GENERAL REQUIREMENTS FOR AUTOMATION SYSTEM

1. GENERAL

1.1 Summary

.1 This Section covers supply and installation of the general requirements for the automation system for the work including but not limited to:

.1 Automation system PLC cabinets.

.2 Marshalling panels.

.3 Miscellaneous automation system equipment, network cabinets and switches.

.4 Fibre optic panels and cabling.

.5 Automation system servers, operator workstations, communications infrastructure, and associated network equipment.

.6 Facility communications networks and equipment.

.7 Process instrumentation.

.8 Process control devices.

.9 Fieldbus communication components.

.10 Automation field junction boxes.

.11 Programmable Logic Controllers and associated cards and devices.

.12 Integration into the existing Process Control System (PCS).

.2 Automation system programming, configuration, testing, and commissioning shall be the responsibility of the automation system integrator under the supervision of the controls (automation system) lead.

.3 All automated equipment in the Facility shall be integrated with the automation system.

.4 All work shall be coordinated with Division 16 requirements and Specifications.

1.2 Standards

.1 Manitoba Building Code.

.2 WSTP Automation Design Guide.

.3 WSTP Electrical Design Guide.

.4 WSTP Identification Standard.

.5 WSTP HMI Layout and Animation Design Guide.

.6 WSTP Data Retention Standard.

.7 BICSI 607 – Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings.

.8 Institute of Electrical and Electronics Engineers (IEEE):

.1 IEEE 802.3 - Standard for Ethernet.

.9 International Electrotechnical Commission (IEC):

.1 IEC 61131-3 - Programming Industrial Automation Systems.

.2 IEC 61850 - Communication Networks and Systems in Substations.

.3 IEC 61511 - Safety Instrumented Systems for the Process Industry Sector.

.10 Standards in Section 16010 – Electrical General Requirements.

1.3 Submittals

.1 Provide submittals in accordance with Sections 01300 - Submittals and 16010 - Electrical General Requirements and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Shop Drawings Submittals in accordance with Sections 01300 – Submittals and 16010 – Electrical General Requirements, and include the following:

.1 System overview drawing (including one-line network topology).

.2 Schematic diagrams showing all components and cabling requirements.

.3 Detailed drawings for automation system communications and server cabinets, including BOM for each cabinet, network port designations device layout and input/output (I/O) terminal block designations.

.4 Network Architectures and Block Diagrams.

.5 Instrument Loop Wiring Diagrams.

.6 IO Module Wiring Diagrams.

.7 Detailed information for the system hardware and software.

.8 Installation and maintenance instructions.

.9 Automation system I/O interface schedule.

.10 PLC and miscellaneous controller logic and programming.

.11 HMI graphics including screens, equipment, interactable elements, pop up boxes, navigation, and trends.

.3 Nameplate schedules in accordance with City Nameplate Standards and the WSTP Identification Design Guide.

.4 Test program (factory acceptance test) for automation system panels.

.5 Testing and commissioning schedule outlining all activities and tests.

.6 Submit testing and commissioning schedule outlining all activities and tests.

.7 Process Control Narratives.

.8 Functional Requirements Specifications.

.9 Informational Submittals:

.1 Provide informational submittals in accordance with other Specification Sections including but not limited to the following:

.1 Training Plan: In accordance with Appendix 18G.

.2 Testing and Commissioning Forms: In accordance with Schedule 18 Technical Requirements and Section 17810.

.3 Operation and Maintenance Data: In accordance with Sections 17907 and 17908:

.1 Outline of O&M data.

.2 Sufficient detail to allow operation, removal, installation, adjustment, calibration, maintenance and purchasing replacements for each PCS component.

.4 As-Built Drawings: In accordance with Schedule 18 Technical Requirements.

.2 Extra Materials:

.1 List of proposed spares, expendables, and test equipment. Separate Submittals for each PCS subsystem.

.2 Recommended Spare Parts: List of, and descriptive literature for, additional spares, expendables, and test equipment recommended by PCS Integrator. Include quantities, unit prices, and total costs.

1.4 Quality Assurance

.1 Automation system panel Manufacturer shall be Schneider Electric certified, and CSA approved for the type of Work and installation required.

.2 Automation system integrator shall have at least five (5) years' proven corporate experience using Schneider Electric trained technicians and completed at least five (5) industrial process projects in the last five (5) years of similar scale and complexity as the Project configuring and programming PLC control system software using:

.1 Schneider Electric Modicon as per Appendix 18E – Standardized Goods.

.2 EcoStruxure Control Expert (formerly Unity Pro) software as per Appendix 18E – Standardized Goods.

.3 Or approved equivalent.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Product:

.1 Schneider Electric Modicon M580 Control System as per Appendix 18E – Standardized Goods.

2.2 Configuration, Components and Features

.1 Service Conditions:

.1 Provide electrical power from each independent UPS system (dual supply) to each Automation System PLC, RIO, marshalling and network cabinet.

.2 Locate PLC, RIO, and network panels in an automation room or an air-conditioned electrical room.

.3 PLC, RIO, networking, and marshalling panels shall not be located in process areas or hazardous, corrosive or wet areas/locations.

.4 Instrumentation shall be designed and installed per the Manufacturer's requirements and recommendations.

.2 Configuration:

.1 All configuration services shall be provided by a common automation system integrator for the Project to keep consistency throughout the graphics, navigation, interfaces, and programming style.

.2 Pre-manufactured vendor packages by companies who provide specialized process controllers may be programmed and configured by their own integrator, but shall be integrated to the PCS by the common automation system integrator. Program the automation system to function as set out in the designed and reviewed Process Control Narratives.

.3 Automation system controllers shall be configured to execute defined control strategy including but not limited to; scanning of all input signals, generation of control actions

based on configured control strategy, output to a final element, and transfer data to servers. The Design Builder shall provide the following to the DB system integrator for the automation system configuration:

.1 Completed I/O database files.

.2 Process Global Overview Diagrams.

.3 P&ID Diagrams.

.4 Control schematics.

.5 Process Control Narratives.

.6 Functional Requirement Specifications.

.7 Alarm Lists.

2.3 Equipment and System Controls

.1 PLC Panels:

.1 PLC Panels shall connect to MCCs, Manufacturer supplied equipment controls, PMCS, UPS units, and I/O cabinets using Ethernet interface via a fault-tolerant Ethernet RIO ring network.

.2 Provide accessories necessary for Schneider PLC equipment and communication interfaces in the PLC panels.

.3 Provide passive cooling for the cabinets. If a cabinet is installed in a corrosion-controlled environment conditions, use circulation fans for forced cooling.

.4 Provide power supplies, data switches, power conditioners, terminals and all other components required for the PLC Panels.

.5 Supply of terminal blocks, single phase control power circuit breakers, and all associated materials is the responsibility of the panel Manufacturer.

.6 The PLC and interface requirements shall include the latest technology provided by Schneider Electric available at the later of the following dates:

.1 No earlier than two (2) years after the Effective Date, or

.2 No later than one (1) year prior to the anticipated Functional Completion date of the automation system as set out in the Project Schedule.

.2 PLC Panels:

.1 Provide PLC panels as set out in the Final Design.

.2 PLC panels shall connect to field instrumentation or equipment panels and controller cabinets for field wiring using Ethernet interface.

.3 Design, fabricate and install cabinets with all necessary components in the process areas as set out in the Final Design and confirmed by the suppliers.

.4 Example of typical hot-standby rack arrangement and architecture is provided in the Automation Design Guide.

.5 Example of typical Mid-Grade PLC and I/O Rack arrangement and architecture is provided in the Automation Design Guide.

.6 Example of typical Remote I/O Rack arrangement and architecture is provided in the Automation Design Guide.

.7 Supply of terminal blocks, single phase control power circuit breakers, and all associated materials is the responsibility of the panel Manufacturer.

.8 Installation of terminal blocks, single phase control power circuit breakers and all associated materials within the PLC panel is the responsibility of the Manufacturer.

.3 Automation System Information Management Hardware:

.1 All computers supplied shall be complete with application software and all applicable licenses. The computers shall be pre-configured with all software and configuration files and ready to connect and operate when delivered to the site.

.2 Network components (managed switches):

.1 Primary/secondary LAN and HMI:

.1 Schneider Electric. This product was standardized by the City via RFP 756-2013.

.2 Primary/secondary Control:

.1 Schneider Electric. This product was standardized by the City via RFP 756-2013.

.3 Automation system and plant maintenance network:

.1 Schneider Electric. This product was standardized by the City via RFP 756-2013.

.4 Security appliance (router/firewall):

.1 Moxa EDR-G903 Industrial Secure Router with Firewall/NAT/VPN.

.5 Field devices and remote I/O Ethernet Switches:

.1 Schneider Electric as per Appendix 18E – Standardized Goods.

.3 The network components shall include the latest technology recommended by Schneider Electric available at the later of the following dates:

.1 No earlier than two (2) years after the Effective Date; or

.2 No later than one (1) year prior to the anticipated Functional Completion date of the automation system as set out in the Project Schedule.

.4 Operator and engineering stations shall serve as control stations by monitoring the devices in the system, recording events, indicating alarm conditions, and displaying and logging device data. Workstations shall have the following minimum requirements:

.1 Processor: Dell Optiplex Quad Core Intel Xeon Processor 2.4 GHz or faster.

.1 Or approved equivalent.

.2 Memory: 8 GB DDR3 (min.).

.3 Operating System: Windows Server 2016 or greater.

.4 Hard Drive: 1 TB (min).

.5 2 GB or better Graphics Card.

.6 Mouse: optical two-button mouse, USB.

.7 Network Adapter: 2 x Intel PRO 1000PT dual port server adapter.

.1 Or approved equivalent.

.8 2 x Video Monitor LCD 24”.

.9 Power Supply: Energy Smart redundant power supply.

.10 Microsoft Office Basic.

.11 Symantec Endpoint Protection – DB shall use the City’s existing bulk license. If technical reasons prohibit this provide:

.1 McAfee virus scan suite.

.2 Or approve equivalent.

.5 Supply and install communication and server cabinets as set out in the Final Design.

.6 Network and communications cabinets:

.1 DELL Netshelter SX 42U.

.2 Or approved equivalent.

2.4 Ease of Integration

.1 The automation system shall import or export process data from the following:

.1 Wonderware Historian by Schneider as per Appendix 18E – Standardized Goods.

2.5 Design Life Cycle

.1 Provide a system that shall have an asset service life and technology life cycle of not less than ten (10) years from the Handover. Include a defined technical migration path for future upgrades and phased equipment replacement beyond ten (10) years.

.2 Provide firmware and software upgrades during the Performance Period to all installed automation system equipment to maintain uniformity at the most recent revision available.

.3 Use components that use an industry recognized open standard (IEEE802 Ethernet) and are interchangeable for other common components supporting similar standards. Proprietary technology is not permitted.

2.6 Support

.1 Provide a maintenance support agreement for automation system support services that includes local expertise and support capability within Manitoba.

.2 Provide an automation system that City persons are able to carry out routine maintenance, adjustments, and upgrades without third party support or equipment.

.3 Provide documentation and electronic media support training materials to enable City persons to create, capture and retain system knowledge and local support services sufficient to assure that City persons are able to sustain the automation system knowledge in accordance with the Technical Requirements.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 The system integrator shall perform all automation system hardware and software start-up and testing. Start-up and testing shall include, but not be limited to:

.1 Power-up and verification of all system components including automation system virtual servers and automation system clients.

.2 The verification of proper communication between all CPU’s cabinets, servers, and client workstations.

.3 The verification of proper communication between all CPU's cabinets, MCC's, I/O Cabinets, field remote Manufacturer supplied controllers, and other Facility systems (BMS, Security, Fire Alarm, CCTV).

