, quality of materials and workmanship, and supplementary information.
- .7 **Definitions**
- .1 Interpret specialized terms not explicitly defined herein in accordance with ISA-S51.1, NEMA-ICS-1, ANSI/IEEE-Std-100, and The Communications Standard Dictionary, by Martin H. Weik.
- .8 **References**
- .1 This Specification contains references to the following Documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed Documents, the requirements of this Section prevail.

| <u>Reference</u> | <u>Title</u> |
|-------------------------|---|
| API RP550-86 | Manual on Installation of Refinery Instruments and Control Systems, Part I--Process Instrumentation and Control Sections 1 Through 13 |
| ASME Section VII-89 | Rules for Construction of Pressure Vessels |
| ASTM B68-86 | Seamless Copper Tube |
| ASTM D883-89 | Terms Relating to Plastics |
| IEEE 100-88 | Dictionary of Electrical and Electronic Terms |
| ISA RP7.1-56 | Pneumatic Control Circuit Pressure Test |
| ISA RP12.6-87 | Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations |
| ISA S5.4-76 | Instrument Loop Diagrams |
| ISA S18.1-79 | Annunciator Sequences and Specifications |
| ISA S51.1-79 | Process Instrumentation Terminology |
| NEMA 250-85 | Enclosures for Industrial Controls and Systems |

| | |
|-------------------|---|
| NEMA ICS 1-88 | General Standards for Industrial Control and Systems |
| NEMA ICS 2-88 | Industrial Control Devices, Controllers, and Assemblies |
| NFPA 70-90 | National Electrical Code (NEC) |
| SAMA PMC 17-10-63 | Bushings and Wells for Temperature Sensing Elements |
| UBC-88 | Uniform Building Code |
| UL 1012-89 | Power Supplies |
| UL 94-80 | Tests for Flammability of Plastic Materials for Parts in Devices and Appliances Weik, Martin H. Communications Standard Dictionary, Van Nostrand Reinhold Co., 1983 |

- .9 Related Work:
 - .1 Mechanical
 - .2 Electrical
- .10 Qualifications
 - .1 The instrumentation Subcontractor shall be a firm normally engaged and fully competent in the type of Work described in this Section of the Specification. The firm shall have been continuously and successfully engaged in this business for at least five years.
 - .2 Qualified journeyman instrument mechanics that are familiar with the devices being installed shall perform all instrument hook-ups, calibrations, and checkouts.
 - .3 Qualified journeyman electricians shall perform all control wiring installation and connections.
- .11 Codes, Rules, Permits & Fees
 - .1 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this Work.
 - .2 Comply with all rules of the Electrical Safety Act of the Province, CSA Standards, the ULC and the applicable building codes, whether specifically shown on Drawings or not.
 - .3 Give all required notices, submit Drawings, obtain all permits, licenses and certificates and pay all fees required for this Work.
 - .4 Furnish a certificate of final inspection and approvals from an inspection authority to the Contract Administrator.
- .12 Standards of Workmanship
 - .1 Execute all Work in a manner, which will result in the completed installation presenting an acceptable appearance, to a level of quality defined in the general conditions of this Specification.
 - .2 Employ a competent supervisor and all necessary licensed tradesmen to complete the Work in the required time.
 - .3 Arrange and install products to fit properly into designated building spaces.

- .4 Install products in accordance with the recommendations and ratings of the product manufacturers.
- .13 Contract Drawings and Specifications
- .1 Refer to Division 1.
 - .2 Supply and install all items and accessories specified by the Drawings or the Specification in the quality and quantity required. Perform all operations as designated by the Specification according to the methods prescribed, complete with all necessary labour and incidentals.
 - .3 Treat any item or subject omitted from this Division's Specifications or Drawings, but which is mentioned or reasonably specified in other Divisions' Specifications or Drawings and pertains to the instrumentation and control system, as being integral to the overall system. Provide such specified items or subjects.
 - .4 Provide all minor items and Work not shown or specified but which are reasonably necessary to complete the Work.
 - .5 If discrepancies or omissions in the Drawings or Specifications are found, or if intent or meaning is not clear, consult the Contract Administrator for clarification before submitting Bid in accordance with B4.
 - .6 The responsibility to determine which Division provides various products and Work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of Specifications.

1.2 EQUIPMENT

- .1 Receiving, Storing, and Protection of Components during Construction
 - .1 Examine each component upon delivery to Site. Report all damage noted to the Contract Administrator prior to accepting or rejecting delivery. All instrumentation primary elements, control components, panels, etc. shall be placed in a secure, dry, heated storage building. Maintain the space temperature above 10°C and the space relative humidity below 50 percent.
 - .2 Perform a preliminary examination upon delivery to ensure that:
 - .1 All instrumentation and control components supplied for this project under this Section of the Specification comply with the requirements stated in the instrument Specification sheets.
 - .2 All instrumentation and control components supplied under other Sections of this Specification, to be connected to instrumentation and control components supplied under this Section of the Specification, comply with the requirements stated in the Contract Documents.
 - .3 Itemize all non-conformities noted above and forward them to the Contract Administrator. Any delays in construction resulting from the delivery to Site of non-conforming instrumentation and control components shall be borne by the Contractor.
 - .4 Do not install primary elements or other sensitive equipment until construction is sufficiently completed to provide an "operating condition" environment. Notify the Contract Administrator prior to installing any equipment of this type.

- .5 Ensure that covers where required are properly installed on all equipment. Provide all covers, padding, guards, etc. as required to guard any equipment against damage.
- .6 Return all damaged equipment to the factory for total corrective repairs. If deemed necessary by the Contract Administrator, the damaged equipment shall be replaced with new product. The Contractor shall bear any costs due to construction delays resulting from the delay in delivery of acceptable equipment.

1.3 SITE

- .1 Classification of Plant Areas
 - .1 Refer to Division 26

1.4 DOCUMENTATION

- .1 Submittals
 - .1 Submit Shop Drawings for all products supplied by this Division.
- .2 Operations and Maintenance Manuals
 - .1 Refer to Division 1 for general O&M Manual submittal information.
 - .2 In addition to the requirements specified in Division 1, provide the following information:
 - .1 Table of Contents - Arrange contents sequentially by systems under Section numbers. Label tabs of dividers between each to match section numbers in the Table of Contents.
 - .2 Systems Descriptions - A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.
 - .3 Maintenance and operating instructions for all equipment and controls – These operating instructions need not be manufacturer's data but may be typewritten instructions in simple language to guide the City in the proper operation and maintenance of this installation.
 - .4 A copy of all wiring diagrams complete with wire coding.
 - .5 Include type and accuracy of instruments used.
 - .6 Set of final reviewed Shop Drawings.
 - .7 Provide a tabulated list of all consumables utilized (fuses, lamps, etc.) indicating where used, type, rating and reorder details.
- .3 Construction Record Drawings
 - .1 Maintain on-site a complete set of Construction Record Drawings as listed in Division 1 of this Specification.
 - .2 In addition to the requirements as stated in Division 1, record the following information on the Drawings:
 - .1 All changes, alterations or additions
 - .2 All instrumentation cable and control tubing

- .3 All changes to the numbers and location of outlets, motors, panels and end devices that may occur during the course of the Work.
- .3 Before requesting the Certificate of Total Performance, make any necessary final corrections to the Drawings, sign each print as a certification of accuracy and deliver all sets to the Contract Administrator for approval.

