

DIVISION 25

INTEGRATED AUTOMATION

Part 1 General

1.1 GENERAL CONDITIONS

- .1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.
- .2 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this Section.
- .3 All Sections of all Divisions of the Specifications and these documents inclusive form part of the Contract documents.
- .4 All Control system drawings shall be sealed by a Professional Engineer registered in the province having jurisdiction in the location of the installation.

1.2 DESCRIPTION

- .1 This section specifies the General Provisions for the supply, delivery, installation, calibration and commissioning of the process control and instrumentation system, including all control and graphic panels, as specified herein and /or detailed on the drawings.
- .2 Provide a complete and fully operating control and instrumentation system, with facilities and services to meet the requirements described herein, and in complete accord with applicable codes and ordinances.
- .3 The specifications do not purport to cover details entering into the design of the system which shall be the responsibility of the Contractor.
- .4 During the Integration design and construction, the Contractor is invited to suggest modifications or improvements to the Contract Administrator.
- .5 The work to be done shall include the provision of all labour, materials, tools and equipment as well as the application of a competent knowledge of construction, whether or not directly specified or shown on the plans, required for the installation testing and placing into service the complete control and instrumentation system, except when it is specifically mentioned that certain materials and/or labour are not part of the contract.
- .6 These specifications shall apply to and govern all trades doing control and instrumentation work and shall be read in conjunction with and form a part of the general specifications of the project.
- .7 The Control and Instrumentation work includes but is not limited to the following:
 - .1 Control panels.
 - .2 Programmable Logic Controller (PLC) System.
 - .3 Programming.
 - .4 PLC system to be programmed to provide all required interface and interlocks with Vendor supplied equipment. System integrator shall be responsible for any and all programming, commissioning and hardware required to interface to vendor equipment.

- .5 After award of Contract, the Contractor shall contact the Contract Administrator for an alarm template that will allow the station alarms to smoothly map into City's ClearSCADA.
- .6 Coordinate and cooperate with the City to ensure that communications are functional and systems are complete.
- .7 Provide integrated automation for mechanical systems. Review mechanical design and shop drawings. Coordinate and cooperate with the mechanical trade and mechanical vendors. Provide instrumentation for the measurement of flow, level, pressure, temperature, etc.
- .8 Indicators and annunciators
- .9 Uninterruptible power supplies (UPS)
- .10 Control wiring, cable tray and conduit
- .11 Communication systems
- .12 Spare Parts & Manuals

1.3 RELATED WORK

- .1 General Requirements - Division 01
- .2 Finishes - Division 09
- .3 Process Integration - Division 40
- .4 Heating, Ventilation & Air Conditioning - Division 23
- .5 Electrical - Division 26
- .6 The following Sections of Division 25 are included in Process Control and Instrumentation.
 - .1 Field Equipment Panels - Section 25 14 23
 - .2 Process Controller – Section 25 30 01
 - .3 Instruments - Section 25 30 02

1.4 SUBMITTALS

- .1 Information packages submitted for review and/or approval shall include:
 - .1 An index page.
 - .2 Have component items identified with the Specification Section and equipment tag from the equipment and/or instrument list.
 - .3 Where manufacturers' information, catalog, cut-sheet, or brochure information is used, which list more than one style or member of a family or options, the actual component or item being supplied shall be clearly highlighted.

1.5 EQUIPMENT MANUFACTURERS

- .1 All equipment shall be manufactured by experienced manufacturers who can demonstrate in-use records for all equipment offered.
- .2 Requests for approval of alternative suppliers shall be submitted to the Contract Administrator. Refer to Division 01 - Submittals.

- .3 Equipment shall be supplied by a single manufacturer, to the extent reasonably practicable, and particularly where aesthetics are of concern, such as in panels.

1.6 CODES AND REGULATIONS

- .1 The work shall comply with the requirements of the current edition of the Electrical Code, and all local provincial and municipal rules, laws and ordinances pertaining to the work.
- .2 The Contractor shall familiarize themselves with and comply with:
 - .1 Winnipeg Electric Bylaw.
 - .2 City of Winnipeg Water & Waste Department: Identification Standard.
 - .3 City of Winnipeg Water & Waste Department: Electrical Design Guide.
 - .4 City of Winnipeg Environmental Management Policy.

1.7 PERMITS AND FEES

- .1 Obtain the required construction permits, arrange for inspections and supply the Contract Administrator with approval certificates pertaining thereto including a certificate of final inspection.

1.8 REFERENCE STANDARDS

- .1 Unless otherwise specified, equipment shall conform to appropriate standards and recommendations of:
 - .1 The American Society of Mechanical Engineers, hereinafter referred to as ASME Standards.
 - .2 The Instrument Society of America, hereinafter referred to as ISA.
 - .3 The Canadian Standards Association, hereinafter referred to as CSA.
- .2 All equipment shall be metric - SI Standard.

1.9 MANUALS

- .1 Refer to Division 01, General Requirements, for requirements for Operation and Maintenance Manuals.
- .2 Provide operating and maintenance brochures for all equipment and arrange for their insertion into the Operation and Maintenance Manuals. The information shall include all applicable, descriptive and technical data, maintenance and operating procedures, wiring diagrams, spare parts lists, service representatives, and suppliers for replacement parts. The information shall be neatly and orderly assembled in binders.
- .3 Requirements for operation and maintenance of process control and instrumentation equipment shall be as specified in various clauses of Division 25.