.4 Install automation system cabinets in each electrical room.

.5 Install all power wiring and grounding required to meet the automation system Manufacturer's recommended practices and Good Industry Practice.

.6 Install all power, control and instrumentation wiring to automation system controller cabinets, field marshalling panels, interconnection to field controls, motor control, and other monitoring and control equipment to the automation system.

.7 Install and connect all services required for the CPU's, including the AC power supply, from the UPS distribution panels. Provide equipment grounds up to and including clean instrumentation ground.

.8 Install all communication cabling required to interconnect the smart MCC's to communication modules located in the controller cabinets.

.9 The doors are hinged on the left side of the cabinet set. This applies to both the front and the rear door.

.10 Provide redundant power feeders from the installed UPS distribution panels as set out in the Final Design.

.11 Supply, install, fasten, test, and terminate all control circuits, and all branch circuits from automation system panels and I/O panels.

.12 Complete equipment checkout, functional and operational testing activities for automation system in accordance with Section 17908 – Automation System Testing.

END OF SECTION

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

1. GENERAL

1.1 Summary

.1 This Section specifies general requirements for instrumentation and control related items. This section shall be supplemental to the requirements defined in other Specification Sections.

.2 Comply with latest edition of all applicable codes and standards whether referenced in this Section or not.

.3 In the event any inconsistency is discovered between the Specifications, codes or standards, the most stringent shall apply.

1.2 Standards

.1 Institute of Electrical and Electronics Engineers (IEEE):

.1 C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

.2 IEEE 802.3u, 100BASE-TX, 100BASE-FX Ethernet at 100 Mbit/s.

.3 IEEE 802.3z, 1000BASE-X Gbit/s Ethernet Over Fibre Optic.

.4 IEEE 802,3ab, 1000BASE-T Gbit/s Ethernet Over Twisted Pair.

.5 IEEE 802,3x, Flow Control.

.2 The International Society of Automation (ISA):

.1 S5.1 - Instrumentation Symbols and Identification.

.2 S50.1 - Compatibility of Analog Signals for Electronic Industrial Process Instruments.

.3 62443 - Security for Industrial Automation and Control Systems.

.3 Canadian Standards Association (CSA):

.1 C22.1 Canadian Electrical Code.

.2 C22.2, Electrical Safety Code.

.4 National Electrical Manufacturers Association (NEMA).

.5 National Fire Code, National Fire Protection Association (NFPA):

.1 NFPA 820 - Fire Protection in Wastewater Treatment Plants.

.6 Comply with the following City of Winnipeg Standards documents:

.1 Automation Design Guide.

.2 Electrical Design Guide.

.3 HMI Layout and Animation Plan.

.4 Identification Standard.

.5 Tag Naming Standard.

.6 Winnipeg Electrical By-Law.

.7 Information Bulletins.

.7 Manitoba Hydro:

.1 Manitoba Electrical Code, most current adopted revision.

.2 Manitoba Hydro Inspection Notices.

1.3 Acronyms and Abbreviations

.1 CP: Control Panel.

.2 DCS: Distributed Control System.

.3 FAT: Factory Acceptance Test.

.4 FOCS: Fibre Optic Communication Subsystem.

.5 HVAC: Heating, Ventilating, and Air Conditioning.

.6 I&C: Instrumentation and Control.

.7 I/O or IO: Input and Output.

.8 HMI: Human-Machine Interface, alias for Operator Interface.

.9 LCP: Local Control Panel.

.10 MCC: Motor Control Center.

.11 O&M: Operation and Maintenance.

.12 OWS: Operator Work Station.

.13 PC: Personal Computer.

.14 PCS: Process Control System comprising PLC's, and HMIs, communications systems and related hardware and software.

.15 PCU: Process Control Unit, a DCS subsystem.

.16 PCS: Process Instrumentation and Control System.

.17 P&ID: Process and Instrument Diagram.

.18 PLC: Programmable Logic Controller.

.19 SAT: Site Acceptance Test.

.20 SIT: Site Integration Test.

.21 SIFT: System Integration Functional Test.

.22 UPS: Uninterruptible Power Supply.

.23 VFD: Variable Frequency Drive.

.24 See the Identification Standard for further abbreviations.

1.4 Supplemental Documents

.1 Documents related to the Automation Work:

.1 Process Control Narratives.

.2 Instrument Lists:

.1 Instrument lists are provided to aid the Contractor's work. If there are any discrepancies between these documents and the Drawings and Specifications, the Drawings and Specifications shall take precedence.

.3 IO Lists:

.1 IO lists are provided to aid the Contractor's work. If there are any discrepancies between these documents and the Drawings and Specifications, the Drawings and Specifications shall take precedence.

.4 Instrument Datasheets.

.5 Manual Control Details.

.6 Cable Lists.

.7 Automation Equipment List.

1.5 Submittals

.1 Provide submittals in accordance with Sections 01300 - Submittals and 17800 - General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Submit proposed Submittal breakdown list consisting of all PCS component submittals. Sequencing and packaging of information to be in accordance with Progress Schedule.

.3 Partial Submittals not in accordance with Progress Schedule shall not be accepted.

.4 Obtain Contract Administrator’s approval if Submittals for a PCS subsystem are to be made in multiple packages.

.5 Provide submittals sufficiently in advance of requirements to allow time for review. Instrumentation and Controls Submittals over 100 pages long shall have an additional 5 Business days allowed for City and Contractor Administrator’s review.

.6 Mark Shop Drawings and data submitted showing only items applicable to the Work. If the Submittal contains information from a product catalogue, only the catalogue pages pertaining to the specific products shall be submitted. Submissions containing catalogue pages that do not pertain to the submitted products shall be rejected.

.7 Shop Drawings and Product Data:

.1 Prior to delivery of any Products to job site, submit Shop Drawings and Product Data as specified in Section 01300 Submittal Procedures for all equipment as required in the Specifications.

.2 Prior to submitting the Shop Drawings to the Contract Administrator, the Contractor shall review the Shop Drawings to determine that the equipment complies with the requirements of the Specifications and Drawings.

.3 The term “Shop Drawing” means drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data, which are to be provided by the Contractor to illustrate details of a portion of the Work. Indicate materials, methods of construction and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed. Indicate cross-references to design drawings and specifications. Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract price. If adjustments affect the value of the Work, state such in writing to the Contract Administrator prior to proceeding with the Work.

.4 Equipment tag identifiers shall be included on all Shop Drawings and product data submittals to clearly identify the equipment they apply to.

.5 Provide CSA or cUL certified equipment and material.

.6 Manufacture of Products shall conform to revised Shop Drawings.

1.6 Drawings and Specifications

.1 The intent of the Drawings and Specifications is to indicate labor, products, and services necessary for a complete, installed, tested, commissioned and functional installation.

.2 PCS Drawings shall indicate approximate route to be followed by conduits and cables and general location of electrical equipment. They do not show all structural, architectural, and mechanical details. The details on exact cable or conduit routing, and exact equipment installation location is to be determined on site and coordinated with all other trades.

.3 The PCS Specifications and Drawings and the Specifications of all other Divisions shall be considered as an integral part of the Work. Any item or subject omitted from either the specifications or Drawings but is mentioned or reasonably specified by the Drawings or Specifications of other Divisions, shall be considered as properly and sufficiently specified and shall be provided.

.4 If any discrepancy or omission in either the Drawings or Specifications are found, or if the intent or meaning is not clear, advise the Contract Administrator for clarification before submitting a bid.

.5 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

.6 Various package unit types of equipment are included in the Work. It is the responsibility of the Contractor to familiarize themself with the requirements of the equipment vendor, and to include all materials and labor for a complete and working installation. In some cases this means that control panels, instruments, actuators, etc. need to be wired and connected in the field. The Contractor shall include all costs to perform such services as part of his tender submittal. Coordination between the equipment vendor and the contractor shall be performed prior to tender bid closing date, and all costs shall be included in the tender. Request for extras due to lack of coordination from the Contractor and the equipment vendors will not be accepted.

.7 Cables schedules and lists where shown do not include all cables required to perform the complete facility installation. They shall be used as a general guide. Accurate cable lists, quantities, take-offs remain the responsibility of the Contractor.

1.7 Care, Operation, and Start-up

.1 Instruct City maintenance and operating personnel in the operation, care and maintenance of systems, system equipment and components.

.2 Where services of a manufacturer’s factory service engineer is required, arrange and pay for services to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with all aspects of its care and operation.

1.8 Permits, Fees and Inspection

.1 The Contract Administrator shall submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of Work.

.2 The Contractor shall pay associated fees as required by the Electrical Inspections and Permitting department.

.3 Notify the Contract Administrator of changes required by Electrical Inspection Department prior to making changes.

.4 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Contract Administrator.

1.9 Materials and Equipment

.1 Equipment and material to be CSA or cUL certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.

.2 Minimum enclosure type to be used is NEMA 12 unless otherwise specified.

.3 Junction Boxes:

.1 All field wiring connections to be located in junction boxes with terminals. The design documents show the expected junction boxes to be required. However, the Contractor must provide all junction boxes required, whether or not the junction boxes are shown in the design documents.

1.10 Finishes

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

.1 Paint enclosures light grey to ANSI 61 grey enamel, unless otherwise specified.

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

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

1.11 Equipment Identification

.1 Identify PCS equipment with nameplates.

.2 All identifiers shall be consistent with the most recent version of the City of Winnipeg Water and Waste Department Identification Standard 510276-0000-40ER-0002 and as shown on drawings.

.3 Nameplates:

.1 Lamacoid, 3 mm thick plastic nameplates, mechanically attached with self tapping stainless steel screws, white face with black lettering. Note: “Sheet Metal Screws” or other sharp pointed screws are NOT acceptable.

.2 Sizes as follows:

Table 1.1: Nameplate Sizes

Size	Dimension	Lines of Text	Text Height
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	40 x 90 mm	2 lines	8 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	5 mm high letters
Size 8	35 x 100 mm	3 lines	5 mm high letters
Size 9	45 x 100 mm	4 lines	5 mm high letters
Size 10	75 x 160 mm	3 or 4 lines	8 mm high letters

.3 Wording on nameplates to be approved by Contract Administrator prior to manufacture.

.4 Allow for average of fifty (50) letters per nameplate.

.5 Identification to be in English.

.4 Provide nameplates for the following, sizes as shown:

.1 Cabinets – Size 8.

.2 Small Junction Boxes (150 mm x 150 mm or smaller) – Size 1.

.3 Large Junction Boxes – Size 2.

.4 Control panels – Size 8.

.5 Field Devices (Instruments, Actuators, etc.) – Size 4.

1.12 Wiring Identification

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

.2 Wire tags to be heat shrink type with mechanically printed black letters on white background.

1.13 Conduit and Cable Identification

.1 Colour code conduits, boxes and cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.

.3 Colours: 38 mm wide prime colour and 19 mm wide auxiliary colours.

Table 1.2: Conduit and Cable Colour Code

System	Prime Band	Aux. Band
Medium Voltage (>750 V)	Orange	
347/600 V	Yellow	
120/208/240 V Power	Black	
UPS 120/208/240 V Power	Black	Green
Control Wiring (120 V)	Black	Orange
Fire Alarm	Red	
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring (<50 V)	Blue	Orange
Intrinsically Safe	Blue	White
Ground	Green	
Fibre Optic	Purple	

.4 Cable Identification: Supply and install lamacoid type cable identification tags for all cables. Install identification tag at both ends.

1.14 As-Built Drawings and Documents

.1 Refer to Schedule 18 Technical Requirements for additional requirements for As-Built Drawings and documents.