Part 2 Products

2.1 GENERAL

- .1 Refer to the requirements of Division 1
- .2 Selected Products:
 - .1 Provide products and materials that are new and free from all defects.
 - .2 The design has been based on the use of the first named product where multiple products have been listed.
- .3 Alternate Products
 - .1 Refer to Division 1 for consideration of alternate products.
 - .2 Alternate products and materials to those specified will only be considered by the Contract Administrator if they are shown in the Bid as a material variation, and if they are submitted with an appropriate price adjustment. The Contract Administrator will reserve the right to accept or reject any alternative without explanation.
 - .3 The alternate submission shall provide sufficient information to enable the Contract Administrator to determine whether the alternate is acceptable or unacceptable.
 - .4 Provide complete information on required revisions to other Work and products to accommodate each alternate product.
 - .5 The Contractor assumes full responsibility when providing alternate products or materials that all space, weight, connections, power and wiring requirements etc. are considered and compensated for. Any costs incurred for additional components, changes to other services, structural or space requirements, layouts and plans, etc. that may arise from the use of the alternate shall be borne by the Contractor.
- .4 Quality of Products
 - .1 All products provided to be CSA and ULC approved where applicable.
 - .2 If products specified are not CSA approved, obtain approval of the relevant provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
 - .3 Refer to Division 1 of this Specification for further information.
- .5 Uniformity of Manufacture
 - .1 Unless otherwise specifically called for in the Specification, uniformity of manufacture to be maintained for similar products throughout the Work.
- .6 Product Finishes

- .1 Products to be manufacturers' standard finish. Where special finishes are specified refer to Division 9 for details on quality and workmanship of the finishes.
- .7 Use of Products During Construction
 - .1 Any equipment used for temporary or construction purposes is to be approved by the Contract Administrator. Clean and restore to "as new" condition all equipment prior to the time of Substantial Performance.

2.2 INSTRUMENTATION

- .1 General
 - .1 Instruments to be suitable for the environmental conditions in which they are to be installed.
 - .2 Determine where injurious conditions may be expected to occur and make proper provision to protect the instruments to ensure their proper and reliable operation.
 - .3 Provide power surge protection, heating cables and devices to protect instruments, equipment and lines from being functionally impaired or damaged by power surges or environmental conditions such as moisture or freezing.

2.3 IDENTIFICATION

- .1 Refer to Division 26 for general identification requirements. Provide lamicoïd nameplates with 6 mm black lettering on white background. Identify the loop tag number (where applicable) and the device name, function, and instrument range or setpoint value on the nameplate.
- .2 Where it is not possible to attach a lamicoïd nameplate to a field instrument component, provide the component with a stainless steel metal tag firmly wired to the device and identified with the loop tag number.
- .3 Identify all wires where they terminate at the marshalling panels, junction boxes and field devices with a heat shrink sleeve with machine printed labeling.
- .4 Clearly mark all panels, pull boxes, junction boxes, etc. to indicate the nature of service.
- .5 Provide neatly typed circuit directories for panel power distribution systems to indicate loops or devices powered by the circuit and the fuse size.
- .6 Identify all exposed control conduits at all pull box locations, where the conduits enter or leave a room, and 13 m on centre throughout the room. This shall apply to conduits above removable ceilings. Use Thomas & Betts TY-RAP 5532-M labels conduit identification.
- .7 For direct current wiring use black for positive and white for negative.
- .8 For thermistor wiring to motors use red and blue coloured, insulated wire.

Part 3 Execution

3.1 SITE EXAMINATION

- .1 Refer to the requirements of Division 1.
- .2 No additional compensation will be given for extra Work due to existing conditions that a Site examination prior to Bid should have disclosed.

3.2 COORDINATION WITH OTHER DIVISIONS

- .1 Examine the Drawings and Specifications of all Divisions and become fully familiar the Work. Before commencing Work, obtain a ruling from the Contract Administrator on any conflicting issues between Divisions. No compensation will be made for any costs arising from conflict not identified before Work has commenced.
- .2 Coordinate the Work to be performed under this Section of the Specification with all Divisions installing equipment to ensure that there are no conflicts.
- .3 Install anchors, bolts, pipe sleeves, hanger inserts, etc. required in ample time to prevent delays to other Division's installation Work.
- .4 Lay out the Work and equipment with due regard to architectural, structural and mechanical features. Architectural and structural Drawings take precedence over electrical Drawings regarding locations of walls, doors, and equipment.
- .5 Structural members shall not be cut without prior approval of the Contract Administrator.
- .6 Examine previously constructed Work and notify the Contract Administrator of any conditions, which prejudice the proper completion of this Work.

3.3 PRODUCT HANDLING

- .1 Use all means necessary to protect the products included in this Division before, during and after installation, and to protect products and installed Work of all other trades.
- .2 Any damage to the products and/or installed Work shall be repaired or replaced by the Contractor at no additional cost to the City and to the approval of the Contract Administrator.
- .3 Remove advertising labels from all products installed that have such labels attached. Identification or CSA labels are not to be removed.
- .4 Remove dirt, rubbish, grease, etc. resulting from Work performed under this Division of the Contract from all surfaces.

3.4 SEPARATION OF SERVICES

- .1 Maintain separation between the electrical wiring system, piping, ductwork, and the instrumentation cables so that each system is isolated (except at approved connections to such systems) to prevent galvanic corrosion. In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is unacceptable.

- .2 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings are not to be used for the support of wiring.
- .3 Classifications of Circuits
 - .1 The circuit categorization shall of first priority follow Canadian Electrical Code with respect to separation for electrical safety and the following shall apply with respect to electro-magnetic compatibility:

| | |
|----------------|--|
| Very Noisy | High voltage circuits and their associated grounding |
| | High current (>200 A) LV circuits. |
| | Harmonic-rich LV circuits |
| | DC circuits: un-suppressed or above 50 V |
| Noisy | Low current class two (2) circuits |
| | Medium power pulsed or radio frequency circuits |
| Indifferent | ELV digital status circuits |
| | Intrinsically safe circuits |
| | Telecommunications circuits |
| | Fire alarm and emergency lighting circuits (note that some fire alarm circuits may fall into the category of signal circuits). |
| Sensitive | Any other emergency, shutdown, or high integrity circuit (e.g. toxic gas alarm). |
| | Analogue signal circuits |
| Very Sensitive | Data communication circuits |
| | Low level voltage and current signals (e.g. from instrument sensors). |

- .4 Separation of Circuits
 - .1 This Section relates to the running of cables carrying differing types of circuit in close proximity to one another and to other services. Sensitive circuits shall normally be run in overall shielded cable. Very sensitive circuits shall normally be run in individually twisted pair shielded cable.
 - .2 For cables sharing the same support/containment system, the following shall provide guidance to minimize extraneous interference.

| Segregation between circuits | Very Noisy | Noisy | Indifferent | Sensitive | Very Sensitive |
|------------------------------|---------------------------------|---------------------------------|---------------|-----------|----------------|
| Very Noisy | Thermal grouping as per CE Code | 150 mm | 300 mm | 300 mm | 300 mm |
| Noisy | 150 mm | Thermal grouping as per CE Code | 150 mm | 150 mm | 150 mm |
| Indifferent | 300 mm | 150 mm | Separation of | 100 mm | 100 mm |

| | | | | | |
|----------------|--------|--------|----------------|----------|----------|
| | | | circuit types. | | |
| Sensitive | 300 mm | 150 mm | 100 mm | Touching | 50 mm |
| Very Sensitive | 300 mm | 150 mm | 100 mm | 50 mm | Touching |

3.5 WIRE AND CABLE

- .1 Refer to Division 26

3.6 EQUIPMENT CONNECTIONS

- .1 Prior to the connection of signal wiring to process control and instrumentation devices, check the device voltage rating and polarity for compatibility with the corresponding loop and/or schematic diagram. Where device and circuit characteristics are found to be incompatible, the connections are not to be made. Report the condition immediately to the Contract Administrator.
- .2 All control wiring diagrams illustrate typical control circuits applicable to the type of equipment specified. Control circuits may vary with different manufacturer's equipment. Verify all control circuits with the manufacturers of the equipment and make any corrections to the control wiring diagrams that may be required.
- .3 Provide power disconnect terminals in the marshalling panels for all devices and PLC/DCS input/outputs sourced from the panel. Provide local power disconnect switches for all 120VAC power instruments. Mount adjacent to the instrument.
- .4 Provide a disconnecting means in the cable connecting each ultrasonic transponder to the transmitter. This disconnect shall consist of a terminal strip in a local water proof junction box.