1.10 SHOP DRAWINGS

- .1 Refer to Division 01, General Requirements.
- .2 Provide network drawings, layout drawings of instrument and control panels, schematic diagrams and detailed loop drawings of all devices listed in the instrumentation data sheets and any equipment connected to the control system. The Contract Administrator review of shop drawings shall be for general arrangement only and shall not relieve the

Contractor from responsibility for errors, proper fitting, construction of the work, and furnishing of materials.

- .3 Control drawings shall be updated as the work progresses and shall be submitted to the Contract Administrator as Drawings of Record when the work is completed.
- .4 All control drawings, panel layout drawings, and schematic drawings, and PLC programs shall be sealed by a Professional Engineer in good standing with, and registered with, the provincial Professional Engineering Association in the jurisdiction in which the site work is to be performed.
- .5 Submit shop drawings for the following items:
 - .1 Control Panels
 - .2 Control panel contents and components
 - .3 Panel layout drawings
 - .4 Loop drawings for all items connected to the control system
 - .5 Loop drawings to indicate instrument ranges and settings
 - .6 Individual loop drawings required for each loop – typical loop drawings that apply to multiple devices will not be permitted.
 - .7 Panel wiring schematics
 - .8 Field instruments
 - .9 Power supplies
 - .10 PLC and I/O enclosures
 - .11 PLC and I/O modules
 - .12 PLC terminals
 - .13 Interconnection drawings, showing system equipment and field device connections. Clearly identify enclosure and terminals that wiring is run “from” and “to”.
 - .14 PLC software documentation, which shall include as a minimum:
 - .1 I/O listing entailing a complete list of all system addresses, both used and spare, with a service description for each including mnemonics.
 - .2 PLC Program Printout, complete with description headings, comments for each rung or function block, and mnemonics for each element.
 - .3 Data table listing, identifying all preset values and their service.
 - .4 Written description of the program(s).
 - .15 Where there is an HMI, SCADA, or graphic interface provided, submit proposed graphics or screens.
 - .16 Make indication of quantities with shop drawings for all except the minor items or incidental items such as panduit. Make indication of tag numbers or otherwise identify which pieces of equipment correspond to which shop drawings.
 - .17 Indicate dimensions and mounting for all equipment.

1.11 DRAWINGS OF RECORD

- .1 Refer to Division 01, General Requirements.
- .2 Submit all control drawings and PLC programs for the instrumentation system.

1.12 COORDINATION OF WORK

- .1 Cooperate and coordinate with other trades on the project.
- .2 Make suitable arrangements with other trades to make provision for the control and instrumentation work and be responsible for the assurance that such provisions are satisfactory for the control and instrumentation work.
- .3 Check drawings and specifications of other trades for coordination with the control and instrumentation trade. If any conflicts are found, obtain a ruling from the Contract Administrator before proceeding.

1.13 AS-BUILT DOCUMENTATION

- .1 As work progresses, record on one (1) set of contract drawings, any change to conduit or cable tray layout as well as any approved changes and deviations from the original contract and/or working drawings recorded in red. At completion of work, submit to the Contract Administrator one clean mark-up set. Refer to section 26 05 00 for details.
- .2 In addition to the as-built contract drawings, submit as-built documentation for inclusion in the Maintenance Manuals.
- .3 Provide as-built PLC programming hard copy and back-ups (2 copies) on compatible CD Rom to the Contract Administrator.
- .4 All software development packages and manufacturer's development manuals shall be turned over to the Contract Administrator.
- .5 No final contract payment shall be made until all as-built documentation has been accepted by the Contract Administrator.

1.14 WARRANTY

- .1 Warranty system assembly, installation, hardware, software, and communications operations for all parts and labour for a period of one year from date of project total performance.

Part 2 Products

2.1 MATERIALS

- .1 All materials shall be new and the best of their respective kind.
- .2 All materials shall bear the approval of the Canadian Standards Association (CSA) or cUL unless otherwise noted.
- .3 All materials shall be suitable for full operation within, unless otherwise noted:
 - .1 Normal areas: NEMA 12 gasketed nonventilated is preferred, NEMA 12 gasketed and ventilated is acceptable where nonventilated is not feasible.
 - .2 Category 1 only areas: NEMA 4X or NEMA 3,
 - .3 Category 2 areas: NEMA 4X as indicated.
- .4 See subsequent clauses for specific equipment and instrument specifications.

2.2 POWER SUPPLY

- .1 Provide all necessary power supplies for controls and instruments.
- .2 Power wiring to field devices shall be minimum #12 AWG.

2.3 CONTROL WIRING

- .1 Unless specified otherwise, all conductors for control wiring shall be copper with RW90, X-link insulation, insulation voltage to be suitable for the highest voltage to which the conductors may be exposed.
- .2 Colours:
 - .1 Power - 120/240VAC supply - Black
 - .2 Power - 120/240VAC neutral - White
 - .3 Power - 24 VDC supply - Blue
 - .4 Power - 24VDC Common - Brown
 - .5 Discrete control - AC - Red
 - .6 Discrete Control - DC - Blue
 - .7 Intrinsically Safe (IS) - IS (light) Blue
 - .8 Protective Earth (PE) - Green/Yellow
 - .9 Signal Ground / Instrumentation Earth (IE) - Green
- .3 Instrumentation wiring for analog signals shall be individually shielded, multi-pair cable #16 AWG (7x16) tinned copper.
- .4 Wiring for PLC digital inputs to be #14 AWG minimum.
- .5 Where dimensional details are required, work with the applicable structural and architectural drawings.
- .6 The Contractor is responsible for correcting any work completed contrary to the intent of the drawings and specification and shall bear all costs for correcting same.