.2 The Contractor shall keep one (1) complete set of white prints at the Site during the work, including all addenda, change orders, Site Instructions, clarifications, and revisions for the purpose of As-Built Drawings. As the Work on-site proceeds, the Contractor shall clearly record in Red Pencil all as-built conditions, which deviate from the original Contract Documents.

.3 The Contractor shall keep one (1) completed set of automation documents at the Site during the work, including all addenda, change orders, Site Instructions, clarifications, and revisions for the purpose of As-Built documents. This includes, but is not limited to the following:

.1 IO Lists.

.2 Instrument Lists.

.3 IP Address Lists.

.4 Automation Equipment List.

.4 On completion of the work, minimum of four (4) weeks prior to final inspection, submit As-Built Drawings and documents to Contract Administrator for review. The Contractor shall certify, in writing signed and dated, that the As-Built Drawings are complete and that they accurately indicate all electrical services, including exposed as well as concealed items.

.5 Comply with all other City of Winnipeg standards and requirements.

1.15 Operation and Maintenance (O&M) Manuals

.1 Provide operation and maintenance manuals as specified herein and in accordance with Appendix 18F – O&M Information.

.2 Include in the operations and maintenance manuals a minimum of:

.1 Cover page including project name, year, name of owner and electrical consultant. Cover page shall be enclosed in a clear plastic cover.

.2 Index.

.3 List of Manufacturers and supplier for all items.

.4 Names, address and phone number of all local suppliers for items included in maintenance manual.

.5 Stamped and signed Shop Drawings.

.6 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of portions or features of the installation.

.7 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.

.8 All test results performed. This includes but is not limited to fibre optic tests; Control System network tests; Profibus Network Tests; FAT, SIFT, SIT and SAT tests.

.9 PLC and HMI Programs on USB memory stick.

.10 As-Built drawings.

.11 Signed and dated warranty certificate.

.12 Signed and dated approval by the local Electrical Inspections Department.

.13 All other requirements outlined in the specifications.

.3 Submit draft document prior to the start of commissioning.

1.16 Environmental Conditions

.1 Equipment and systems are to be rated to correctly operate in the environment in which they are to be installed.

.2 Exterior devices shall be rated to operate in an exterior environment with temperature range of -40°C to +40°C.

2. PRODUCTS

2.1 General

.1 The design is based upon the Manufacturers and model numbers shown on the drawings and in the specifications. If a manufacturer chosen after project award is different from that on which the design is based, the design must be modified by the Contractor based on the chosen manufacturer. If additional engineering work is required, the Contractor must provide the Engineer's seal for the change to the design.

.2 Substitutes:

.1 Provide all additional and modified wiring, raceway, enclosures, intrinsically safe barriers, and accessories at no additional cost associated with approved substitutes.

.3 Like equipment items:

.1 Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.

.2 Implement all same or similar functions in same or similar manner. For example, control logic, sequence controls, and display layouts.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Preparation and Protection

.1 Schedule expediting of materials and execution of work in conjunction with associated work of other trades in order to meet the required work schedule.

.2 Post engraved warning signs to meet requirements of local bylaws, Inspection Authority and Contract Administrator.

.3 Protect those working on or in vicinity of exposed electrically energized equipment from physical danger. Shield and mark live parts in accordance with local regulations. Indicate the appropriate voltage.

.4 Arrange for installation of temporary doors, barriers and similar items for access to rooms and areas containing electrical equipment. Keep these doors locked at all times, except when under direct supervision.

.5 Permanently identify with lamacoid nameplate, equipment energized from multiple power sources, noting voltages, power source locations, supply disconnect designations and grounding electrode location.

3.3 Warning Signs

.1 As specified and to meet the requirements of Electrical Inspection Department and the Contract Administrator.

.2 Lamacoid 3 mm thick plastic engraving sheet, red face, white core, mechanically attached with self tapping screws, 20 mm text.

3.4 Mounting Heights

.1 Unless otherwise noted, or in contravention of codes and standards, mount equipment replacing existing equipment at the same height.

.2 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.

.3 Typical mounting heights are as follows:

.1 Wall mounted instruments: 1.5 m Above Finished Floor (AFF).

.2 Wall mounted junction boxes: 1.5 m AFF.

.3 Wall mounted small panels: 1.5 m AFF.

.4 Wall mounted large panels: Top of cabinet at 2.0 m AFF.

.5 Gas detection horns and strobes: 2.0 m to 4.0 m AFF.

.6 Motor control hand switches: 1.5 m AFF.

.7 Valve actuator control stations: 1.5 m AFF.

.4 If mounting height of equipment is not indicated, verify with the Contract Administrator prior to proceeding with the installation.

3.5 Modifications to Existing Cabinets

.1 Where significant modifications are made to existing cabinets, the cabinet shall be inspected by the Authority Having Jurisdiction.

3.6 IP Addresses

.1 IP Addresses shall be provided to the Contractor for all network devices after project award. The Contractor shall be required to sign a Non-disclosure Agreement and confidentiality agreement in relation to the IP Addresses.

3.7 Devices with Integral Leads

.1 For devices with integral leads, if the location of the device does not allow the leads to reach the junction box as shown on the drawings, provide additional wiring, conduit and boxes as required to extend the leads to the associated junction box.

3.8 Location of Devices

.1 Allow for change of location of devices at no extra cost or credit, provided that the distance does not exceed 3000 mm (10') from that shown on the drawings, when the requirement is made known prior to installation.

3.9 Conduit and Cable Installation

.1 Sleeves through concrete: schedule 40 galvanized steel pipe, sized for free passage of conduit.

.2 For wall, partitions, and ceilings the sleeve ends shall be flush with the finish on both sides but for floors they shall extend 25 mm (1") above finished floor level.

.3 Fire stop opening with ULC approved assembly for the installation conditions.

.4 Provide a detailed proposed conduit routing plan to the Contract Administrator prior to proceeding with the installation of conduit.

.5 If possible, avoid routing conduits through hazardous area.

.6 Separate cables of different voltage levels when cables are installed parallel to each other.

3.10 Cutting, Patching, and Drilling

.1 Provide all cutting and patching as required.

.2 Return exposed surfaces to an as-found condition.

.3 Exercise care where cutting/drilling holes in existing concrete elements so as not to damage existing reinforcing, or any other systems run in the concrete.

.1 Locate reinforcing and other existing systems using ground penetrating radar, X-Ray or other suitable means. Mark out on the surface of the concrete the locations of rebar and all other systems.

.2 For all holes larger than 50 mm passing through reinforced concrete, mark the location of the desired hole and all embedded systems. Obtain approval from the Contract Administrator prior to cutting.

.4 Firestop and seal all penetrations.

.5 Ensure that water ingress will not occur.

.6 Provide expansion joints for penetrations where shifting can occur.

3.11 Anchor Installation

.1 The Contractor shall exercise care where installing anchors into existing concrete elements so as not to damage existing reinforcing. All anchors shall be installed utilizing carbide tip drill bits. The existing reinforcing shall be located utilizing a reinforcing bar locator and marked out on the surface of the concrete. The drill holes shall be advanced to the required depth for installation of the anchors. Should reinforcement be encountered while drilling, the hole shall be terminated and repositioned to clear the reinforcement. Do not use core bits that can easily intercept and damage/cut the reinforcing during drilling.

3.12 Field Quality Control

.1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentice's program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties. A maximum of one apprentice is permitted per qualified electrician.

.2 The Work of this Division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province of Manitoba.

3.13 Touch-Up Painting

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

.2 Obtain necessary touch-up paint of original type and quality from equipment manufacturer.

.3 Clean surfaces to be painted. Feather out edges of scratch marks. Make patch inconspicuous.

.4 Apply one or more coats until damaged surface has been restored to original finish condition.

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

.6 Do not paint nameplates, tags, CSA labels, warning plates and operating instructions. Observe field painting of electrical equipment or raceways. Labels shall be visible and legible after the equipment is installed.

3.14 Cleaning

.1 Comply with the requirements of Section 01741.

.2 Clean construction debris and materials from enclosures, before final electrical tests. Vacuum the interior and exterior of enclosures to ensure all equipment is free from debris. No loose items shall be in the bottom of cabinet before the final electrical tests. Any spare parts, drawings, documentation, etc. should be stored in the appropriate area in the cabinet.

3.15 Provision for Future Expansion

.1 In each location where space for future equipment is indicated, leave such space clean. Install conduit, wiring and other work in such a manner that necessary connections can be made in future without dismantling existing equipment, raceways or wiring. Consult with Contract Administrator whenever necessary.

END OF SECTION

FIELD SERVICES

1. GENERAL

1.1 Summary

.1 This Section describes the requirements for field services required to place, install, wire, connect, test, verify and document the installation of all components and related training.

.2 Provide all labour, equipment and materials required for the installation, testing and commissioning, and start-up of the PCS.

.3 Cooperate and coordinate with the City, the PCS system integrator, and other contractors to fully test and commission all components of the PCS system.

.4 Provide network connections and power supply connections, from the electrical distribution panels for all equipment requiring power.

.5 Coordinate the installation of equipment.

.6 Coordinate the field instrumentation requirements with other Divisions.

1.2 Submittals

.1 Submit the proposed forms for documenting the checkout and verification phases of all of the work.

1.3 Quality Assurance

.1 Provide a qualified, factory authorized field-service representative for the installation and set-up of new equipment. Submit qualifications to the Contract Administrator for review.

.2 Provide the services of qualified installers for any equipment and communications cable required to and from the patch panels, and to the PLCs and PCS. For fibre optic media systems use personnel expressly trained at splicing, terminating, and testing of fibre optic cabling. Submit qualifications of each installer to the Contract Administrator for review.

.3 For installation of field raceways and wiring use qualified trades people.

2. PRODUCTS

2.1 Equipment and Materials

.1 Provide all equipment and materials necessary for the un-loading, handling, placement, installation and testing of all control system equipment.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Installation

.1 Provide for the off-loading and placement of all equipment in the field.

.2 Inspect equipment for mechanical and electrical damage prior to shipping, arrival at Site, during unpacking and after final placement of equipment. Notify the Contract Administrator in writing of any damages incurred. Replace or repair any damaged equipment to the satisfaction of the Contract Administrator.

.3 Prepare damage reports and make all claims against the carrier. Notify the Contract Administrator in writing that the claim has been submitted and provide the Contract Administrator a copy of the damage report.

.4 Contractor shall provide adequate protection for the equipment after installation. In order to maintain the proper environmental conditions for the equipment, do not install equipment until all Work that affects the environmental conditions of the installation area is completed.

.5 Certify in writing that equipment has been installed as per Drawings and recommended installation procedures. Submit certification to the Contract Administrator. Report any discrepancies to the Contract Administrator.

.6 Provide and install the AC power supply from the distribution panels and connect to systems ground for the equipment. Certify in writing that equipment power and grounding requirements have been satisfied. Submit certification to Contract Administrator. Report any discrepancies to the Contract Administrator.

.7 Certify in writing that field wiring is properly installed and correctly identified. Submit certification to the Contract Administrator. Report any discrepancies to the Contract Administrator.

.8 Adjust equipment settings as necessary to place equipment in trouble-free operation. Submit any amendments to calibration certificates to the Contract Administrator.

.9 Certify that the system is ready for field testing. Submit certification to the Contract Administrator.

.10 Update and submit the As-Built Drawings and CAD files for the installed systems to the Contract Administrator.

END OF SECTION

CONTROL DEVICES

1. GENERAL

1.1 Summary

.1 This Section covers supply and installation of control devices for the Work.

1.2 Standards

.1 Canadian Standards Association (CSA):

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

1.3 Submittals

.1 Provide submittals and Shop Drawings in accordance with Sections 01300 – Submittals, 16010 – Electrical General Requirements and 17800 – General Requirements for Automation System, and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Omron.