3.7 WIRING TO EQUIPMENT SUPPLIED BY OTHER DIVISIONS

- .1 Equipment supplied by the City or by other Divisions, that have external or field mounted control devices, are to be installed, wired and commissioned by this Division.

3.8 ACCESS PANELS

- .1 Provide access panels where instrumentation and control system junction boxes are concealed. Panels to be of adequate size for servicing of the concealed junction box and complete with necessary frames and hinged doors held closed with captive fasteners. The type and size of panels are to be coordinated with the Contract Administrator.
- .2 In removable ceiling areas provide markers on ceiling tile to locate equipment requiring access. Use a 25 mm diameter blue circle painted on the access panel to indicate that it is for instrumentation and control system access.

3.9 Instrument Mounting Stands

- .1 Supply and install instrumentation mounting stands as required. Stands are to be either floor or wall mounted. The mounting stands are to be fabricated from aluminum or galvanized steel.

- .2 Supply and install protective drip shields for any exterior stand-mounted instrumentation equipment. Drip shields are to extend 50 mm past the front and side faces of the equipment. Drip shields are to be fabricated from aluminum.

3.10 SEALING OF WALL AND FLOOR OPENINGS

- .1 Seal all conduit and cable entries passing through outside walls of buildings, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade.
- .2 Seal openings after all wiring entries have been completed.
- .3 Sealing material shall be fire resistant and shall not contain any compounds that could chemically affect the wiring jacket or insulating material. Cable penetrations through fire separations, if required, are to be sealed. Submit shop drawing for rated assembly prior to installation of fire stop.

3.11 SLEEVES

- .1 Provide sleeves of galvanized steel pipe with machine cut ends of ample size to accommodate conduits passing through walls, partitions, ceilings, floors, etc.
- .2 For walls, partitions and ceilings the ends shall be flush with the finish on both sides. For floors the ends shall extend 100 mm above finished floor level.
- .3 Fill the space between the sleeve and the conduit with fire stop material and caulk around the top and bottom with approved permanently resilient, non-flammable and weatherproof silicone base compound. Ensure that the seal is compatible with the floor and ceiling finishes.
- .4 Locate the sleeves and position exactly prior to construction of the walls and floors.
- .5 Failure to comply with the above requirements shall be remedied at the Contractor's expense.

3.12 CONNECTIONS TO MECHANICAL, ELECTRICAL AND EXISTING SYSTEMS

- .1 Refer to Division 26 for the required tie-in procedures.

3.13 TAGGING STANDARDS FOR DEVICES AND WIRING

- .1 Tag all devices, wires, and I/O using the assigned loop, equipment, or device tag name. Where tag naming and numbering is not specified, the Contract Administrator will provide naming and numbering that is consistent with the plant naming conventions.

3.14 TESTING OF INSTRUMENTATION LOOPS

- .1 After all devices within a loop have been connected, check the loop for correct functioning and interaction with other loops, where applicable. Provide written notice to the Contract Administrator when the loops are going to be tested so that the tests may be witnessed at the Contract Administrator's discretion.

- .2 Check the operation of final control elements such as solenoid valves, actuators, etc. by manual control before checking with automatic control.
- .3 Check and simulate all alarms and shutdown functions.
- .4 Verify the status of all points connected or accessible to the Distributed Control System.
- .5 Test all tubing for leaks in compliance with ISA RP7.1. Isolate all instruments when tubing is being tested to protect against over pressure.
- .6 Perform tests and record results on the test data forms that are included in this Section. Develop additional and/or more detailed test forms as necessary to suit more complex instrumentation.
- .7 Sign and date all test reports. Submit the test reports to the Contract Administrator within five Business Days of testing.
- .8 Coordinate and cooperate with City staff while they verify the Distributed Control System I/O.

3.15 CALIBRATION

- .1 Instruments are to be factory pre-calibrated. Verify calibration after installation for all instruments installed under these Specifications. Provide a printed record of the factory calibration parameters for "smart" devices.
- .2 Prior to calibration, completely program all "smart" transmitters including entries of the appropriate range and tag number. Provide a printed record of smart device serial numbers against their assigned tag number with all programmed parameters.
- .3 Instruments to be set up and calibrated by an accredited instrument technician working under the approval of the instrument Manufacturer.
- .4 Calibrate all instruments to an accuracy of 0.5 percent of full range, or to the manufacturer's stated accuracy of the instrument whenever an accuracy of 0.5 percent is not achievable.
- .5 Prior to instrument installation perform the following applicable calibration for each instrument and its associated signal conditioning equipment:
 - .1 Calibrate all inline flow meters by a draw-down test
 - .2 Calibrate all density meters by lab samples
 - .3 Calibrate all vacuum and pressure instruments by manometer or accurate test instrument and hand test pump
 - .4 Calibrate gas detectors using standard gas sample
 - .5 Calibrate temperature instruments against a standard lab thermometer.
 - .6 Calibrate online analyzers with known samples.

3.16 COMMISSIONING

- .1 Refer to the requirements of Division 1 for additional requirements.

.2 Inspections

- .1 Provide two weeks' written notice to the Contract Administrator prior to energizing any system to allow for inspection by the Contract Administrator of the following:
 - .1 Proper mounting
 - .2 Proper connections
- .2 During Commissioning, demonstrate to the Contract Administrator proper calibration and correct operation of instruments and gauges
- .3 Commissioning of the instrumentation and control system to include but not be limited to the following.
 - .1 Verify installation of components, wiring connections and piping connections.
 - .2 Supervise wiring continuity and pipe leak tests.
 - .3 Verify instrument calibration and provide written report.
 - .4 Function check and adjust the instruments and control equipment under operational conditions.
 - .5 Coordinate manufacturer's service personnel as required for complete system testing.
 - .6 Instruct plant personnel in correct method of instruments and control equipment operation.
 - .7 Direct plant personnel at hand-over as to final adjustment of the system for correct plant operation.
 - .8 Ensure that the Manufacturer's representatives cooperate to complete the Work of this Section.
 - .9 Verify signal levels and wiring connections to all instrumentation and control equipment.
 - .10 Coordinate and cooperate with City staff to commission the Distributed Control System I/O points.

3.17 TRAINING

- .1 Provide training, as described in detail in Division 1, in the proper operation and maintenance of all control devices, control valves, and ancillary instrumentation described under this Division of the Specification.