2.4 CONDUIT, CABLE TRAY, WIRING AND CABLE

- .1 Supply and install all conduit, cable tray, wiring, control and instrumentation cables for the control, instrumentation and low line voltage control for building services.
- .2 Conduit, cable tray, and wiring for power, lighting, miscellaneous electrical systems, power supplies to control instrumentation fed from panel boards, and building service panels including other components requiring line voltage power supply shall be supplied and installed as specified in Division 26 - Electrical.

Part 3 Execution

3.1 INSTALLATION

- .1 Install and interconnect all process control system equipment and components as indicated.
- .2 Install all equipment in accordance with the manufacturer's recommendations and in a manner that will ensure satisfactory operation upon completion.

- .3 Provide all labour and all necessary equipment including timbers, scaffolding, tools and rigging materials for installation of the equipment.
- .4 Contractor shall be responsible for coordinating all mechanical, electrical and other works for the equipment being installed.
- .5 Installation shall meet the minimum standards set forth by Standards and Practices for Instrumentation, Tenth Edition - 1989.
- .6 Use trained personnel to install systems and controls as per approved shop drawings and in accordance with manufacturer's recommendations.
- .7 Follow building lines with all piping and electrical wiring runs. Utilize proper separation and wiring techniques.
- .8 The in-line mechanical installation of certain items specified to be supplied in this section are specified to be installed in Division 40.

3.2 TESTING

- .1 Thoroughly test all control equipment, components, and systems for proper operation and report in writing to the satisfaction of the Contract Administrator.
- .2 Tests shall include:
 - .1 Complete operational test including interlocks, functions, features, options, etc., for all instrumentation, PLC, and computer system control operations.
 - .2 Operation of alarm initiating devices.
 - .3 Calibration of all instruments.
- .3 Supply all necessary test equipment and personnel to completely test the entire instrumentation and process control system.

3.3 PROCESS NARRATIVES AND CONTROL PHILOSOPHIES

- .1 GENERAL
 - .1 Provide delays on motor starts to prevent rapid cycling of motors and to enforce sequential starting rather than simultaneous starting of motors.
 - .2 Within groups of motors, provide automatic alternation.
 - .3 Within groups of motors, where one motor is unavailable due to a condition such as manual override or fault, provide automatic changeover to motors that remain available.
 - .4 Provide automatic control for motors and devices.
 - .5 Provide manual override control for motors and devices via selector switches. Make connections to PLC for awareness of Not In Auto conditions.
 - .6 Coordinate SCADA requirements with Contract Administrator.
 - .7 Communicate station status, variables, and alarms with City SCADA.
 - .8 Implement heartbeat or other means of communication monitoring for remote communications where requested by City.
 - .9 Motors shall be installed to accommodate ready and convenient lockout, tagging, disconnection, removal, replacement, and reconnection.

.2 WETWELL PUMPING

- .1 Automatic lift station pump control shall be based on wetwell level.
- .2 The Low Level (Stop), High Level (Lead Start), High High Level (Lag Start), and High High High Level (Alarm) setpoints shall be configured in the process display relay. Setpoints shall be operator adjustable.
- .3 Float switches shall provide backup Low Level (Stop), High Level (Start) and High High Level (Alarm) functionality.
- .4 In the event of failure of the PLC, the process display relay shall be capable of continuing to provide basic automatic level control.

.3 DRYWELL SUMP PUMP

- .1 The sump pump shall have integral level control via piggyback controller on the attachment cord.

.4 STATION LIGHTING

- .1 Station lighting shall be a Master ON, Partial Delay Off control. When turned ON, building and drywell lighting shall come on. When turned OFF, a portion of lighting in all areas shall remain ON for 3 minutes then turn OFF. This allows anyone who is inadvertently still in these areas time to exit prior to lights going off. In areas with only one lighting fixture, Partial Off cannot be implemented. Instead, when master light switch is turned OFF, turn these lights OFF for one second then back ON for three seconds, then OFF for one second, then ON for 3 minutes then OFF. Provide time delay relaying and contactor in small enclosure labeled "LIGHTING CONTROL/ MASTER ON TIME DELAY OFF".

.5 EXTERIOR LIGHTING

- .1 Exterior lighting shall be photocell control with switch for Auto/Off control. Label switch "EXTERIOR LIGHTING" and switch positions "AUTO/OVERRIDE OFF".

.6 HEATING AND VENTILATION

- .1 See electrical drawings and mechanical drawings and specifications.