.2 Schneider Electric.

.3 Allen Bradley.

.4 Phoenix Contact.

.5 Or approved equivalent.

2.2 Configuration, Components and Features

.1 Control Relays:

.1 Designs shall use flat-pin encapsulated type plug-in relays.

.2 120 VAC relays shall be Idec RH2B-ULC type, 2PDT, plug-in, complete with test button, operation indicator, and surge suppressor or approved equal.

.3 4 VDC relays shall be Idec RH2B-ULC type, 2PDT, plug-in, complete with test button, operation indicator (red), and surge suppression RC Circuit. RC circuit may be external to relay using Manufacturer’s approved components, soldered and insulated using heat-shrink sleeves or approved equal.

.4 Relay contacts shall be form C rated 110 VAC, 10 A resistive and 7.5 A inductive.

.5 The quality and type of relays shall be based on Idec types.

.1 Acceptable Products:

.1 Omron LY 2PDT (120 VAC) and MY 2PDT (24 VDC).

.2 Or approved equivalent.

.2 Timing Relays:

.1 Do not use plug-in timer relays.

.3 Pushbuttons:

.1 Minimum standard is heavy duty, oil tight, push-to-test, or as specified for field-located devices.

.2 Operator colour coding: refer to WSTP Automation Design Guide.

.3 Operator style: flush for start and reset, extended for stop, mushroom head for emergency stop.

.4 Contact arrangement shall suit control requirements.

.5 Provide NEMA 4X legend plates and nameplates in accordance with the Standard Details.

.6 Acceptable Product:

.1 Schneider products.

.2 Or approved equivalent.

.4 Limit Switches:

.1 Standard is for heavy duty and oil tight limit switches.

.2 Adjustable wand type operating levers.

.3 Acceptable Product:

.1 Schneider products.

.2 Or approved equivalent.

.5 Selector Switches:

.1 Minimum standard is heavy duty, oil tight, or as specified for field-located devices.

.2 Switches shall be maintained or spring return as specified.

.3 Switches shall have a minimum of 2 positions.

.4 Operator style:

.1 Manufacturer's standard style.

.5 Contact arrangement shall suit control requirements.

.6 Provide NEMA 4X legend plates and nameplates in accordance with the Standard Details.

.7 Acceptable Product:

.1 Schneider products.

.2 Or approved equivalent.

.6 Indicating Lights:

.1 Minimum standard is heavy duty oil tight, or as specified for field-located devices.

.2 24 V or 120 VAC transformer type push-to-test, LED type.

.3 Lens colours: refer to WSTP Automation Design Guide.

.4 Provide NEMA 4X legend plates and nameplates in accordance with the Standard Details.

.5 Acceptable Product:

.1 Schneider products.

.2 Or approved equivalent.

.7 Control Circuit Transformers:

.1 Single phase, dry type.

.2 Provide dead-front primary fuse required by CSA/EEMAC.

.3 Indicating-type secondary fuse as required by load being served.

.4 Close voltage regulation as required by magnetic and solenoid coils.

.5 VA rating as required by loads being serviced plus an allowance of 20% for future requirements.

.8 Control Fuse Holders and Fuses:

.1 Provide fuse protection for all control circuits including primary and secondary windings of instrument transformers, voltage sensing circuits, and current sensing circuits.

.2 Type and size as selected by panel builder for protection of equipment being served.

.3 Door mounted fuse holders for small dimension fuses 6.4 mm x 31.8 mm (¼ inch x 1¼ inch) Bussmann. Use different models for different voltages including:

.1 120 VAC circuits, Type HKL with clear octagon knob.

.2 12 VDC circuits, Type HKT with amber octagon knob.

.3 24 VDC circuits, Type HKX with amber flat sided knob.

.4 Fuse holder mounted on back pan shall be dead-front type (Finger-Safe) Ferraz Shawmut Ultrasafe complete with blown fuse indicator. All control power fuse holders shall be complete with blown fuse indicators, LED lights. Blown fuse indicators shall be located on the inside of the equipment enclosure.

2.3 Spare Parts

.1 Provide spare parts that are identical to and interchangeable with similar parts installed and in accordance with Schedule 18 Technical Requirements and the following:

.1 Three (3) spare fuses for each type and size of fuse used.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 All common components for the entire works shall be of the same Manufacturer and model to simplify spare part inventory requirements and ease of maintenance.

.3 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

END OF SECTION

PROGRAMMABLE LOGIC CONTROLLERS

1. GENERAL

1.1 Summary

.1 This Section covers supply and installation of programmable logic controllers (PLC) and remote inputs and outputs (RIO).

.2 Provide PLC based control systems for each building and process area where specified in the process and HVAC sections of the Technical Requirements. All new PLC systems shall be provided in accordance with the Technical Requirements, and the Automation Design Guide.

.3 Unless otherwise specified, all PLC and HMI systems software, licensing, and programming services shall be provided by the Design Builder (DB) systems integrator.

.1 DB shall notify the City before purchasing any software licences. If the City has a bulk license for the required software the City may require the Design Builder to use their copy of the license.

.2 DB shall maintain a list of software licenses owned for the project and submit the list to the City every six months. Lists shall at a minimum include:

.1 License name.

.2 License version.

.3 License quantity.

.4 Expiration date.

.1 If the license will expire within the next 6 months, indicate if the license will be renewed.

.5 Indicate if the license will be assigned to the City upon handover, if so, indicate the projected handover date.

.6 License cost.

.7 Any unique identifiers for the license (key numbers, etc.).

.4 Provide PLC based control systems when specified as part of a stand-alone vendor equipment package in accordance with the requirements detailed in Divisions 11 and 15. PLC based control systems supplied as part of a vendor equipment package shall conform with the Schedule 18 Technical Requirements, and the Automation Design Guide.

.5 Where PLC based control systems are supplied as part of a vendor equipment package, the equipment vendor shall supply all PLC hardware components, HMI station, data communications hardware, termination accessories, special interface modules and associated software and licences. The equipment vendor shall program the system and provide a fully functional, tested, and operational system, and shall cooperate with the DB systems integrator to test and commission the package interface to the plant SCADA.

.6 Provide the testing and commissioning of the entire PLC communications network to the automation system using Ethernet protocol.

.7 Conform to the requirements of Divisions 15, 16, 17, the Technical Requirements, and the Automation Design Guide.

1.2 Standards

.1 Canadian Standards Association (CSA):

.1 CAN/CSA E61131-2 – Programmable Controllers – Part 2: Equipment Requirements and Tests.

1.3 Submittals

.1 Submit product data in accordance with Sections 01300 – Submittals, 16010 – Electrical General Requirements, and 17800 – General Requirements for Automation System.

.2 A copy of the documented PLC and HMI program files shall be submitted in electronic form.

1.4 Software Ownership

.1 The City shall fully own all PLC programming logic supplied, and may utilize the software provided for any purpose including:

.1 Modification and revision.

.2 Use at other City facilities.

.2 The City may turn the software over to a 3rd party for use at any City owned facility.

.3 Provide source code for all custom software and function blocks, and any other software logic utilized in the application.

.1 Source code for base function blocks provided by the PLC Manufacturer is not required.

1.5 Design Requirements

.1 Design and implement a complete operating PLC and RIO system.

.1 The design shall be based upon the supplied Functional Requirements Specification.

.2 Utilize a tag naming convention that extends and does not conflict with the tag scheme utilized in the Functional Requirements Specification. Variable tag names shall be derivatives of the equipment tags based on the Identification Standard.

.2 The PLC and HMI software design shall be authenticated by a Professional Engineer licensed to practice in Manitoba.

.3 The Design shall incorporate existing Function Blocks into the final design.

.4 The Design Builder and City shall review the overall design at various stages. Make changes as requested by the Design Builder.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Provide the following Schneider Electric PLC and HMI products as per Appendix 18E – Standardized Goods:

.1 Processor M580; with Hot/Standby abilities for process area main PLCs and critical processes with dedicated PLC.

.2 Communication modules.

.3 HMI Magelis GTO 12.1” or higher.

.4 Vijeo Designer environment.

.5 AVEVA Plant SCADA software.

2.2 Performance Criteria

.1 Function:

.1 PLC systems shall be control panel mounted, fully programmed, functional, and operational as a stand-alone control system ready to be integrated with the automation system.

.2 When required by the application or when specified, provide a Schneider Electric HMI, as per Appendix 18E – Standardized Goods, for equipment operation and alarming, completely configured and programmed.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Factory Acceptance Testing:

.1 Provide all applicable testing and testing forms in accordance with Section 17905 – Instrumentation General Requirements and 17907 – Instrument and Controls Testing.

.2 Provide factory acceptance testing of Manufacturer supplied and programmed equipment system prior to shipment.

.3 Testing of Manufacturer supplied and programmed system to consist of a complete simulation of the process or equipment to be controlled and verification of interlocking and operator station controls and alarming.

.4 Additional testing includes, but is not limited to, testing of all PLC I/O panel wiring connections, testing of all HMI screens and pushbutton functions, testing of all interlocks with equipment supplied by others, confirming the operation integrity of all network communications including the link and "failure relay".

.5 Provide Manufacturer’s representative to witness testing and commissioning of field operation of the equipment and communication connection to the automation system.

3.2 Installation

.1 PLC and HMI:

.1 Install PLC hardware and HMI in accordance with the Manufacturer’s latest installation publication.

.1 Confirm firmware and software versions prior to programming or installation with the City. When a new firmware or software version is available for equipment in the Project notify the City.

.2 Keep firmware and software versions consistent throughout the project and up to date with the Manufacturer’s release. Do not update or change the firmware or software version for the Project without acceptance by the City. The City may elect to delay the updating the Project firmware and software versions.

.2 Utilize "single slot" I/O addressing as defined by the Schneider Electric programming manual for the system.

.3 All PLC discrete I/Os shall be 24 VAC. All equipment I/O points shall be isolated points powered from the equipment being controlled.

.1 Use interposing relays where 120 VAC is required.

.4 When specified or required, provide a Schneider Electric HMI for equipment operation and alarming, completely configured and programmed, and complete with programming software.

.5 Configure and wire HMI in accordance with the Manufacturer’s installation and programming manual. Contact Engineer of Record for address assignments when the HMI or PLC is connected to the plant control or maintenance Ethernet network.

.6 Provide Manufacturer's representative for a minimum of two (2) Business Days for witness testing and commissioning of each complete packaged system.

.2 Miscellaneous:

.1 Unless specified otherwise, complete installation in accordance with CSA C22.1 and as amended for use in the Province Manitoba by the Manitoba and local electrical authorities.

.2 Provide minimum 25 percent spare slots in the PLC rack.

.3 Discrete output cards shall carry rated connected loads without the need for interposing relays.

.4 Mount the PLC and HMI on a control panel at an ergonomically correct operating height.

.5 Provide a minimum of two (2) software licenses for the HMI and programming software unless a City copy of the license is being used.

.3 Wiring:

.1 All wire and cable to meet requirements of Sections 16122 – Wires and Cables and 16126 – Communication Cables.

.2 Use 16 AWG conductors from I/O wiring arm to panel terminal blocks only: all field and equipment conductor sizing and wiring types shall meet requirements detailed in Section 16122 – Wires and Cables.

.3 Wire all I/O to terminal blocks, whether used or spare.

.4 Grounding and Bonding:

.1 Ground and bond PLC and HMI to the ground bus within the control panel in accordance with the Manufacturer’s latest grounding publication and the CEC.

.2 Use a minimum 8 AWG copper conductor to ground HMI and I/O chassis.