3.18 TEST FORMS

| <u>Form No.</u> | <u>Title</u> |
|------------------------|------------------------|
| .1 ITR | Instrument Test Report |
| .2 LCR | Loop Check Report |

LOOP CHECK REPORT

- CHECKED OUT OK
- NOT APPLICABLE
- FURTHER ACTION REQUIRED

| | INSTRUMENT TAG NO. | | | | | | | | |
|---|--------------------|--|--|--|--|--|--|--|--|
| LOOP NO. _____ SHEET NO. _____ P & I DWG. NO. _____ | | | | | | | | | |
| INSTALLATION COMPLETE | | | | | | | | | |
| Primary Element | | | | | | | | | |
| Impulse Lines | | | | | | | | | |
| Block and Drain Valves | | | | | | | | | |
| Air Supply/Filter/Reg. | | | | | | | | | |
| Wiring | | | | | | | | | |
| Tracing/Insulation/Housing | | | | | | | | | |
| Mounting and Location | | | | | | | | | |
| PLC/SCADA I/O & Status | | | | | | | | | |
| CALIBRATED | | | | | | | | | |
| Impulse Lines Press. Tested | | | | | | | | | |
| LOOP CHECKED | | | | | | | | | |
| Element To Receiver | | | | | | | | | |
| X Mtr. to Receiver | | | | | | | | | |
| X Mtr./Trans. to Receiver | | | | | | | | | |
| X Mtr./Trans. to Switches | | | | | | | | | |
| Switches to Annunciator | | | | | | | | | |
| Interlocking Circuit | | | | | | | | | |
| Controller to Valve | | | | | | | | | |
| Controller Action D or R | | | | | | | | | |

REMARKS:

READY FOR START-UP

DATE: _____

Installed by: _____

Checked by: _____

INSTRUMENT TEST REPORT

SYSTEM: _____

SERVICE: _____ TAG NO. _____

LOCATION: _____

MAKE: _____ MODEL: _____

SERIAL NO.: _____ CSA: _____

ELEMENT: _____ RANGE: _____

DESIGN SETTING/RANGE: _____ CONTACT TO: _____ ON: _____

SIGNAL IN: _____ OUT: _____ ASSOCIATED INSTRUMENT: _____

INSTRUMENT CONDITION: _____ CONFORM TO SPEC: _____

PROJECT NO.: _____ DATA SHEET: _____

| TEST METHOD | TEST 1 | | | | TEST 2 | | | |
|--------------|--------|------|--------|------|--------|------|--------|------|
| | INPUT | | OUTPUT | | INPUT | | OUTPUT | |
| | INC. | DEC. | INC. | DEC. | INC. | DEC. | INC. | DEC. |
| TEST POINT 1 | | | | | | | | |
| TEST POINT 2 | | | | | | | | |
| TEST POINT 3 | | | | | | | | |
| TEST POINT 4 | | | | | | | | |
| TEST POINT 5 | | | | | | | | |
| COMMENTS | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| GRAPHS | | | | | | | | |
| | | | | | | | | |

TESTED BY: _____ CHECKED BY: _____
 DATE: _____ DATE: _____

Part 1 General

1.1 REFERENCES - GENERAL

- .1 Suppliers, Equipment, Products, and Execution must meet all requirements detailed in Section 29 05 00.
- .2 Local control stations shall be supplied to house local control switches, push buttons and indicator lights associated with field devices (valves, drives etc). The control stations shall be located in close proximity to their associated devices. Where a group of devices are located within close proximity to each other, the local controls may be combined into a single common local control panel. Line of site must be maintained between all devices and the respective local controls.

Part 2 Products

2.1 GENERAL

- .1 Unless otherwise specified, provide outside finishes on all enclosures in ANSI 61 Grey as specified in Division 9.
- .2 The enclosures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors without any warpage.

2.2 ENCLOSURES

- .1 Provide Electrical EEMAC Type 1A gasketed enclosures in main floor of building.
- .2 Provide Electrical EEMAC Type 4 enclosures for below grade valve chamber.
- .3 Enclosures for mounting field control indicator lamps and switches in unclassified areas to be Allen Bradley model 800T die cast enclosures.

2.3 PANEL ENCLOSURES

- .1 Fabricate panel enclosures from 11 gauge steel panels complete with necessary stiffening to form a rigid free-standing lineup. The structures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors. Provide removable top and bottom cable entry plates.
- .2 Provide panels with front access only. Doors shall be key lockable and fitted with 3-point heavy duty latching assemblies. Provide a continuous piano hinge and a pneumatic hold open device on each door.
- .3 Finish the interior of the enclosure with white paint. Provide a switched fluorescent light fixture and 120 VAC duplex convenience receptacle inside the enclosure.

2.4 MARSHALING AND CONTROL PANELS

- .1 Supply, fabricate, checkout, layout, document and deliver to Site fully equipped and functional panels.
- .2 Supply all components contained on or within the panels fully wired under this Section of the Specification.
- .3 The selection of all accessories, materials and methods for fabrication not covered by this Specification, but which are necessary to complete the fabrication of the control panels, is the responsibility of the panel fabricator.
- .4 Fans and filters shall be installed to pressurize all control panels thus discouraging dust accumulation and providing air purging for temperature and corrosion control.
- .5 Marshalling and control panels shall be adequately sized to facilitate a professional, uncluttered arrangement. Provide adequate internal and external space to accommodate a 20 percent increase in each type of component used.
- .6 Control and marshalling panel layouts and wiring diagrams are to be provided by the Contractor as Shop Drawings.

2.5 NETWORK CABLING TERMINATION CABINETS

- .1 Double hinged wall mounted cabinet for 19 inch rack mounted equipment.
- .2 NEMA 12 cabinet with glass door and locking wing knobs.
- .3 Cabinet to house fibre patch panel, Cat 5E patch panel and Ethernet switches.
- .4 Provide 120 VAC duplex receptacle and power bar with minimum six outlets.
- .5 Provide horizontal wire management under each patch panel and Ethernet switch.
- .6 Provide vertical wire management on one side.
- .7 Provide blank panels for all empty rack units.
- .8 Provide shelf 3U for mounting equipment.
- .9 Cabinet sized for 8 rack units.
- .10 Hoffman ProTek DH Type 12, or approved equal.

2.6 WIRING AND ACCESSORIES

- .1 Provide wiring inside the panels according to the following Specifications:
 - .1 Control wiring to be a minimum of #16 AWG tinned stranded copper; insulation rated at 300 V.
 - .2 Wiring for power distribution shall be a minimum of #14 AWG tinned stranded copper; insulation rated at 600 V.

- .3 Install cables in accordance with the requirements of Division 16.
- .2 Tag each wire at both ends with a heat shrink sleeve that is machine printed. Allow approximately 20 mm of wire insulation between the tag and the bare wire.
- .3 Wiring systems with different voltage levels or types shall be suitably segregated within the panel, according to relevant electrical codes.
- .4 Run all wiring in enclosed plastic wireways such as Panduit. Size all wireways so that the total cross sectional area of the insulated wire and cable does not exceed 40 percent of the cross sectional area of the wire way.
- .5 Provide a minimum clearance of 50 mm between wire ways and any point of wire termination.
- .6 Terminate all wiring, incoming and outgoing, at terminal strips mounted inside the panels. Identify each terminal strip with a terminal strip number, defined as follows:
 - .1 Wire identification to use the connected field device tag name with the wire's corresponding end device terminal number appended to it.
 - .2 Identify every joint and/or terminal of the above wire run with the same identifier until the wire meets another tagged device, at which point the wire identifier will change to use the new device name and terminal number.
 - .3 For example, pressure transmitter S740-FIT located in the field has a 1 PR-TPSH cable connected to it. The cable runs through a junction box to a marshaling panel. The wire identifiers for the pair of wires would be S740-FIT all the way to the marshaling panel.
 - .4 Identify spare wires by using the cable tag, wire number and an "-SP" suffix.
 - .5 Arrange wiring on terminal blocks such that all internal panel wiring terminates on the inboard side of the terminal blocks and all external wiring terminates on the outboard side.
- .7 Provide a 120 VAC panel power distribution system and a 24 VDC power distribution system in each panel. Provide a thermal magnetic circuit breaker on each main power circuit and a fused terminal block for each branched circuit off the main.
- .8 Provide disconnect type terminal blocks Weidmuller WTR 4 series to isolate field wiring that is powered sourced from the panel. Provide a dedicated fused disconnect type terminal block to isolate each individual PLC input and output.
- .9 Provide sufficient terminals so that not more than two wires are connected under the same terminal. Provide 20 percent spare terminal capacity at each terminal block assembly.
- .10 Terminals shall be Weidmuller W Series color coded as follows:
 - Red = positive 24 VDC
 - Black = analog signal plus
 - White = analog signal common and VAC neutral
 - Grey = 120 VAC
 - Green = ground

- .11 Provide nameplates for each device on or within the panels and enclosures. Nameplates shall be white lamicaid with black lettering, a minimum of 25 mm x 75 mm in size with up to three lines of 5 mm lettering. Securely fasten nameplates in and situate them in a visible location.