.7 ALARMS

- .1 Provide the following alarms in addition to others indicated. Provide all works required to implement and annunciate the alarms.
 - .1 Pump P-L01 Fault
 - .2 Pump P-L02 Fault
 - .3 Fire (Heat Detector)
 - .4 Flood (Building Main Floor)
 - .5 Building Low Temperature
 - .6 Building High Temperature
 - .7 Power Fail (Utility Power)
 - .8 Standby Generator Fault
 - .9 Standby Generator Fail

3.4 START-UP AND COMMISSIONING

- .1 Upon completion of the installation, the Contractor shall be responsible for testing to determine correct system operation and sequences as intended in the Contract Documents. Process Instruments such as flow, level, pressure transmitters, etc., shall be checked for operation prior to process start-up, by manipulating operating controls like set points, auto-manual selectors, etc. Status and alarm contacts to be checked by manipulation or jumpering at the sensing element.
- .2 Check sheets for all instrumentation and PLC I/O to be filled out during the commissioning process and submitted to the Contract Administrator.
- .3 Results of tests are to be logged by the Contractor and submitted to the Contract Administrator. Any apparent defects shall be reported and corrected.
- .4 When preliminary checks have been completed and process equipment is operating or ready to operate, individual systems shall be calibrated in accordance with the latest ISA recommendation.
- .5 After calibration and upon submittal of all PLC I/O and instrumentation check sheets the system shall be placed in operation in conjunction with the Contract Administrator and/or the City's designated operating personnel.
- .6 Refer to Section 01 91 13 – General Commissioning Requirements

3.5 SPARE PARTS

- .1 The Contractor shall provide the following spare parts:
 - .1 Two (2) plug-in control relays of each type and coil-voltage used complete with base.
 - .2 Two (2) plug-in time delay relays of each type and coil-voltage used complete with base.
 - .3 Five (5) fuses of each type and ampacity used.
 - .4 Five (5) indicating lights of each type, voltage, and colour used.
 - .5 One (1) push button assembly including contact blocks of each type used.
 - .6 One (1) selector switch assembly including contact blocks of each type used.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

- .1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.
- .2 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this Section.
- .3 All Sections of all Divisions of the Specifications and these documents inclusive form part of the Contract documents

1.2 SCOPE

- .1 This section covers the supply and installation of all field located motor control stations and control panels.

1.3 QUALITY ASSURANCE

- .1 CSA C22.2 No. 14-13 Industrial Control Equipment

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 25 05 00 and Division 01.
- .2 Include schematics, wiring diagrams, and mounting information.
- .3 Make indication of quantities. Indicate by equipment tag, or otherwise, which specific device each shop drawing corresponds to. Where one shop drawing corresponds to multiple instances of a device, identify the devices by tag or other description.

Part 2 Products

2.1 ENCLSOURES

- .1 All enclosures and devices shall be suitable for the location they are installed and shall be rated as follows, unless otherwise noted:
 - .1 NEMA 12 in normal environments, gasketed nonventilated
 - .2 NEMA 4X or NEMA 3R in Category I only environments
 - .3 NEMA 4X in Category II environments
 - .4 NEMA 3R in outdoor environments

2.2 PUSHBUTTONS

- .1 Heavy duty oiltight, operator flush, black, with 1-NO and 1-NC contacts rated at 10 A, 120Vac, labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position.
- .2 Acceptable manufacturer(s): Allen-Bradley, Telemecanique.

2.3 INDICATING LIGHTS

- .1 Heavy duty Oiltight, push to test LED type, lens colour as indicated, supply voltage: as required, labels as indicated.
- .2 Acceptable manufacturer(s): Allen-Bradley, Telemecanique.

2.4 SELECTOR SWITCHES

- .1 Number of positions as required, labelled as indicated, heavy duty oiltight, operators as indicated, contact arrangement as indicated, rated 120Vac, 10 A.
- .2 Acceptable manufacturer(s): Allen-Bradley, Telemecanique.

2.5 CONTROL RELAYS

- .1 Number of poles as required, must be double throw type (Form C).
- .2 Removable relay cube from base
- .3 Acceptable manufacturer(s): Allen-Bradley, Omron, Carlo Gavazzi

2.6 PANEL MOUNTED ALARMS

- .1 Supply panel mounted alarms, as indicated, with the following features:
 - .1 NEMA 4X.
 - .2 60 to 80 dBA (at 2 ft.).
 - .3 Continuous tone.
 - .4 24Vdc supply.
 - .5 CSA, cUL, or ETL certified.
- .2 Acceptable manufacturer(s): Sonalert SC628 series, or approved equal in accordance with B7.

2.7 DC POWER SUPPLIES

- .1 Where DC power sources are required, each shall be a system comprised of:
 - .1 Two identical supplies.
 - .2 Each supply shall be able to supply at least 150% of the connected load.
 - .3 Paralleling rated.
 - .4 Each supply connected to one input of a redundancy module.
 - .5 Redundancy module to have at least one status output to be monitored by the PLC. Output shall indicate the status of the redundancy.
 - .6 Power supplies and redundancy modules all to be from the same manufacturer, and from the same product family from that manufacturer.
- .2 Acceptable manufacturer(s): Weidmuller PRO-M family, Phoenix Contact TRIO family

2.8 TERMINALS

- .1 Provide tension clamp terminals.
 - .1 Number indicated plus 20% spare
- .2 Terminals to be rated for connected load.

- .3 Double stack terminals will not be permitted unless written approval is obtained from the Contract Administrator.
- .4 Acceptable manufacturer(s):
 - .1 Weidmuller - Z tension clamp.
 - .2 Phoenix Contact - CLIPLINE ST spring-cage.