END OF SECTION

PLC PROGRAMMING GUIDELINES

1. GENERAL

1.1 Summary

.1 This Section covers the programming guidelines to be followed when Schneider Electric Modicon PLC hardware provides the control logic for packaged equipment for the Work.

.2 Conform to the requirements of Section 17905 – Instrumentation General Requirements.

.3 Use this Specification in conjunction with Section 17831 – Programmable Logic Controllers.

.4 Use the configuration provided within the City Standards.

.5 The City may have applicable standard blocks, developed on other projects, available for use by Design Builder as a basis for program development. Design Builder shall request these standard blocks prior to beginning any programming for the PLC, HMI, or PCS. The Design Building shall use the provided standard blocks where their functionality applies. Should the City not have standard blocks available, Design Builder shall be responsible for providing these blocks in accordance with the Technical Requirements.

.1 Submit RFIs for clarification if the programmer is unsure if a standard block applies to a given circumstance. DB shall provide all rework to re-program any work not completed with standard blocks for no extra cost unless clarification via RFI was sought and permission or confirmation to not use the standard blocks was granted.

.6 The City may have standard graphics, developed on other projects, available for use by Design Builder as a basis for HMI development. Design Builder may request these standard graphics prior to beginning any programming for the PLC, HMI, or PCS. The Design Building shall use the provided graphics where their functionality applies. Should the City not have standard graphics available, Design Builder shall be responsible for providing these graphics in accordance with the Technical Requirements.

.1 Submit RFIs for clarification if the programmer is unsure if a graphic applies to a given circumstance. DB shall provide all rework to re-program any work not completed with standard graphics for no extra cost unless clarification via RFI was sought and permission or confirmation to not use the standard blocks was granted.

1.2 Submittals

.1 Submit product data in accordance with Sections 01300 – Submittals, 16010 – Electrical General Requirements and 17800 – General Requirements for Automation System.

.2 Provide three (3) copies of documentation as detailed in this Section. Each copy to consist of:

.1 Printout of program showing all descriptors and including address references. Only cross references of outputs are to be shown below the rung.

.1 Printouts to be printed on 279 mm x 216 mm (11 x 8.5 inch) paper in landscape mode, bound in a no bigger than three inch, 3-ring binder(s), printed at 8 lines per

inch and 12 characters per inch resolution, and program sections to be separated and identified by tabs.

.2 Copy of the program and documentation files on a USB flash drive. The USB flash drive will include the latest version of all required files.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Schneider Electric Vijeo Citect HMI development software as per Appendix 18E – Standardized Goods.

.2 Schneider Electric Ecostruxure ControlExpert (formerly Unity Pro XL) PLC programming software as per Appendix 18E – Standardized Goods.

.3 Schneider Electric Wonderware Historian client as per Appendix 18E – Standardized Goods.

.4 Schneider Electric SoMove motor control equipment configuration software or approved equivalent.

.5 MDT AutoSave change management software or approved equivalent.

2.2 Performance Criteria

.1 Program Documentation:

.1 Refer to the Automation Design Guide for programming language preferences and related justification. Function blocks are generally preferred for most general applications. Ladder logic may be used where analog operations are not required. Instruction list, structured text, and SFC are generally not recommended except for special circumstances where the preferred languages prove to be too cumbersome or inefficient.

.2 Provide program documentation in detail so that City staff experienced in PLCs but inexperienced in the process area are able to troubleshoot maintenance calls without extensive training. Provide all documentation in the English language.

.3 The standards in this Specification give minimum levels of documentation and are not meant to limit the documentation supplied.

.4 Provide a symbol and address comment for all word and bit addresses.

.5 Where address comments are inappropriate, use instruction comments to improve clarity and understanding.

.6 Provide rung/block comments of sufficient detail to provide the maintenance staff a clear definition of program functionality and how it relates to process flow.

.7 Provide rung/block comments at least every five (5) rungs/blocks to describe functional groups of the program. Where the program is complex, provide comments at every rung/block to ensure the maintenance staff can understand and troubleshoot the program without extensive training.

.8 A description of the sequence of operation is required separate from the ladder logic/functional block documentation.

.9 Provide supplemental documentation where rung/block comments do not fully describe or provide sufficient detail for maintenance staff to understand and troubleshoot the program. Supplemental documentation will include, but not be limited to, details of:

.1 Intelligent modules.

.2 High level programs.

.3 Sequencers.

.4 PID controls.

.5 Program flow.

.6 LAN communication (Ethernet IP, Modbus TCP).

.7 Data flow diagrams for analog modules.

.10 Samples of documentation have been provided by the City.

.11 Document all unused input or outputs supplied as "SPARE" in the address comment.

.12 Name program files as related to content in that file.

.13 Any user made function blocks must contain an accurate description of its logic and purpose.

.14 Provide a searchable compiled PDF of all custom function blocks including a description, implementation example with its explanation, and a reference to where it can be found in use in the system. Provide instructions on how to integrate each custom function for new applications.

.2 Programming Guidelines:

.1 Refer to the Automation Design Guide for programming language preferences and related justification. Function block is generally preferred for most general applications and ladder logic may be used where analog operations are not required. Instruction list, structured text and SFC are generally not recommended except for special circumstances where the preferred languages prove to be too cumbersome or inefficient (for example, mathematical calculations/formulas).

.1 Structured text shall be used, if possible, when constants, settings, or parameters must be hard-coded.

.2 Structured text or ladder logic shall be used when possible, for mapping physical I/O.

.2 These programming guidelines exist for the purpose of allowing maintainable programs to be developed and to facilitate the implementation of reliable control systems. All applications have unique properties, and all programs cannot therefore be identical. These guidelines are intended as an aid to keep program structure consistent across the City.

.3 The guideline in no way inhibits innovative ideas, new engineering applications, or methods of the design. Obtain approval from the Engineer of Record prior to deviations from the guidelines. Comprehend the basic requirements of the equipment and ensure the engineering design and programming concepts reflect the Specifications.

.4 Maintain revisions list corresponding to program changes by the programmer and record, along with the date, in the program title as follows:

.1 X.Z –YYYY – MM – DD.

.2 Where X is a major change and Z is a minor change number.

.5 Program Files:

.1 Break programs up into multiple program files to provide better program organization. Program file lengths to be determined by the individual process. Program files to be less than fifty (50) rungs in length.

.2 Do not exceed forty (40) program files in total number per process area and sort appropriately.

.3 Locate program file breaks at logical breaks in the process.

.4 Program flow shall follow a pattern of process flow.

.5 Use program file MainProgram to schedule all other files. Limit control logic to program files other than file MainProgram.

.6 Limit control program file nesting to two (2) levels deep.

.7 Use non-control program files to isolate control rungs and make troubleshooting easier.

.8 Non-control program files shall reside as the last files and may include the following:

.1 Diagnostic Files: ethernet, debugging, system health, and process considerations.

.2 Calculations.

.3 Data Block Transfers.

.4 Traps.

.9 Schedule non-control program files on either a time or event basis in order to minimize scan times if they are not required to run continuously.

.10 Other control program files may include:

.1 Fault Routine for orderly shutdown or power-up.

.2 Selectable Timed Interrupt file – use only when it is the only method a process has to interrupt another process. The interrupt time selected shall be longer than the scan time of the interrupt file.

.6 Logic.

.1 Do not multiplex logic unless memory requirements are critical.

.2 Any parameter passing between program files shall be explicit in the logic.

.3 Avoid indirect and indexed addressing.

.4 Instructions most likely to be false shall be left most on rungs in order to minimize scan times.

.5 Latched (OTL) instructions shall not be used on output rungs except where status must be retained on power outage.

.6 The display size for control rungs with symbols on and comments off shall not be exceeded. Rungs shall be printable on one (1) page.

.7 Minimize the number of intermediary (store) points.

.8 Diagnostic rungs shall be a minimum 10 percent of program size. Diagnostic rungs shall include but shall not be limited to reporting of I/O rack status and the battery low indication.

.7 Block Transfers and Message Instructions.

.1 Instructions shall be time or event scheduled.

.2 Provide data integrity logic. Data integrity logic shall include, but shall not be limited to:

.1 Buffered and synchronized data where appropriate.

.2 Error checking using block transfer and message instruction status bits.

.3 Checking queue full bits and taking appropriate action.

.3 Do not use continuous mode.

.4 Provide logic to set all data to a safe state in the event communications is lost.

.8 Valuable data (setpoints, constants, settings) shall be protected from data loss in the event of a PLC cold start. Design Builder shall use the Schneider recommended method of assigning these %MW addresses and disabling initialization of %MW on cold start. Use of the %S94 bit for this purpose is not allowed unless otherwise directed by the City.

.9 PLC hardware alarms shall be read by SCADA directly from the PLC's system words; there shall be no intermediate PLC logic used to generate PLC hardware alarms that are available from the PLC's system words.

.10 The following M580 configuration settings shall be enabled to allow online modification of PLC programs:

.1 Online Modification in Run or Stop.

.2 Allow Logic Mismatch (for Hot Standby configuration), using the default value of 20 for the allowed number of logic mismatches.

.11 Analog inputs shall be configured so that readings within the range of 3.8 - 20.5 mA are allowed, and any reading outside this range shall be treated as faulted.

.12 I/O addressing in the PLC shall match the PID drawings to facilitate troubleshooting.

.1 Topological addressing shall be used for local I/O.

.2 Device DDT addressing shall be used for remote I/O, and module names shall reflect the physical module location (bus, drop, rack and slot – e.g. EIO1.D1.R1.S1).

.3 In mixed applications (i.e., local and remote I/O) Device DDT type I/O shall be used for both.

.13 Nested custom derived function blocks (DFBs) shall be avoided whenever possible.

.14 Elementary variables shall be used for links between different programming sections.

.1 Avoid the use of DFB pin names for inter-section links.

.2 Connectors/links shall be used for connections within a section.

.15 Communication to all field network devices shall utilize DTMs from Schneider's DTM library.

.1 In no case shall manually polling data using read/write function codes be used without written approval from the City. Each instance of manually polling requires separate approval. When requesting approval, this specification and clause shall be referenced.

.16 Program tasks shall be structured in sequential order: "Inputs Mapping Sections", followed by "Process Sections", followed by "Outputs Mapping Sections".

.1 Monitoring, alarms, and configuration sections shall be located at either the head or end of the program task.

.3 Ethernet:

.1 Data integrity is of paramount importance whenever a serial link is used in control involving personnel safety, equipment safety, and avoidance of environmental impact. Serial links used for control and operator I/O (live displays or stop-starts) to incorporate a watchdog timer causing an orderly shutdown to a safe state and initiating an alarm on failure of the serial link.

.2 Real-time control shall be performed by the local PLC.

.3 Structure programs to synchronize loading data from unsolicited communications into the control program.

.4 Include programs to monitor the processors on the data highway and take appropriate actions if one goes offline.

.5 Provide every device on a highway that uses only the Basic Command Set, with a separate Integer file to be assigned in all PLCs on that highway which communicate with it. The Integer file number (in decimal) shall correspond to the station number (in octal) of the Basic Command Set device.

.6 Make file assignments and reserve necessary files in all PLCs communicating on the highway.

.7 The method of error checking on the asynchronous link shall be cyclic redundancy check.

.8 Minimize highway traffic by reporting the exception with unsolicited writes.

.1 Partition data into separate files, as opposed to data blocks, within one (1) file to allow for better memory management. Allow for expanding and contracting file sizes without affecting adjacent data table areas.

.2 Data table files shall be smaller than one hundred (100) elements and segmented by physical production areas.

.3 Data tables shall be arranged to facilitate easy troubleshooting and maintenance. Include the grouping of related functions (motor starters and controls) into logical areas and patterns that reflect the process sequence.