2.7 PANEL GROUNDING

- .1 Provide a ground system for the instrumentation circuits, isolated from the main power system ground to each marshaling panel.
- .2 Provide grounding lugs for each panel, suitable for termination of up to #2 AWG copper grounding conductor.
- .3 Provide in each marshaling panel an isolated grounding bus bar 6 x 25 x 600 mm, equipped with necessary lugs for accepting two (2) #2 AWG grounding conductors.
- .4 Firmly bond all panel-mounted devices on or within the panels to ground. Provide supplementary bonding conductors for backpanels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

Part 3 Execution

3.1 MOUNTING HEIGHTS

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

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

- .1 Submit product data in accordance with CW 1110 and Division 26.

1.2 RELATED WORK

- .1 Refer to Division 26

1.3 INSPECTION

- .1 Provide adequate notice to the Contract Administrator so that all cable installations can be inspected prior to energizing equipment.

1.4 STANDARDS

- .1 All wire and cable shall be CSA approved.

Part 2 Products

2.1 TWISTED PAIR SHIELDED CABLES (TPSH)

- .1 TPSH shall be constructed as follows:
 - .1 Two (2) copper conductors, stranded, minimum #18 AWG, PVC insulated, twisted in nominal intervals of 50 mm
 - .2 Insulated for 600 V, 90°C
 - .3 100 percent coverage aluminum foil or tape shield
 - .4 Separate bare stranded copper drain wire, minimum #18 AWG
 - .5 Overall flame retardant PVC jacket to CSA-C22.2
 - .6 The entire cable assembly to be suitable for pulling in conduit or laying in cable tray.
 - .7 Interlocked aluminum armour and outer PVC jacket.
 - .8 Shaw Type 1751-CSA or Beldon equivalent
- .2 Where multi-conductor TPSH cables are called for, each pair shall be individually shielded, continuous number coded, and the cable assembly shall have an overall shield and overall flame retardant PVC jacket.

2.2 RTD AND MULTI CONDUCTOR SHIELDED CABLE

- .1 RTD cables shall be CSA approved and shall be constructed as follows:
 - .1 Three or more copper conductors, stranded, minimum # 18 AWG
 - .2 PVC insulated for 600 V
 - .3 100 percent coverage aluminum foil or tape shield

- .4 Separate bare stranded copper drain wire
- .5 Interlocked aluminum armour and outer PVC jacket.
- .6 Overall flame retardant PVC jacket to CSA-C22.2

2.3 TECK CABLES

- .1 As per Division 26

2.4 WIRE

- .1 As per Division 26

2.5 100 Base TX Category 5E Communication Cable

- .1 Category 5E cable shall be CSA approved and constructed as follows:
 - .1 4 bonded pairs, solid stranded, #24 AWG
 - .2 Interlocked aluminum armour
 - .3 Rip cord
 - .4 PVC inner and outer jackets
 - .5 UL verified to Category 5E
 - .6 Insulated for 300 V
 - .7 Belden 121700A or approved equal

2.6 Fibre Optic Cables

- .1 Provide break out style fibre optic cable assemblies where indicated in the Specification and Drawings.
- .2 Fibre optic cables shall be indoor/outdoor direct burial rated loose tube, rodent protected and constructed with specified quantity of 50/125/250 μm multi-mode glass fibres, spiral interlocked armour, and outer polyethylene jacket. Maximum attenuation shall be 3.5/1.0 dB/km. Minimum modal bandwidth shall be 220 MHz*km
- .3 Provide terminations for fibre optic cables including; buffer tube fan out kits, connectors, termination/distribution panels, and wall mount enclosures, as specified in Division 29
- .4 Provide 50/125/250 μm multi-mode duplex fibre patch cords for inter-cabinet connections.
- .5 Number of fibres are indicated on Drawings, in general fibre optic loop shall be 24 fibre, fibre optic cables to power meters and protection relays shall be 2 fibre.

Part 3 Execution

3.1 ANALOG SIGNALS

- .1 Use TPSH cable for all low level analog signals such as 4-20 mA, pulse type circuits 24 VDC and under, and other signals of a similar nature.
- .2 Use RTD cable for connections between RTDs and transmitters or control system RTD inputs.

3.2 DIGITAL SIGNALS

- .1 Use TPSH cable for all low level input (24 V and below) and output signals to the control system.

3.3 INSTRUMENT POWER

- .1 Use Teck cable or wire and conduit for power to instruments, for 120 V signals other than those mentioned above and as otherwise indicated on the Drawings. Use stranded wire and cable to supply power to instruments.

3.4 INSTALLATION

- .1 Install instrumentation cables in conduit systems or in cable trays. Use a minimum of 300 mm and a maximum of 1000 mm length of liquid tight flexible conduit to connect the field sensors to the conduit.
- .2 Where non-armoured instrumentation cables are installed in cable trays, provide barriers in the tray to separate instrumentation cables from power cables.
- .3 At each end of the run leave sufficient cable length for termination.
- .4 Do not make splices in any of the instrumentation cable runs.
- .5 Cable shields shall be terminated on insulated terminals and carried through to the extent of the cable.
- .6 Ground cable shields at one end only. Unless otherwise specified, ground the shields at the marshalling panel.
- .7 Protect all conductors against moisture during and after installation.

3.5 CONDUCTOR TERMINATIONS

- .1 All equipment supplied shall be equipped with terminal blocks to accept conductor connections.
- .2 Instrumentation conductors, where terminated at equipment terminals other than clamping type terminal blocks, shall be equipped with Burndy-YAE-2 or STA-KON, self-insulated, locking type terminators, sized as required to fit conductors and screw terminals.

3.6 TESTING

- .1 Test all conductors for opens, shorts, or grounds. Resistance values shall not be less than those recommended by the cable manufacturer.

3.7 IDENTIFICATION

- .1 Identify all instrumentation cables.
- .2 Identify each conductor with wire numbers using a machine printed Raychem TMS heat shrink wire marker or approved equal in accordance with B6.

3.8 Fibre Installation:

- .1 Always follow the Manufacturer's guidelines for minimum bend radius and tension. Minimum bend radius shall be a minimum of 20 times the cable diameter.
- .2 When installing loose-tube cables, use a silicone injection or sealer to prevent gel migration.
- .3 All fibre installations and terminations shall be performed by personnel experienced in fibre optic cable installation.
- .4 Fibre Terminations:
 - .1 Ensure that the fibres are not damaged when the buffer tubes and fibre coatings are removed.
 - .2 After the coating is removed, clean the fibre with isopropyl alcohol to assure the fibre is clean.
 - .3 Use only high performance connectors as classified and required by TIA-568-A.
- .5 Perform cable testing with optical time domain reflectometer instrument and provide complete detailed test report. Test all runs upon completion of permanent terminations, using instrumentation acceptable to Contract Administrator. Before commencing testing, submit sample test data sheets and information with respect to test instrumentation to be used.
 - .1 Ensure that test instrument is temperature-stabilized or is temperature-independent or temperature-compensated before commencing test.
 - .2 Test for following:
 - .1 Run attenuation at [850] and [1300] wavelengths.
 - .2 Run length.
 - .3 Before recording results, compare readings to predicted values based on cable specification and run length, using connector and patch cord losses as part of predicted value. Retest runs with:
 - .1 Attenuation values greater than 6.0 dB/km @ 850 nm and 4.0 dB/km @ 1300 nm
- .6 All fibres must pass the cable testing.