2.9 GENERAL

- .1 Supply the control panels in accordance with the general arrangement and dimensions indicated on the appropriate drawings. Panels must be complete with all instruments, meters, switches, indication lights, relays, etc., as specified herein or as indicated.
- .2 Unless otherwise specified, provide removable lamacoid nameplates having letters not smaller than 6 mm to identify equipment.
- .3 Panels must have overall CSA or cUL approvals prior to being shipped to site. Generally, the approvals of individual components contained within a panel will factor into the overall approval being applied to the panel. Sufficient component and inspection options exist to select between materials and methods, including inspections by approvals agents at the point of construction, to allow for panels to be so approved.

2.10 CONSTRUCTION

- .1 NEMA construction standards, to the Types described in 2.1 above, for all panels unless otherwise specified.
- .2 Unless otherwise specified fabricate floor mounted panels, indicated, of high grade, cold rolled smooth sheet metal steel no thinner than 3 mm thick with all doors and edges neatly turned and finished smoothly. Visible welding seams will not be accepted.
- .3 Construct rigid panels and racks with an angle iron or channel supporting frame, suitably braced and stiffened to prevent any deformation during shipping or installation, and provide a surface free from dents, warping or other deformation. Provide a four-sided channel iron mounting base with front recess.
- .4 Provide flush fitting, gasketed, doors hung on piano type hinges with three-point latches and locking-type handles.
- .5 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.
- .6 Use rear connected fittings to hold equipment and instrument cases on the panel, but where not possible; any front fixing that is required shall be only by means of chrome-plated, brass or stainless steel machine screws.
- .7 Panel surfaces shall be thoroughly cleaned and degreased before painting. One primer coat shall be covered by two finished paint coats.
- .8 The surface finish shall be free of runs, drops, ridges, waves and laps. The paints shall be applied in such manner as to provide an even film covering corners and crevices. The interior finish shall be white and the exterior finished will be selected after award of the contract.
- .9 Panel Accessories: a pocket, 250 mm wide x 150 mm high x 25 mm deep, to hold pertinent drawings and manuals on the lower half of the inside door.

2.11 INTERNAL WORKS

- .1 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120-volt supply.
- .2 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments. Conductors shall be extra flexible stranded copper of gauges sufficient to carry the required currents, and shall in no case be smaller than #16 AWG extra flexible.
- .3 Identify all wiring by means of plastic slip-on type or thermally printed heat-shrink type markers. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, and where practical, contained in plastic wiring channels with covers.
- .4 Each terminal shall be clearly indelibly marked with the wire number connection to it. Each field connecting conductor shall be served by one terminal. Provide 20% spare unit terminals. Provide all necessary terminal block accessories such as manufactured jumpers and marking tape.
- .5 Wire all spare PLC-card I/O points to terminals. These spare points are to remain grouped with the other points from their respective cards.
- .6 Mount all internally mounted equipment on DIN rail or mount on a rack and arrange for ease of access and removal when necessary.
- .7 Arrange all terminal blocks in the panel in groups such that all low level signals such as 4-20mA DC are located in one area, followed by contact closure type signals (limit switches, etc.), that do not subsequently energize starters, etc. but are for status indication, and the remainder that contain powered circuits, are to be arranged in such a manner and location so as to prevent interference into the low level signal.
- .8 Submit proposed terminal block layout and identification scheme for review prior to manufacture.
- .9 Provide suitable spaces around the terminal blocks for incoming and outgoing conductors or cable assemblies, with a minimum space of 5cm between terminals and wire trough.
- .10 Where the panel has been designed to allow cable entry through the top of the panel, provide a minimum of 15cm space from the panel's top inner surface to the upper face of the wire trough to allow for cable bends, dressing and labelling.
- .11 Where the panel has been designed to allow cable entry through the bottom of the panel, provide a minimum of 15cm space from the panel's bottom inner surface to the lower face of the wire trough to allow for cable bends, dressing and labelling.
- .12 Provide plastic cable troughs equal to Panduit complete with snap-on covers for containing the cables. Cables are not to be bunched and tied, but laid in.

2.12 PANEL MANUFACTURER

- .1 Construction shall be performed by an established panel manufacturer who shall comply with all building codes, factory, and Department of Labour regulations and has CSA or cUL approval as a manufacturer for all components of the work they undertake including control panels, MCCs, service entrances, etc. Panels, components, or any items delivered without indicated approvals, without prior explicit written consent of the Contract Administrator, will not be accepted.

- .2 Acceptable panel manufacturer(s): Celco Controls Ltd, Manco Control Systems Inc

2.13 SPARE PARTS

- .1 As specified in Section 25 05 00 – Common Work Results – Integrated Automation.

Part 3 Execution

3.1 INSTALLATION

- .1 Install pushbutton stations, control and relay panels, control devices as indicated and interconnect as indicated.

3.2 TESTS

- .1 Perform tests in accordance with Sections 25 05 00 and 26 05 00.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at a time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.
- .5 Submit one copy of test results to the Contract Administrator.

3.3 START-UP AND COMMISSIONING

- .1 Perform all panel start-up and commissioning in accordance with Section 25 05 00

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

- .1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.
- .2 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this Section.
- .3 All Sections of all Divisions of the Specifications and these documents inclusive form part of the Contract documents.