.4 If the data table elements exceed one hundred (100) elements, store most frequently used data in the memory areas indicated above. Position references to data in higher addresses further right on a rung so their instructions are less likely to be executed during each program scan.

.5 Data table files shall have 25 percent spare storage capacity up to a maximum of one hundred (100) spare elements. Create a minimum fifty (50) elements for each data table type.

.6 To set to a safe state, provide logic in the appropriate Input area of the data table associated with each active chassis and set the inhibit bit(s) in the event that any of these racks fault. Input field data to remain in its last state upon a chassis failure. Logic

is required to periodically attempt to reset the failed chassis as appropriate to the application.

.7 Use input file 1 and Output file 0 for field device state data only.

.8 Setup an I/O status file to allow for masking and reporting of rack status.

.4 PLC Processor Configuration:

.1 Use the major fault bit to force the processor into program mode upon power up if the process requires this feature.

.2 Provide a minimum of 25 percent unused I/O capacity above the machine's initial requirements for future expansion.

.3 Provide a minimum of 25 percent user logic memory above the systems initial requirements.

.4 Do not use complimentary I/O chassis techniques.

.5 Do not install EEPROM's in the processor.

.6 Configure the PLCs for Automatic Start in Run.

.7 All PLCs' time shall be synchronized to the primary and secondary HMI servers using the primary as the primary NTP source.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

END OF SECTION

APPLICATIONS SOFTWARE

1. GENERAL

1.1 Summary

.1 Applications software is the software that provides functionality unique to this project, and that requires specific configuration from the standard software. All Applications software shall be developed or configured by the Contractor under this contract.

.2 This Work includes:

.1 Developing, testing, debugging, troubleshooting, documenting, training, and system start up of a complete and comprehensive Process on the Process Control System (PCS). The PCS is comprised of distributed area PLCs, RIOs, and Profibus networks working with HMI and Historian Servers and operator workstations on a dedicated, layered network to provide robust and reliable control system to run NEWPCC Biosolids operations.

.2 Set up, configure, and develop all programs, databases, environments for a fully operable system as described in the Drawings, Specifications, and Appendices.

.3 Modify and tune the control loops and software interfaces to create a cohesive control system including:

.1 Proportional, Integral, and Derivative (PID) response parameters for control loops.

.2 Individual equipment performance.

.3 Data communication between processors, workstations, and servers.

.4 Operator and maintenance workstation displays.

.5 Networking hardware configurations.

.6 PLC and HMI configurations.

.4 Provide temporary PLC programming as required during testing and commissioning. Provide all updates to programming as required during the project to keep the NEWPCC plant functional for the operations staff to maintain the provincial license.

.3 The Contractor shall schedule the workshops specified in this Section. Provide a minimum of three (3) weeks notice for a software design workshop.

.1 Provide all PLC programming on vendor and new PLCs to facilitate data exchange as required for the seamless integration of the PLCs into the PCS. All monitoring, controlling, and alarming of PLCs shall be accessible from any PCS workstation after the integration.

.2 Configure all network settings and configurations for reliable communication between the provided devices and the existing plant. Where redundant paths are installed, provide configuration to allow for automatic fail-over to the redundant network paths.

.3 At anytime when equipment is controlled by the PCS, the Operators must have the means to control the equipment, including automated control for control loops. Provide infrastructure and access to required setpoints, provide training to operators on use of PCS system.

.4 Refer to Appendix A for the associated City Standards. These City Standards are to be followed for all installations associated with this project.

.4 All application software and configuration either developed or modified under this contract shall be owned by the City. The City may use this software for maintenance or development within NEWPCC or for other City Projects. The City may provide this application software to third parties to develop software on the City's behalf. All applicable intellectual property developed under this project shall be transferred to the City.

1.2 Software Design Workshops

.1 Location: Contractor's Trailer on site.

.2 Objective: To allow for oversight and review of the Applications Software development.

.3 The Contractor shall prepare and distribute an agenda prior to the workshop.

.4 The Contractor shall collaborate with the City in the workshop.

.5 The Contractor shall take minutes and distribute the minutes within two (2) business days of the workshop.

.6 Workshops:

.1 Configuration Workshop:

.1 Occurrence: Once at beginning of project.

.2 Scope: Contractor shall review with the City and Contract Administrator all Application Software that will be used in the project and how they will interface. The schedule for software development shall be reviewed as well. Requirements for software development submittals shall be discussed.

.2 Standardized Logic Block Workshop:

.1 Occurrence: As frequent as required to ensure all standardized logic blocks are demonstrated and reviewed.

.2 Scope: Contractor shall review with the City and Contract Administrator the standardized logic blocks. Contractor shall demonstrate to the City and Contract Administrator the standardized logic blocks. Workshops may combine multiple standardized logic blocks together.

.3 Standardized HMI Graphic Workshop:

.1 Occurrence: As frequent as required to ensure all standardized HMI graphics are demonstrated and reviewed. Scope: Contractor shall review with the City and Contract Administrator the standardized HMI graphics. Contractor shall demonstrate to the City and Contract Administrator the standardized HMI graphics. Standardized HMI graphics include HMI layouts, equipment graphics, HMI navigation, user interface elements and trending. Workshops may combine multiple standardized HMI graphics together.

.4 Pre-Programming Workshop:

.1 Occurrence:

.1 Once after review of the PCNs and Vendor logic but before significant development has started on the PCS development for the area.

.2 Once per PLC to be integrated. After review of the PCNs and PLC logic but before significant development has started on the PCS development for the PLC Integration.

.2 Scope: Contractor shall review the process area requirements with the City and Contract Administrator. The Contractor shall gather input from the operations and maintenance staff in attendance. Major control loops and how the logic will be implemented in the PCS shall be reviewed at the meeting. Network interface maps affecting the area shall be reviewed at the meeting.

.5 Commissioning Area Workshop:

.1 Occurrence:

.1 Once per PLC integration at the end of the PCS development.

.2 Scope: Contractor to review with the City and Contract Administrator the commissioning plans and proposed sequencing of commissioning within the area and associated schedule. Review and demonstrate the developed logic. Review and demonstrate the developed HMI Screens. Review required communication between the new equipment and the existing PCS before, during, and after commissioning. Review Operator control requirements and process downtimes during switchover. Review and demonstrate all required HMI functionality including alarming and trending. Demonstrate all functionality as requested by the Contract Administrator and City.

1.3 Submittals

.1 Submit the following in accordance with Section 01300. Provide with Construction Schedules an updated schedule based on software development.

.1 Every two (2) weeks at the construction meeting while the software is under development, a lead developer that is familiar with the state of the software development shall attend and share their screen to review the progress made since the previous software review.

.1 Provide demonstrations of the software upon request.

.2 Provide software to Contract Administrator upon request.

.2 Shop Drawings:

.1 Outline of applications software to be developed.

.1 An overview description of each major software package, programming language and configuration method to be used for each different type of application.

.2 Schedule of each applications software.

.3 Standardized HMI Graphics:

.1 Submit documented copies of the standardized HMI graphics including screen layouts, HMI navigation, facility overview, active alarm page, historical events, trends, faceplates, process area and user interfaces.

.2 Documentation shall at a minimum include all details required to understand the use of the graphic including:

.1 Description.

.2 Animation(s).

.3 Colour(s).

.4 HMI Faceplates:

.1 The faceplates shall be developed in conjunction with the standardized function blocks for seamless interfacing of the logic and faceplates.

.5 User Interactions.

.6 User Interaction Response.

.7 Trend Screens.

.8 Active Alarms.

.9 Historical Events.

.10 Headers and Footers.

.11 Dashboard.

.12 See the HMI Layout and Animation Plan in Appendix A for additional requirements.

.3 Demonstrate all HMI graphics.

.4 Software Design Submittal:

.1 Preliminary Design:

.1 Submit HMI and PLC design criteria prior to initiating programming. Criteria shall include:

.1 PLC function blocks derived from the PCN.

.2 The PLC program structure.

.3 PLC memory map in broad categories (address ranges).

.4 The programming languages to be utilized.

.5 HMI Layout and animation criteria

.2 25% Design:

.1 Submit a 25% complete submittal, including Software Logic and HMI screens in pdf and native format.

.2 Include updated interface maps in excel and pdf format meeting the criteria of the automation design guide.

.3 The intent of this submittal is to ensure that the methodology being utilized is as per requirements prior to a bulk portion of work being completed. At the 25% stage, copies of code for similar pieces of equipment should not be completed.

.4 A plan for all HMI screens in the area including a draft layout shall be included. Submit at least 3 unique and distinct screens at 99% level of design.

.5 The 25% Design submittal shall be resubmitted for review after incorporating all comments.

.3 99% Design

.1 Submit a 99% complete submittal for each area a minimum of 20 working days prior to the FAT, including:

.1 Complete software logic and HMI screens in pdf and native format.

.2 PLC database and HMI interface data map in excel and pdf format.

.3 Third party interface list in excel and pdf format.

.4 FAT and SIFT procedure.

2. PRODUCTS

2.1 PLC Software Development

.1 EcoStruxure Control Expert shall be used to develop all PLC software.

2.2 SCADA Set-up

.1 Plant SCADA Project:

.1 Cluster Name: NEWPCC.

.2 System wide parameters shall be defined in the Parameters Section under Set-up.

.3 Parameters specific to a group of Servers and clients shall be defined in profile except where parameters are required to be defined in the local .ini file.

.4 Parameters specific to an individual machine shall be defined in local .ini.

.2 All alarms shall be recorded with the accurate synchronized time.

2.3 PLC Program Requirements

.1 The PLC system shall provide all functionality of the DCS controller being replaced including:

.1 Manual controls.

.2 Automatic controls.

.3 Alarm annunciation.

.4 Continuous control loops.

.5 Redundancy.

.2 Refer to the Automation Design Guide for PLC Programming Requirements.

.3 Additional requirements for PLC and PLC program in Section 17831.

.4 PLCs shall be programmed with Function Blocks.

.5 All process control shall be implemented on the PLC.

.1 No HMI logic shall control the process.

.2 PLC function shall remain undisturbed if connection to the HMI lost.

.6 Format Function Block layouts into sheets the size of 279 mm x 432 mm (11 x 17 inch) paper for ease of printing. Group Function Blocks by logical control groups. Use landscape sheet orientation.

.7 Break PLC program into sections based on either control loops or parallel process trains.

.8 Break PLC program sections into subsections based on individual equipment operation.

.9 Do not use indirect addressing and non-visible data links.

.10 All timer settings, set points, and miscellaneous adjustments shall be determined during application software development and plant start up. All settings and adjustments shall be easily made through the programming software.

.11 Unless otherwise indicated, reset and start running all strategies following a power interruption. Software signal selectors and mode memories that are either toggled or advanced by momentary signals shall be required to retain their last setting through power outages, unless indicated otherwise by the City.

.12 Logic outputs of function blocks shall only access Inputs and Outputs

.1 Accessing function block's public variables are not allowed.

.13 All function blocks shall be connected by visible Link. Where this is unable to be achieved, this shall be thoroughly documented in a manner that it cannot be missed. This documentation shall be consistent throughout the project. Documentation of non-visible links shall be approved by the Contract Administrator on a case-by-case basis.

.14 Limit cross over links to avoid clutter in the code. Simplify links as much as possible for ease of reading and maintenance.

.15 All Bool variables shall be named based on the variable when the value is 1 being true.

.16 Function Blocks shall be connected/placed in a way that minimizes execution and propagation delay.

.17 Documentation:

.1 Overall process description, include relevant description on associated sheets.

.2 Hyperlinks to allow for clicking and following of signals.

.3 Physical hardware arrangement notes including equipment tags and IO cards in use.