3.9 Cat 5E Installation:

- .1 Always follow the Manufacturer's guidelines for minimum bend radius and tension.

- .2 All installations and terminations shall be performed by personnel experienced in Cat 5E cable installation.
- .3 Perform cable testing with time domain reflectometer instrument and provide complete detailed test report. Test all runs upon completion of permanent terminations, using instrumentation acceptable to Contract Administrator. Before commencing testing, submit sample test data sheets and information with respect to test instrumentation to be used.
 - .1 Test for the following:
 - .1 Continuity.
 - .2 Pair placement and polarity.
 - .3 DC resistance.
 - .4 Characteristics at highest contemplated frequency:
 - .1 Attenuation - data cable.
 - .2 Mutual Capacitance - data cable.
 - .3 Near-end crosstalk (NEXT) - data cable.
 - .5 Run length.
 - .2 Tests to be conducted to Cat 5E standards
 - .3 Reconnect or re-install and retest as necessary to correct excessive variations.

END OF SECTION

Part 1 General

1.1 REFERENCES - GENERAL

- .1 Equipment, products and execution must meet all requirements detailed in Section 29 05 00.

Part 2 Products

2.1 TRANSMITTERS AND INDICATORS

- .1 Provide transmitters and indicators.
- .2 Transmitters shall have adequate power output to drive all devices associated with the signal loop. Provide signal boosters as required to achieve adequate signal strength or to isolate the signal.
- .3 All transmitters to have local indication scaled in engineering units as specified in the engineering Specifications. Provide a lamicoid label indicating the calibrated range and engineering units and mount adjacent to the transmitter. Mount the transmitter so the indicator is visible by operations personnel.
- .4 Where available as an option, the transmitter shall be supplied with an isolated fault contact.
- .5 Standard of acceptance for instrumentation shall be as follows:
 - .1 Temperature Transmitters (RTD): Rosemount, ABB, Foxboro

Part 3 EXECUTION

3.1 References - General

- .1 Refer to Section 29 05 00.

END OF SECTION

Part 1 General

1.1 REFERENCES - GENERAL

- .1 Refer to Section 29 05 00

Part 2 Products

2.1 GENERAL

- .1 Use normally closed contacts for alarm actuation. The contacts open to initiate the alarm.
- .2 Use normally open contacts to control equipment. The contacts close to start the equipment.
- .3 Contacts monitored by solid state equipment to be hermetically sealed and adequately rated for the connected load.
- .4 Contacts monitored by electro-magnetic devices such as mechanical relays to be rated NEMA ICS 2, designation B300.
- .5 Provide double barriers between switch elements and process fluids such that failure of one barrier will not permit process fluids into electrical enclosures.
- .6 Switch electrical enclosures to be rated EEMAC 4, minimum.
- .7 120 VAC switches to have a 4 A rating.

2.2 INDICATORS, PUSHBUTTONS AND SELECTOR SWITCHES

- .1 All control indicator lamps, pushbutton switches, and selector switches in ordinary locations to be Allen Bradley 800T or 800E series.
- .2 All control indicator lamps, pushbutton switches, and selector switches in classified or Category 1 & 2 areas, or outdoors to be Allen Bradley 800H series.
- .3 All control indicator lamps shall be push-to-test type.

2.3 RELAYS

- .1 The Quality and type of relays shall be based on Omron relays.
- .2 120 VAC relays to be Model LY 4PDT, plug-in, complete with test button and operation indicator, and surge suppressor.
- .3 24 VDC relays to be Model MY 2PDT plug-in, complete with test button and operation indicator, and surge suppressor diode.
- .4 Time delay relays for behind panel mounting to be Model H3BA, 2PDT, plug-in, and programmable for sixteen (16) time ranges and four (4) operation modes.

- .5 Time delay relays for flush panel mounting and operator accessible timing range modifications to be Model H5BR, SPDT, screw terminals, programmable for five (5) timing ranges and eight (8) operation modes, complete with digital display, module for time settings and flexible protective cover.
- .6 Where the contact ratings of the relays listed are insufficient for the application select an appropriate type from an approved Manufacturer with the same quantity of contacts as was originally specified.
- .7 Provide relay plug-in sockets for DIN mounting complete with stacked screw clamp terminals.

2.4 PROCESS SWITCHES

- .1 Standard of acceptance for instrumentation shall be as follows:
 - .1 Float Switches: Flygt, Consolidated Electric, Warwick, Magnetrol
 - .2 Key Switches: Medeco
 - .3 Magnetic Door Contacts: GE

Part 3 Execution

3.1 REFERENCES - GENERAL

- .1 Refer to Section 29 05 00

END OF SECTION

Part 1 General

1.1 REFERENCES - GENERAL

- .1 Equipment, Products and Execution must meet all requirements detailed in Section 29 05 00.

Part 2 Products

2.1 MISCELLANEOUS PANEL DEVICES

- .1 Pilot Lights
 - .1 Provide LED transformer type pilot lights for extended lamp life, oil tight, push to test, complete with appropriate colour lenses. Normal colours used are run=red, stop=green, fault=amber. Refer to Division 26 for additional information
- .2 Terminals
 - .1 Provide strap screw type terminal blocks rated for 600 V.
 - .2 Identify each terminal block within an enclosure with a unique machine printed terminal block number. Cabinet chassis grounding terminal blocks to be identified by the electrical ground symbol.
 - .3 Connections to screw terminals to be locking fork tongue insulated crimp type wire connectors.
 - .4 Terminals to be Weidmuller or approved equal in accordance with B6.
 - .5 Provide a group of terminals for each of 120 VAC hot and neutral and 24 VDC positive and negative power. Distribution wiring to have a thermal magnetic circuit breaker upstream of all major blocks of loads, adequately sized to protect the connected load while not causing nuisance tripping.
 - .6 Provide Weidmuller disconnect type terminal blocks for each load or loop powered from the marshalling panels.
- .3 Nameplates
 - .1 Refer to Section 29 05 00

2.2 Industrial Ethernet Switches

- .1 Install rack mounted Ethernet Switches in separate network cabling termination cabinet mounted next to all control panels housing PLCs that interface to the WTP control and operator interface network as shown on the drawings. Connect to the PLCs, local HMIs, VFDs, power meters and motor protection relays as shown on the drawings using cable rated for 100 Base-TX, 10 BaseFL, or 100 BaseFX communication, as required by the device.
- .2 Switches shall comply with IEEE 802.3, 802.3u, 802.3x, 802.1D, IEC 61950-3.
- .3 Switched shall be connected in a ring topology utilizing a 1000SX Multimode backbone.

- .4 Provide switches as required to connect to the equipment indicated in the Drawings and the following minimum spare ports:
 - .1 4 - 10/100 Base T(x) RJ45 ports
 - .2 2 - 10 BaseFL multimode ports
 - .3 2 - 100 BaseFX multimode ports
- .5 Provide one (1) switch in each network cabinet.
- .6 Switches shall include one (1) relay output alarm contact rated for 1A@24 VDC.
- .7 Input power shall be 120 VAC.
- .8 Switches shall be fast spanning for a sub-second recovery in a ring configuration.
- .9 Switches shall be Ruggedcom RSG2100 or approved equal.

2.3 Fibre Termination Panel

- .1 Fibre termination panel suitable for the termination of one (1) 6-strand multimode fibre optic cables.
- .2 Termination panel shall be rack mounted, hinged front and rear doors, complete with grounding kit and cable strain relief.
- .3 Install in network cabling termination cabinet
- .4 Leviton DP-525 or approved equal.