1.2 SCOPE

- .1 This section covers the supply and installation of the programmable controller.

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Division 01 – Submittals and include details on all CPU functions, programming, flow charts, operator menus, control sequences, schematics, component dimensions, data storage quantity, data storage speed, data storage back-ups, and program storage back-ups.

Part 2 Products

2.1 PLC SYSTEMS

- .1 A typical PLC system shall be as shown on the drawings and include:
 - .1 Central processing unit (CPU) including power supply.
 - .2 I/O modules: discrete input, discrete output, analog input and analog output
 - .3 Remote monitoring hardware.
 - .4 All necessary supporting hardware, e.g. PLC backplane, terminal strips, etc.
 - .5 PLC programming.
 - .6 After award of Contract, the Contractor shall contact the Contract Administrator for an alarm template that will allow the station alarms to smoothly map into City's ClearSCADA.
- .2 Environmental Conditions
 - .1 Temperature ratings:
 - .1 Storage temperature: -40 to 85°C.
 - .2 Operating temperature: 0 to 60°C.
 - .2 Humidity: 0 to 93% non-condensing.
 - .3 Altitude: 2000 metres full operation.
 - .4 Vibration and shock:
 - .1 Shock (half sine wave): °15g peak, 11 msec, 3 pulses/axis.
 - .2 Vibration: 10 to 57 Hz @ 0.075 mm d.a 57 to 150 Hz @ 1G.

- .3 Free fall: 1m.
- .5 RFI and EMF Protection:
 - .1 RFI/EMF susceptibility: 27 to 500 MHz: 10 V/m.
 - .2 Electrostatic discharge: 8 kV/ 4 kV contact.
 - .3 Surge withstand: IEC 801-5 2000 V, shield to ground.
- .3 Central processing unit (CPU):
 - .1 General:
 - .1 The CPU shall consist of rack-mounted sub-assemblies (modules) which solve application logic, store the application program, store numerical values related to the logic, and interface to the I/O modules.
 - .2 The CPU shall provide local diagnostic information via LED indicators and relay contact outputs. All indicators shall be marked as to their respective function.
 - .3 A dry contact shall provide for remote PLC failure alarm indication. The CPU shall come complete with all necessary software to provide for this alarm function.
 - .4 Power back-up for one year via lithium battery, or capacitor to allow PLC to store program to non-volatile memory prior to shutdown on power loss.
 - .5 On board Ethernet port or Ethernet communication module to be included in system.
 - .2 Program Storage:
 - .1 System program memory sufficient to contain the final program with 100% spare capacity.
 - .2 PLC program storage medium shall be solid state RAM. RAM memory shall have battery back-up capability of retaining all stored program data through a continuous power outage for 12 months under worst case conditions, or capacitor to allow PLC to store program to non-volatile memory prior to shutdown. Capability shall exist to remove battery from RAM module without interrupting system power.
 - .3 50msec maximum scan time.
 - .4 Time-of-day clock.
 - .5 Watchdog timer.
 - .3 Programming Languages:
 - .1 According to IEC 61131-3: LD (Ladder diagram).
 - .4 Input/Output (I/O) Modules:
 - .1 General:
 - .1 All I/O modules shall be of the rack-mounted plug-in type modular design. Each I/O module shall be keyed to prevent module insertion into the wrong rack slot.
 - .2 LED indicators adjacent to each I/O point.
 - .3 All user wiring to the I/O modules shall be through a heavy duty terminal strip. Removable, push-in type terminal strip shall allow for module replacement without disturbing field wiring.

- Pressure type screw terminals shall be used to provide fast, secure wire connections.
- .4 Malfunction of an I/O module shall not affect the operation of the remaining I/O modules or the CPU.
 - .5 CPU shall retain status of all I/O points of a failed I/O module.
 - .6 Isolation shall be provided between all internal logic and external power circuits. Isolation shall meet minimum specification of 1500V RMS.
- .2 Discrete Inputs:
 - .1 No. of modules: As required.
 - .2 Description: Isolated Input Module.
 - .3 Number of points: As required plus 20% or minimum 6 spare points, of each type of input card used, whichever is greater.
 - .4 Operating voltage: 10-30Vdc, 120Vac, as required by system.
 - .5 See drawing(s).
 - .3 Discrete Outputs:
 - .1 No. of modules: As required
 - .2 Description: Relay (NO) Output Module.
 - .3 Number of points: As required plus 20% or minimum 4 spare points, whichever is greater.
 - .4 Max. current/pt.: 2 Amp, Resistive.
 - .5 See drawing(s).
 - .4 Analog Input:
 - .1 No. of modules: As required
 - .2 Description: Analog Input Module
 - .3 No. of channels: As required plus 20% or minimum 4 spare points, whichever is greater
 - .4 Operating current: 4 to 20 mA
 - .5 Isolation: 1000 Vac Channel-to-Bus
 - .6 Accuracy: 0.05% of full scale current
 - .7 See drawing(s).
 - .5 Analog Output:
 - .1 No. of modules: As required.
 - .2 Description: Analog Output Module.
 - .3 As required plus 20% or minimum 2 spare points, whichever is greater
 - .4 Operating current: 4 to 20 mA
 - .5 Isolation: 2500 Vdc Channel-to-Bus
 - .6 Accuracy: 0.2% of full scale current.
 - .7 See drawing(s).