.4 Signal names.

.5 Communication parameters and signals.

.6 Animation Table.

.7 Associated HMI screens.

2.4 HMI Software Requirements

.1 Existing HMI Server Software to tie into:

.1 I/O server.

.2 Report server.

.3 Alarm server.

.4 Trend Server.

.5 OPC Server.

.6 Modbus Driver.

.7 DNP3 Driver.

.8 Ethernet IP Driver.

.2 Manufacturer and Model:

.1 Aveva Plant SCADA.

.2 This product was standardized by the City. No alternates or substitutes will be accepted. Provide software licenses as required throughout the project duration.

.3 General:

.1 The Contractor shall develop the HMI design to allow for monitoring and control of the plant. HMI screens and layouts shall be based on the existing P&ID drawings as a guide. Refer to the City's HMI Layout and Animation Plan for requirements and guidelines for PCS screen development.

.1 If there is a discrepancy between the P&IDs and the HMI Layout and Animation Plan, the contractor shall submit an RFI to the Contract Administrator for guidance clearly showing the discrepancy using visuals where needed.

.2 Provide navigation from the main screen so that:

.1 Any process area shall be reached in one click of the mouse.

.2 Any control loop shall be reached in two clicks of the mouse.

.3 Any individual device shall be reached in three clicks of the mouse.

.3 Provide area to area navigation elements to allow for complete circular navigation through all process areas at the process area level.

.4 Maintain consistent graphics throughout the project. Utilize the same graphic for each instance of the same function, type of equipment or device displayed on the HMI.

.5 Maintain consistent layouts throughout the project based on frameworks developed on the existing PCS. Where frameworks do not exist on the existing PCS, provide proposed frameworks as a Submittal for review.

.6 Layout the screens to best depict the actual process occurring while maintaining readability.

.7 Develop Event Journal for operator actions. The Event Journal shall include but shall not be limited to journal log, user logon, time, change of process values, setpoints, and digital signals status change. The journal shall log current values to new values.

.8 Develop help screens and onscreen directions to provide additional information to help the operations staff understand the control options where complex operations are required.

.9 Where possible, design overview displays similar to the physical layout of the facility. The perspective to the physical layout should be from the local main control room.

.10 Provide operators access to all current setpoints available on the DCS. Limit set point ranges to match the DCS operation. Ensure setpoint permissions for Operators and The City AICG are maintained.

.11 Display all monitored values. Graphic context shall update based on measured values.

.4 Loss of Communication Sensing by the control system:

.1 Monitor the health of each PLC at the plant including vendor supplied PLCs which are on the Control Network by directly monitoring the PLC systems' words. Display their various status parameters such as low battery, Primary/Secondary, Running/Not Running, and communications (normal/fail) conditions.

.2 Generate alarm if communication with the hot PLC fails or the hot PLC is not running for 60 seconds.

.5 PLC hardware alarms that are available from the PLC's system words shall be read by Plant SCADA directly from the PLC's system words without the use of intermediate PLC logic.

.6 Configure the servers as primary/secondary redundant wherever possible. Provide functionality so the servers may be manually set as the primary or secondary server.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Tuning

.1 Attain optimum system response and performance by tuning hardware and software components. Include the following:

.1 Poll block frequency and phasing.

.2 Point scan frequency.

.3 Trend scan frequency.

.4 Modbus RTU/TCP, LAN.

.5 Page change linkage.

.6 Plant Monitoring, Reporting and Data Logging.

.7 Regrouping of PLC points and files to optimize the quantity of blocks transmitted to process computers.

.8 Elimination of network transmission errors and time-out occurrences.

.2 Optimize PLC, PC, and network software to impose minimum loads on the equipment, with the following priorities:

.1 Minimal network traffic.

.2 PC processing.

.3 PLC processing.

.4 Network processing.

3.3 Reports

.1 The City may add and commission reports as Operations requires in areas handed over to the City.

.2 The City may directly connect to PLCs for data reporting requires in areas handed over to the City.

3.4 Vendor PLC Integration

.1 Integrate all vendor PLCs into the main PCS.

.2 Include all screens into the main PCS and add the available alarms, IO points, and navigation to create a seamless transition when interfacing with the vendor PLC equipment.

.3 Commission all functionality and interfaces of the vendor PLCs to show the functionality is maintained.

3.5 Software Copies

.1 Use and keep up to date version control application to save and track the program versions and the schedule of when each version is active in the plant. Provide the version control schedule and any historical application versions upon request of the Contract Administrator.

3.6 Software Repairs

.1 When on-site commissioning and integration has begun, supply continuous services to effect start up, fine tuning, and removal of deficiencies in the software or data. Complete the integration and repairs within 1 month or less. If at the end of 1 month the software is not completely correct, then repair services may be provided by the Contract Administrator or an agent designated by the City and the actual cost incurred may be deducted from the Lump Sum Contract Price.

3.7 Training

.1 Film and record screens of at least one occurrence of each of the following training types:

.1 Management Seminar.

.2 Operations Training.

.3 Electrical and Instrumentation Maintenance Training.

.4 Software Maintenance Training.

.2 Edit videos to show relevant information with overlays as required, remove any distracting contents. Edit videos to be concise. Submit training videos for the Contract Administrator's review. Provide City with copies of each training video on USB flash drives.

.3 Training timing to be coordinated with the Contract Administrator.

.4 Management Seminar:

.1 Occurrence: Once.

.2 Length: One (1) day.

.3 Location: NEWPCC.

.4 Objective: Walk through of new systems. Provide high level understanding of application software for monitoring and controls. Demonstrate how to generate custom reports and trends.

.5 Operations Training:

.1 Occurrence: Four (4) times.

.2 Length: Half Day.

.3 Objective: Walk through new system. Demonstrate each type of control loop. Review each process area in-depth, demonstrating typical operation of each area. Respond to questions as required. Review of new alarm management system. Provide all training required to operate PCS systems. Make time available for questions and provide answers.

.4 Training shall occur before handing the area over to City for operation.

.6 Electrical and Instrumentation Maintenance Training:

.1 Occurrence: Three (3) time.

.2 Length: Two (2) days.

.3 Objective: Walk through new hardware installed. Review drawings and how information is presented. Visit each new panel and show the installation and additional field wiring added. Provide all training required to troubleshoot and fix hardware or wiring issues.

.7 Software Maintenance Training:

.1 Occurrence: Two (2) times.

.2 Length: Five (5) days.

.3 Objective: Review new systems. Review programming methodology. Review standardized logic and HMI graphics. Run a full day tutorial on creating a new compound control loop using the standardized blocks and HMI graphics in a style that matches existing system. Review in detail the PLC control logic and documentation for each area.

3.8 City Access

.1 To facilitate and maintain the plants treatment capabilities, the City shall have super user administrative access to all live system components at all times. Submit system administrative user accounts and passwords in sealed envelopment to City with in five (5) business days of creation or change.

.1 A Field Instruction shall be provided to the Integrator each incident the City is required to modifying the working applications to maintain plant functionality.

.2 The Integrator may maintain the City’s changes or can implement their own correction.

END OF SECTION

CONTROL SYSTEM SERVERS AND WORKSTATIONS

1. GENERAL

1.1 Summary

.1 Provide new PCS Operator Workstations for each building with required software installed and configured.

1.2 Submittals

.1 Provide submittals in accordance with Sections 01300 - Submittals and 17800 - General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

1.3 Equipment Identification

.1 Each Workstation shall be tagged with lamacoid labels on the device enclosure in a spot that is visible.

.1 Labels shall not block visibility of any screens, components, fasteners, or nameplates. If a suitable location cannot be found, notify the Contract Administrator.

2. PRODUCTS

2.1 Software

.1 Provide all software and licenses for a complete and operational system. Install and set up all licenses on hardware specified.

.1 Maintain licenses for the entire duration of the project.

.2 Provide the Contract Administrator with a list every three (3) months of current software licences, account information, expiration dates, renewal information and costs.

.1 License information shall be included in the final O&Ms.

.3 Before installing any software and firmware, discuss and confirm with the City the version of software and firmware to be installed and standardized on.

.4 All servers and workstations shall have at a minimum driver for printing PDFs.

.5 Provide software licenses including, but not limited to the following:

.1 Windows 10 LTSC Enterprise Licence for Operator Workstations (Quantity: 1).

.2 Aveva Plant SCADA desktop client license (Quantity: 1).

.3 Aveva Plant SCADA Connector (Quantity: As Required).

.4 Aveva Historian Client License (Quantity: 1).

.5 Provide additional licenses as required for implementation (ex. OPC licenses).

.6 Maintain licenses for programming and configuring all project equipment throughout the entire project duration (example: EcoStruxure Control Expert eXtra Large – formerly Unity Pro).

2.2 Operator Workstation Hardware

.1 Operator workstations are to be fan-less machines with suitable passive cooling.

.2 Processor:

.1 Minimum: 2.4 GHz.

.2 Minimum: 4 Core.

.3 RAM:

.1 Minimum: 8 GB DDR4.

.4 Storage:

.1 128GB Solid State Drive.

.5 Video Output:

.1 Port 1: HDMI v1.3, 1920 x 1080 60 Hz.

.6 Network Ports:

.1 1 Gb/s Ethernet ports.

.2 Connect to the Supervisory Network.

.7 USB Ports:

.1 Minimum: 4 ports at USB 3 10 Gb/s.

.8 Audio Port:

.1 HDMI and 3.5 mm TRRS audio jack.

.9 Power Supply:

.1 Voltage: 120 Vac.

.2 Rating: Minimum 80 Plus Gold.

.10 Operating System:

.1 Windows 10 LTSC.

.11 Monitor:

.1 Type: LED –backlit LCD.

.2 Size: 32” diagonal.

.3 Aspect Ratio: Widescreen.

.4 Resolution: 1920 X 1080 @60HZ.

.5 Video Interface: VGA/HDMI/DP.

.12 Mouse:

.1 Two (2) buttons with mouse wheel.

.2 Sensor: laser or optical.

.3 Colour: Black.

.4 Connection: Corded, USB.

.5 Mousepad: fabric covered foam pad.

.13 Keyboard:

.1 Layout: Commercial Grade, US-layout, integral number keypad.

.2 Colour: Black.

.3 Connected: Corded, USB.

.14 Cables:

.1 As Required.

.15 Desk:

.1 Provide a new desk for the operator workstation. A table re-purposed for use as a desk shall not be acceptable.

.2 Desk shall allow sufficient space for monitor, keyboard, mouse and mousepad, chair, and other accessories as required.

.3 Minimum two (2) Drawers per desk.

.4 Minimum Load rating: 300 lbs.

.16 Chair:

.1 Provide office chair with leather style finish.

.2 Minimum 5-wheel castor chairs, swivel base.

.3 Adjustable height, recline, and arm rests.

.4 Integrated head rest.

2.3 Operator Workstation Software

.1 License and Install McAfee End Point Security on each PCS Workstation:

.1 Configure McAfee according to Plant SCADA vendor recommendations for compatibility.

.2 The City to provide the local repository for updating the EPS. Schedule automatic updates to be performed weekly for each workstation. Set up the updates to occur on Tuesdays, Wednesdays, or Thursdays at 12:00PM such that the updates are evenly spread across the dates.

3. EXECUTION

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Domain Controller

.1 The City has existing Domain Controllers, join the existing domains.

.2 At a minimum the following shall be completed prior to requesting to join the City's existing domain.

.1 Install the operating system.

.2 Configure the correct time zone.

.3 Configure the network.

.4 Enable Remote Desktop.

.5 Set Remote Registry service start-up type to Automatic.

.6 Disable Windows Update Service.