2.4 Cat 5E Termination Panel

- .1 Rack mounted termination panel suitable for the termination of 24 Cat 5E cables.
- .2 Install in network cabling termination cabinet.
- .3 Connect to PLC Ethernet module.

Part 3 Execution

3.1 REFERENCES - GENERAL

- .1 Refer to Section 29 05 00

END OF SECTION

Part 1 General

1.1 References - General

- .1 Refer to Section 29 05 00 – Instrumentation and Control General Requirements.

Part 2 PRODUCTS

2.1 Power Supply and Conditioning Equipment

- .1 General
 - .1 Provide all DC power supplies as required for all instrument circuits. All circuits are to be powered from the marshalling panels. Power supplies to be Hammond, G.F.C., Weidmuller or approved equal, complete with an over-voltage protection module.
 - .2 Unless otherwise required, all DC power supplies to be rated 28 VDC, adjustable plus or minus 5%, and set to provide 26.4 V on the panel direct current bus. Size the power supply for two (2) times the connected load, minimum size is 2 amps.

2.2 Noise Suppression

- .1 Provide TVSS units in each panel to power AC instrumentation and control (I&C) loads. Power conditioners are to be SquareD, Cutler Hammer, Leviton.

2.3 UPS Power Supply

- .1 Two (2) sources of 120 VAC power will be supplied to each control panel: UPS power for critical loads and non-UPS power for non-critical loads.
- .2 Control and operator interface system hardware including but not limited to programmable logic controllers (PLCs), PLC I/O racks, PLC communication modules, and industrial network switches shall be powered from the UPS.
- .3 Instrument power and associated DC power supplies shall be powered from the UPS.
- .4 Non-critical loads include control panel interior lights and receptacles.
- .5 Provide the total expected critical and non-critical loads fed from each control panel as a Shop Drawing submittal so that the external power sources and UPS can be properly sized.
- .6 Mount UPS in PLC control panel.
- .7 UPS: Eaton PW9130.

Part 3 EXECUTION

3.1 References - General

- .1 Refer to Section 29 05 00– Instrumentation and Control General Requirements, Part 3.

END OF SECTION

Part 1 General

1.1 REFERENCES - GENERAL

.1 Refer to Section 29 05 00

1.2 PLC I/O INDEX

.1 The following spreadsheet gives an itemized list of the new Programmable Logic Control (PLC) System inputs and outputs. It is intended to serve as an aid for determining the cabling requirements for the Work specified in this Division.

Part 2 Products

.1 Not used

Part 3 Execution

.1 Not used

PLC I/O INDEX

| RECORD NO. | REV. NO. | TAG NAME | DESCRIPTION FUNCTION SERVICE | | P&ID DRAWING | I/O SPECIFICATION | | | | | | | |
|------------|----------|----------|-----------------------------------|------------------------|--------------|-------------------|-------|------|--------|------|-------------|----------|-------------|
| | | | | | | ENG. UNITS | SCALE | | ALARMS | | PLC CABINET | I/O TYPE | I/O ADDRESS |
| | | | | | | | LOW | HIGH | LOW | HIGH | | | |
| 0001 | 0 | YS-101 | C/O/H Switch in Computer Position | Valve in Computer Mode | | | | | | | CP-001 | DI | |
| 0002 | 0 | YA-101 | Fault Status | Valve Actuator Fault | | | | | | | CP-001 | DI | |
| 0003 | 0 | ZB-101 | Close Status | Outlet Valve Open | | | | | | | CP-001 | DI | |
| 0004 | 0 | ZD-101 | Open Status | Outlet Valve Close | | | | | | | CP-001 | DI | |
| 0005 | 0 | YB-101 | Close Command | Outlet Valve Open | | | | | | | CP-001 | DO | |
| 0006 | 0 | YD-101 | Open Command | Outlet Valve Close | | | | | | | CP-001 | DO | |
| 0007 | 0 | YS-102 | C/O/H Switch in Computer Position | Valve in Computer Mode | | | | | | | CP-001 | DI | |
| 0008 | 0 | YA-102 | Fault Status | Valve Actuator Faul | | | | | | | CP-001 | DI | |
| 0009 | 0 | ZB-102 | Close Status | Outlet Valve Open | | | | | | | CP-001 | DI | |
| 0010 | 0 | ZD-102 | Open Status | Outlet Valve Close | | | | | | | CP-001 | DI | |
| 0011 | 0 | YB-102 | Close Command | Outlet Valve Open | | | | | | | CP-001 | DO | |
| 0012 | 0 | YD-102 | Open Command | Outlet Valve Close | | | | | | | CP-001 | DO | |
| 0013 | 0 | LA-103 | Level Alarm | Chamber Flood Switch | | | | | | | CP-001 | DI | |
| 0014 | 0 | LA-104 | Level Alarm | Chamber Flood Switch | | | | | | | CP-001 | DI | |
| 0015 | 0 | PI-105 | Pressure Indication | Pipe pressure | | kPA | -100 | 500 | TBA | TBA | CP-001 | AI | |
| 0016 | 0 | FI-106 | Flow Indication | Pump Station inflow | | ML/Hr | 0 | 15 | - | - | CP-001 | AI | |
| 0017 | 0 | FQ-106 | Flow Totalization | Pump Station inflow | | ML | | | | | CP-001 | DI | |
| 0018 | 0 | YB-107 | Door Alarm Contact | Security System | | | | | | | CP-001 | DI | |
| 0019 | 0 | HS-108 | Key Switch | Security System | | | | | | | CP-001 | DI | |
| 0020 | 0 | MN-108A | Alarm ON Lamp | Security System | | | | | | | CP-001 | DO | |
| 0021 | 0 | MN-108B | Alarm OFF Lamp | Security System | | | | | | | CP-001 | DO | |
| 0022 | 0 | TI-109 | Temperature Indication | Ambient Temperature | | Celsius | -10 | 40 | 5 | 38 | CP-001 | AI | |

1. GENERAL

1.1 References - General

.1 Refer to Section 29 05 00.

1.2 Instrument Index

.1 The following spreadsheet gives an itemized list of the instrumentation included as part of this Work.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

INSTRUMENT INDEX

| RECORD NO. | REV. No. | TAG NAME | DESCRIPTION | | MANUFACTURER | MODEL | POWER SUPPLY | CALIBRATED RANGE | MOUNTING | SUPPLIED BY | INSTALLED BY | COMMENTS | SPEC. DATA SHEET | P&ID DRAWING | INSTRUMENT LOOP DIA. | INSTALLATION DETAIL | LOCATION DWG. | |
|------------|----------|----------|-------------------------|------------------------------|--------------|-------|--------------|--------------------|----------------------|-------------|--------------|-----------------|------------------|--------------|----------------------|---------------------|---------------|---------|
| | | | INSTRUMENT TYPE | SERVICE | | | | | | | | | | | | | | |
| 0001 | O | FCV-101 | Electric Acuator | Aqua Duct Valve | | | 600V, 3Phase | | Floor | City | Contractor | | | | | | D-11936 | D-11934 |
| 0002 | O | FCV-102 | Electric Acuator | Aqua Duct Valve | | | 600V, 3Phase | | Floor | City | Contractor | | | | | | D-11936 | D-11934 |
| 0004 | O | LS-103 | Float Level Switch | Valve Chamber Flood Switch | | | 120VAC | 75mm from floor | Bracket | Contractor | Contractor | | I-101 | | | | D-11936 | D-11934 |
| 0005 | O | LS-104 | Float Level Switch | Valve Chamber Flood Switch | | | 120VAC | 75mm from floor | Bracket | Contractor | Contractor | | I-101 | | | | D-11936 | D-11934 |
| 0006 | O | PIT-106 | Pressure Transmitter | Pump Station Inflow Pressure | | | Loop Powered | -100 to 500 KPA | Block&Bleed Manifold | Contractor | Contractor | | I-105 | | | | D-11936 | D-11934 |
| 0006 | O | FIT-107 | Flow Meter | Pump Station Inflow | | | 120VAC | 0 to 15 ML/hr | Remote Transmitter | City | Contractor | | | | | | D-11936 | D-11934 |
| 0007 | O | ZSD-108A | Magnetic Switch | Door Contact Switch | | | 24VDC | | Door Frame | Contractor | Contractor | | I-103 | | | | D-11936 | D-11934 |
| 0008 | O | ZSD-108B | Magnetic Switch | Door Contact Switch | | | 24VDC | | Door Frame | Contractor | Contractor | | I-103 | | | | D-11936 | D-11934 |
| 0009 | O | HS-108 | Key Switch | Security System On/Off | | | 24VDC | | Nema 12 Enclosure | Contractor | Contractor | Medeco lock set | I-104 | | | | D-11936 | D-11934 |
| 0006 | O | TIT-109 | Temperature Transmitter | Ambient Air | | | Loop Powered | -10 to +40 Celsius | Wall | Contractor | Contractor | | I-102 | | | | D-11936 | |