2.2 ACCESSORIES

- .1 For systems requiring a backplane, backplane shall be supplied to house the CPU, AC power supply, communication module, discrete input, discrete output, analog input, and analog output modules as required.

2.3 ACCEPTABLE MANUFACTURERS/PRODUCT GROUP:

- .1 Pumping Station PLC:
 - .1 Schneider: SCADAPack 357, c/w expansion modules 5606 as needed.

Part 3 Execution

3.1 INSTALLATION

- .1 Mount and install PLC and associated equipment in the control panels as indicated on the drawings and as specified in Section 25 14 23.
- .2 Complete PLC and control system installation, testing, start-up and commissioning shall be as described in Section 25 05 00.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

- .1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.
- .2 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this Section.
- .3 All Sections of all Divisions of the Specifications and these documents inclusive form part of the Contract documents.

1.2 SCOPE

- .1 This section specifies the supply installation, field testing, and placing into operation of flow, pressure, temperature, level, turbidity, and other instruments of control and instrumentation.

1.3 RELATED WORK

- .1 General Commissioning Requirements – Section 01 91 13
- .2 Common Work Results – Integrated Automation - Section 25 05 00.
- .3 Field Equipment Panels - Section 25 14 23
- .4 Process Integration – Division 40
- .5 Heating, Ventilation & Air Conditioning – Division 23
- .6 Electrical – Division 26

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Division 01 - Submittals.

1.5 START-UP

- .1 Instrument manufacturer's qualified field service representative shall be onsite as required to perform instrument calibration, testing and commissioning and to instruct City's representative in all aspects of instrument operation and maintenance.

Part 2 Products

2.1 INSTRUMENTS

- .1 Provide each instrument with mechanisms and enclosures that are corrosion resistant.
- .2 Provide each instrument with mechanisms enclosed in a dustproof and a moisture proof case.
- .3 Provide all indicator and gauge dials finished in permanent white with black graduations and figures.
- .4 Potentiometric signals shall have a "live" zero or positive minimum value in the signal range.

- .5 Each component shall be carefully selected and designed for a long lifetime with ample margin to withstand transient and other surge voltages, which may occur in the circuits from any source in the power supply.
- .6 Each component and composite instrument shall be suitable for the location and installation position at the attitude designated on the drawings, e.g., horizontal, vertical or sloped position.
- .7 The Contractor shall provide all power supplies. Instruments shall be powered from the same control panel to which the measured signal is being transmitted, unless specifically noted otherwise. The power source to each instrument shall be individually fused, fuse size based on instrument power requirements.
- .8 Integrating counters and elapsed time meters shall show the total quantity that has passed through the meter and shall not require the use of a multiplier other than cipher additions. The integrators shall have at least seven figures.
- .9 All control panel mounted instruments shall be suitable for flush mounting and shall be furnished with bezel.
- .10 Unless otherwise indicated or specified, all signals shall be of the 4-20 mA type. This applies to both transmitting and receiving instruments.
- .11 All materials shall conform to the standards of the Canadian Standards Association (CSA), or cUL.
- .12 For factory calibrated instruments, the factory calibration sheets shall be submitted in the O&M manual.
- .13 All instruments to be installed per Manufacturer's recommended installation guidelines.
- .14 Provide an instrument I.D. tag fastened to each instrument permanently and legibly marked to match instrument list. Instrument tag to be stainless steel or powder coated aluminum.

2.2 DIFFERENTIAL PRESSURE LEVEL SENSOR/TRANSMITTERS

- .1 Provide hydrostatic differential pressure level sensing system(s) suitable for applications as indicated to monitor water levels as required.
- .2 Power input: As indicated.
- .3 Signal output: 4-20mA, with HART
- .4 Devices shall be wired to the following locations: wet well
- .5 Range: confirm with Engineer prior to shipment.
- .6 Each instrument system and associated components to be CSA or cUL approved, for the area in which they are mounted, before shipment.
- .7 Acceptable manufacturer(s): Rosemount model 3051L flange-mounted liquid level transmitter.

2.3 MAGNETIC FLOW METERS

- .1 Provide magnetic flow meter(s) suitable for the areas as indicated.
- .2 Magnetic flow meter FE/FIT-101 to have following characteristics:

- .1 Electrically rated for use in non-hazardous areas. Shall have CSA, cUL, or ETL certification as an approved electrical device in Canada.
- .2 Pipe size diameter(s) as indicated.
- .3 Flanges: Stainless steel, flanged each end
- .4 Liner: for wastewater water service
- .5 Electrodes: 316 stainless steel
- .6 Enclosure: NEMA 4X
- .7 Product temperature: -10 to 50°C
- .8 Ambient temperature: 10 to 50°C
- .9 Power supply: 120Vac
- .10 Signal output: 4-20 mA flow rate signal to be PLC monitored.
- .11 Signal output: Pulse output flow totalizer signal to be PLC monitored. Pulse duration to be of sufficient duration to ensure that PLC does not miss any pulses, and shall at minimum be 100mSec in duration. Provide one pulse/0.1cubic meters of flow.
- .12 Operating Range: Confirm all operating ranges with Engineer
- .13 Accuracy: better or equal to 0.2%
- .14 Controller/housing mounting, as indicated
- .15 Locally displayed information:
 - .1 Instantaneous flow in litres per second (l/s)
 - .2 Totalizer in cubic metres
- .16 Programming: via meter's controller and HART.
- .17 Capacitance back up for retention of settings and current values.
- .18 Remote-mounted transmitter applications shall be c/w sufficient length of converter cables to connect the flow meter sensor and the remote-mounted transmitter, with integral display, as indicated, and any appurtenances as necessary for the mounting and operation of the remote unit.
- .19 Normal operating pressure: 0-700 kPa (0-100 psi)
- .20 Test pressure: At least 1400 kPa
- .21 Grounding rings: As recommended by manufacturer's installation guideline, and mandatory for PVC pipe.
- .22 Acceptable manufacturer(s): Siemens Sitrans FM MAG 3100P flow sensor and Siemens Sitrans MAG 6000 transmitter, c/w panel mounting enclosure for transmitter and 30m cable kit.

2.4 FLOAT SWITCHES

- .1 Provide float switches as indicated, teardrop shaped submersible, weighted and encapsulated in an enclosure suitable for immersion in potable water and wastewater.
- .2 Acceptable manufacturer(s) shall be Xylem No.ENM-10 or approved equal in accordance with B7. Float switches shall be individually suspended by means of a submersible cable affixed to a galvanized steel float bracket as indicated on the drawings. Provide float rings to prevent cable entanglement. Acceptable manufacturer(s): Xylem No.13-520006 or approved equal in accordance with B7.

2.5 BUILDING FLOOD ALARM SWITCH

- .1 Building Flood Switch shall be Siemens Sitran LVL100 series compact vibrating level switch with the following features:
 - .1 Activate on liquid levels of 13mm above floor.
 - .2 Process connection: Threaded 1" NPT PN 64 / 316L.
 - .3 Switch rating: 20 - 250 V AC/DC.
 - .4 Housing : 316L stainless steel.
 - .5 Electrical connection protection: IP67.
 - .6 Identification: label, foil laser marking.
 - .7 CSA.
- .2 Provide mounting and hardware required for installation.

2.6 INDOOR TEMPERATURE TRANSMITTERS

- .1 Provide building temperature transmitters as indicated, with the following features:
 - .1 Platinum RTD 1000 Ohm measuring element.
 - .2 Loop powered.
 - .3 Scalable 4-20mA output.
 - .4 Range to be monitored: 0°C to 50°C.
 - .5 NEMA 4X environment rating.
 - .6 Wall mounting.
 - .7 CSA, cUL, or ETL certified for the area in which the system components are installed, before shipment.
- .2 Provide all hardware, brackets, and components necessary for wall mounting.
- .3 Acceptable manufacturer(s): Emerson (Liebert) model TW420.

2.7 BUILDING LOW TEMPERATURE THERMOSTAT

- .1 Building low temperature thermostat shall be Honeywell model T631A.

2.8 COMBUSTIBLE GAS DETECTOR

- .1 Provide detectors suitable for the detection of natural gas as indicated, with the following features:
 - .1 Transmitter with local display and remotely mounted sensor as indicated.
 - .2 Transmitter Display: Multi-colour status LED and digital readout of monitored gas concentration.
 - .3 Sensing method: Infra-red (IR).
 - .4 Measuring Range: As indicated.
 - .5 Analog Output: 4-20mA
 - .6 Power: 24Vdc
 - .7 Transmitter Operating Temperature: 0°C to 45°C
 - .8 Transmitter Enclosure: Surface mount, NEMA 4X
 - .9 Sensor Response Time: 90% in less than 11 seconds

- .10 Sensor Operating Temperature: 0°C to 45°C
- .11 Sensor Enclosure: Aluminum or Stainless Steel
- .12 CSA or cUL approval for the area in which the system components are installed, before shipment.
- .13 Provide one complete new calibration kit, including zero and span gases and all required fittings, to be left on site following commissioning.
- .14 Provide hardware and cables required for remote mounting of sensor(s) and transmitter as per drawings.
- .15 Acceptable manufacturer(s): Emerson (Net-Safety) Millennium II, model SC311 sensor and model M21 transmitter.

Part 3 Execution

3.1 INSTALLATION

- .1 Coordinate the work of this Section with the installation of the equipment specified in the relevant Sections of Divisions 23, and as indicated on the Mechanical and Electrical drawings.

3.2 FIELD INSTRUMENT MOUNTING

- .1 "Mounting" shall mean the positioning and fastening with proper brackets in the position required. Local displays and readouts shall be positioned for easy reading, without the use of ladders, by operators.
- .2 All equipment shall be mounted in accordance with manufacturer's recommendations.
- .3 Locations of all field instruments are subject to modification by the Engineer who reserves the right to move any item up to 3 metres from the position shown, without change to the contract price, provided notice is given before the related work has commenced.
- .4 Exact locations of all field instruments shall be site determined by the Contractor to the satisfaction of the Engineer to ensure proper operation of the device.
- .5 Employ any and all means of trade, skill, and workmanship to install all field instruments to the satisfaction of the Engineer.

3.3 COMMISSIONING

- .1 Refer to section 01 91 13 - General Commissioning Requirements

END OF SECTION