Part 1 General

1.1 References - General

- .1 Equipment, Products and Execution must meet all requirements detailed in **Section 29 05 00 – Instrumentation and Control General Requirements.**

1.2 Work Included

- .1 Design, supply, and installation of a programmable logic controller (PLC) based control system that will control and monitor the system in accordance with the requirements defined in the Plans and Specifications.
- .2 All PLC's and Inputs/Outputs (I/O) shall be housed in a central control panel.
- .3 PLC programming will be by others.
- .4 Shop testing, coordinated with programming contractor.
- .5 Start-up and commissioning assistance as required for the control system.

Part 2 PRODUCTS

2.1 PLC's

- .1 General
 - .1 All new PLC equipment to be based on the Modicon M340 Processor family as applicable (no substitutions allowed).
 - .2 Communication protocol for the new PLC network shall be Modbus/TCP. Ethernet communication shall be provided in PLC processor to interface to the City SCADA systems.
 - .3 Provide all necessary racks, power supplies, cables, communication cards, memory cards, programming cables and accessories.
 - .4 Provide 10% spare slot capacity for each PLC panel assembly.
 - .5 Provide 25% spare power supply capacity for each PLC panel assembly.
- .2 PLC
 - .1 Modicon Central Processing Unit (CPU): Model Number BMX P34 2020, c/w two BMX RMS008MP memory cards and USB programming cable.
 - .2 Modicon 6 slot baseplate, BMX XBP 0660.
 - .3 Power Supply: 36W, BMX CPS 3500.
 - .4 I/O modules to meet the specifications defined herein.
- .3 I/O.
 - .1 Digital Inputs: 24VDC, 32 point, Model Number DDI 3202K, c/w Telefast block ABE 7P16 F310 and relays.

- .2 Digital Outputs: 24VDC, 32 point, Model Number DDO 3202K, c/w Telefast block ABE 7R16T330 and relays.
- .3 Analog Inputs: 4 channel, isolated, Model Number BMX AMI 0410.

2.2 System Integration Requirements

- .1 The PLC Control System will be integrated with the City of Winnipeg's supervisory Control and Data Acquisition (SCADA) System by others.
- .2 Cooperate with other contractors, Owner, and Contract Administrator to facilitate installation, testing, validation, and commissioning of the control system.
- .3 Assist the Systems Integrator to establish communication with the PLC's. Test data exchange between the PLC Control System and the City's SCADA system as defined in this Section and the process description.

Part 3 EXECUTION

3.1 References – General

- .1 Refer to Section 29 05 00 – Instrumentation and Control General Requirements, Part 3.

END OF SECTION

Part 1 General

1.1 REFERENCES - GENERAL

- .1 The Work includes the provision of all instrument specification sheets.
- .2 Refer to Section 29 05 00

1.2 INSTRUMENT SPECIFICATION SHEETS

- .1 Provide data sheets to itemize detailed as-built information regarding the Specification of instruments included as part of this Work for each instrument supplied. The data sheets already included in this Section list specific minimum requirements for particular applications.
- .2 Use forms in accordance with the ISA Standard S20 as a template for the preparation of the specification sheets.

Part 2 Products

- .1 Refer to the following specification sheets.

| | |
|---|---|
| INSTRUMENT SPECIFICATION NUMBER: | I-101 |
| DEVICE: | Level Switch |
| TAG: | LS-103, LS-104 |
| TYPE: | Float Switch |
| SERVICE: | Water |
| ENCLOSURE: | Polypropylene float casing with preterminated signal cable |
| SIGNAL CABLE LENGTH: | 20m |
| OUTPUT: | Relay contact resistive – 10A, 250V |
| MOUNTING: | Provide strain relief-type connectors to suspend float at desired location. Fabricate mounting brackets from 316 SS. Provide anti-sway rings to prevent sway. |
| MANUFACTURER AND MODEL: | Flygt ENM-10 Consolidated Electric Warwick Magnetrol |
| ACCESSORIES: | N/A |

INSTRUMENT SPECIFICATION NUMBER: I-102

DEVICE: Temperature

TAG: TT-109

SERVICE: Space temperature

SPAN: -10 to 40 degrees Celsius

SENSOR: 3 wire RTD, Pt 100

INACCURACY: $\pm 0.1\%$ of span

OUTPUT: 4 to 20 mA DC into 500 OHM

POWER SUPPLY: Loop powered 24 VDC

CONSTRUCTION: Stainless steel wetted parts

ELECTRONIC ENCLOSURE: Universal head, aluminum alloy

LOCAL DISPLAY: LCD Display

ACCESSORIES: mounting bracket

MANUFACTURER AND MODEL: Rosemount 644 c/w RDT sensor

**INSTRUMENT
SPECIFICATION NUMBER:** I-103

DEVICE: Magnetic Door Contact

TAG: ZSD-108A, ZSD-108B

SERVICE: Door position monitoring

SENSOR: Reed Switch

OUTPUT: N.O. Contacts, rated 0.5A, 30VDC

MOUNTING: Recessed into door frame

CONSTRUCTION: Designed for use in Steel Doors

MANUFACTURER AND MODEL: GE Interlogix

INSTRUMENT

SPECIFICATION NUMBER: I-104

DEVICE: Switch Lock

TAG: HS-108

SERVICE: Alarm On/Off

OUTPUT: Rated 7A at 125/250 VAC

POSITIONS: Two maintained positions, key removable in both.

MOUNTING: Mount in Allen Bradley 800T enclosure

ACCESSORIES: Complete with two indicator lamps, Green = alarm ON, Red =
alarm Off

MANUFACTURER AND MODEL: Medeco lock tumbler set

| | |
|---|--|
| INSTRUMENT SPECIFICATION NUMBER: | I-105 |
| DEVICE: | Pressure Transmitter |
| TAG: | PIT-105 |
| SERVICE: | Potable Water |
| PROCESS CONNECTIONS: | 0.50 inch NPTF |
| RANGE: | -100-500 kPa To be confirmed at shop drawing stage. |
| INACCURACY: | ±1 percent of span or lower |
| OUTPUT: | 4 to 20 mA DC into 500 OHM load |
| POWER SUPPLY: | Loop powered 24 VDC |
| CONSTRUCTION: | 316 SST |
| ELECTRONIC ENCLOSURE: | EEMAC/NEMA 4X |
| ACCESSORIES: | Block & bleed manifold |
| MANUFACTURER AND MODEL: | Rosemount ABB Ametek Or approved Equal |