.3 Domain Controllers' Windows Time service shall have Startup Type "Automatic". Use the W32tm.exe tool to configure Windows Time service (W32time) "manualpeerlist" provided by the City.

.4 For all computers and servers within the domain:

.1 Windows Time service shall have Startup Type "Automatic". The time source shall be one of the domain controllers by default and no specific time source needs to be specified.

3.3 User Accounts

.1 The HLAP defines the existing preconfigured user groups from the City's existing Domain Controller, accounts of each level shall be provided for the Integrator to complete testing and commissioning. Consult the City in writing if additional domain user groups and/or accounts are required to meet the functionality of the PCS.

.2 The Contractor shall have local administrator privileges (except the Domain Controller) to hardware under the Contractor's ownership.

.3 Local user groups shall be limited to the groups automatically created by required software packages. Consult the City in writing if additional local user groups and/or accounts are required to meet the functionality of the PCS.

.1 Contractor shall use the local administrator to install software for each machine.

.4 Domain/Administrators group shall be included as members of the highest privilege local groups that are required for each software package.

.5 Domain/Administrators group shall have all privilege levels on the running Plant SCADA project.

.6 Domain/Administrators group shall have Server Role of public and sysadmin for SQL Servers.

.7 The City shall retain an account with administrator rights at all times for all hardware. These accounts shall only be used as required on hardware under ownership of the integrator to maintain the treatment capacity and functionality of the plant.

.8 EI Group:

.1 Users in the EI Group shall have view only access to all process equipment and alarms. The EI Group shall be able to remotely operate and acknowledge alarms for electrical equipment.

.2 No other user groups shall be able to remotely operate electrical equipment.

3.4 Workstation Installation

.1 Install Operator Workstations in control rooms as shown on the drawings.

.2 Install computer, monitor, mouse, mouse pad, and keyboard on the operator desk within the control room.

.3 Provide and connect network cabling as required.

.4 Organize all cabling in a neat and tidy fashion. Utilize tie-wraps to group and organize cabling.

.5 Upon installation of HMI and Historian clients, fully test all client application functionality. Correct all deficiencies to enable all Manufacturer's functionalities.

.1 HMI clients shall be set to automatically connect to the Primary HMI Server and automatically fail to the Secondary HMI Server if the Primary Server is not available.

.2 The HMI clients shall have a manual mode to manually set which HMI Server they will connect to.

.3 Historian clients shall be set to automatically connect to the Tier 1 Historian Server and automatically fail to the Tier 2 Historian Server if the Tier 1 Server is not available.

.4 The Historian clients shall have a manual mode to manually set which Historian Server they will connect to.

.6 Disable local operating system firewalls.

.7 Configure Windows to auto login on boot up with a predefined Windows account.

.8 Plant SCADA client shall automatically start with a “view only” user account.

.1 Upon a user logging out, the predefined “view only” account shall automatically log in.

.9 Configure Print to PDF as the default printer for the autologin windows user account.

.10 Request and map City Drives to a network folder determined by the City.

.1 Configure the drives to reconnect at sign-in for Operators.

.11 Install BGInfo and set to Auto Start on user login.

.1 A sample configuration of BGInfo currently used by the City shall be provided for minimum requirement.

END OF SECTION

MAINTENANCE AND SUPPORT

1. GENERAL

1.1 Summary

.1 This Section specifies the requirement for maintenance and support of equipment and products.

.2 Maintain equipment per Manufacturer's recommendations up to the final completion of the construction.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Support Services

.1 Duration:

.1 The duration of support services shall extend during the warranty period (one (1) year past Total Performance).

.2 Requirements:

.1 Provide telephone support for all products supplied (during regular business hours).

.2 Respond to emergency service calls (during regular business hours).

.3 Telephone Support:

.1 Telephone support shall utilize service personnel knowledgeable in the products and have the required troubleshooting skills.

.2 No payment shall be made for telephone support during the warranty period.

.4 Emergency Service Calls:

.1 Respond to service calls from the City when the Plant Control System is not functioning correctly.

.2 Qualified control personnel shall be available to provide on-site service upon a critical failure, whenever required.

.1 A critical failure occurs when any part of the critical system either supplied or modified by the Contractor is unable to operate.

.2 Critical systems include, but are not limited to:

.1 Communication networks.

.2 MCC.

.3 PLC and RIO systems.

.3 Perform service call work without interruption until the system is restored to a reliable operating condition.

.4 Response Time:

.1 The response time to emergency service calls is to be less than four hours.

.5 Record each service call request, when received separately and include:

.1 Serial number identifying component involved.

.2 Location, date, and time call received.

.3 Nature of trouble.

.4 Names of personnel assigned.

.5 Instructions of work to be done.

.6 Amount and nature of materials used.

.7 Time and date work started.

.8 Time and date of completion.

.6 Costs:

.1 If the issue is determined by the Contract Administrator to be due to poor workmanship or defect of the Contractor, no payment shall be made to the Contractor.

.2 If the issue is determined by the Contract Administrator to be due to failure of a physical component supplied and is covered under Manufacturer's warranty, no payment will be made to the Contractor.

.3 If the issue is determined by the Contract Administrator to be due to an issue outside of the Contractor's responsibility, the Contractor will not be paid for the service call to the Site (or for estimating the required work) but will be paid a mutually agreed upon value to correct the issue, at the discretion of the City.

END OF SECTION

INSTRUMENTATION GENERAL REQUIREMENTS

1. GENERAL

1.1 Summary

.1 The Project includes supplying and installing of instrumentation and control equipment for the Facility. Detailed requirements for specific instrumentation devices, installation requirements are specified in Appendix 18A and 18B.

.2 Provide all instrumentation including all installation, certification, adjustment, and start-up of a complete, coordinated system that will reliably perform the intended functions.

.3 Provide all final power and signal connections, hydraulic, pneumatic, and electric, to all elements provided under this Section and all other instrumentation and control equipment required.

.4 For all elements provided under this Section, and all elements interfaced to the automation system, provide verification and certification that the final signal connections and correctness of adjustment are complete.

.5 The Project will include but not be limited to:

.1 Provision of all instrument and control devices, mounting hardware, installation materials, cable, and terminations required for complete and correctly operating systems.

.2 All testing and commissioning of equipment, devices and/or systems in this Section shall be provided. Testing and commissioning shall be in accordance with Sections 16020 – Electrical Testing and 17908 – Automation System Testing.

.3 The Project shall include a fully tested and commissioned complete control system, including the automation system equipment and software.

1.2 Standards

.1 National Electrical Manufacturer Association (NEMA):

.1 NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6 - Industrial Control and Systems: Enclosures.

.2 IEC 61131-2 - Programmable Controllers Part 2: Equipment Requirements and Tests.

.3 American National Standards Institute (ANSI):

.1 ISA/ANSI S5.4 - Instrument Loop Diagram Standards.

1.3 Definitions

.1 Words and Terms:

.1 Advanced Control:

.1 Multi-variable, constraint, and optimizing controls shall be labeled advanced controls. This includes supervisory controls.

.2 Application Software:

.1 The software written specifically to perform functional requirements for an individual plant when standard software packages cannot be configured to meet the requirements. Application software works with the standard operating software; it does not modify any standard software.

.3 Automation System:

.1 A process automation, control, and diagnostic system that is composed of distinct modules. These modules may be physically and functionally distributed over the Facility. The automation system contains all the modules and associated software required to accomplish the regulatory and supervisory control and monitoring of a process plant.

.4 Auto Sense:

.1 Capability by the system to automatically detect and recognize any hardware upon addition to or removal from the system without user intervention.

.5 Auxiliary System:

.1 A control and/or monitoring system that is stand-alone, performs a specialized task, and communicates with the automation system.

.6 Building Management System (BMS):

.1 A control system for non process related HVAC systems.

.7 Call Up Time:

.1 The time between when the operator initially enters a display request and when all objects, lines, values (good or invalid), trends, and other parts of the display have been fully presented to the operator.

.8 Communications Subsystem:

.1 The hardware and software that performs the transmitting and receiving of digital information.

.9 Configurable:

.1 The capability to select and connect standard hardware modules to create a system; or the capability to change functionality or sizing of software functions by changing parameters without having to modify or regenerate software.

.10 Console:

.1 A collection of one (1) or more workstations and associated equipment including printers and communications devices used by an individual to interact with the automation system and perform other functions.

.11 Cycle:

.1 The scanning of inputs by a PLC, execution of algorithms, and transmission of output values to devices.

.12 Deadband:

.1 The range through which an input signal may be varied without initiating an action or observable change in output signal.

.13 Discrete Control:

.1 Control where inputs, algorithms, and outputs are based on logical (yes or no) values.

.14 Faceplate:

.1 A graphic element that mimics the front panel of an analog controller instrument, hardwired push-button or switch, and the graphical representation on the Operator Interface.

.15 Invalid Value:

.1 The state of a tag value which indicates that the quantity being measured or calculated is out-of-range, not measurable or calculable.

.16 Logs:

.1 Files or printouts of information in chronological order.

.17 Mode:

.1 Control block operational condition, including manual, automatic, or cascade conditions.

.18 Module:

.1 An assembly of interconnected components that constitute an identifiable device, instrument, or piece of equipment. A module can be disconnected, removed as a

unit, and replaced with a spare. It has definable performance characteristics that permit it shall be tested as a unit.

.19 Object Linking and Embedding for Process Control (OPC):

.1 Software application which allows bi-directional real time data flow between two (2) separate applications. These applications may be running on the same or on separate servers.

.20 Operational Data:

.1 The statistical data including alarm limits, tuning parameters, and clamping values.

.21 Operator Console:

.1 A console used by an operator to perform the functions required to monitor and control their assigned units.

.22 Plant Area:

.1 The designated points (inputs, outputs, and calculated values) that belong to a geographic or functional section of a plant or facility or Process Function Code.

.23 Plug and Play:

.1 The ability of hardware equipment to automatically identify itself to the system. When the equipment is powered up it is automatically assigned a unique identity without the need to set any dip or other switches.

.24 Point:

.1 A process variable derived from an input signal or calculated in a process calculation.

.25 Process Data:

.1 The statistical data including input values, output values, and set points.

.26 Redundant Configuration:

.1 A system/subsystem configuration that provides automatic switchover, in the event of a failure, without loss of a system function.

.27 Regulatory Control:

.1 The functions of process measurement, control algorithm execution, and final control device manipulation that provide closed loop control of a plant process.

.28 Reliability:

.1 The probability that the system or component will perform its intended function for a specified period of time.

.29 Self-Diagnostic:

.1 The capability of an electronic device to monitor its own status and indicate faults that occur within the device.

.30 Supervisory Control:

.1 Higher level control functions that interface with regulatory controllers and other automation system equipment to provide integrated control.

.31 System Access Restriction:

.1 Access control by key lock, password, or other equivalent method.

.32 System Alarm:

.1 Alarm that occurs as a result of an automation system hardware or software fault.

.33 System Operating Software:

.1 The Manufacturer's standard software that performs the basic functions of the system.

.34 Verify or Certify:

.1 Where the term "verify" and "certify" are stated in this Specification, provide formal statements in writing that the particular activity has been accomplished. Execute all required verification and certification tasks in an organized manner that is acceptable to the Engineer of Record.

1.4 Submittals

.1 Submit Shop Drawings in accordance with Sections 01300 – Submittals, 16010 – Electrical General Requirements and 17800 – General Requirements for Automation System.

.1 Shop Drawings shall demonstrate that the equipment and services to be furnished shall comply with the provisions of the DBA, including schedules and Appendixes, and shall provide a complete record of the equipment as manufactured and delivered.

.2 Include the following material in the submittal package:

.1 Loop diagrams shall consist of an individual wiring and/or plumbing diagram for each instrument loop showing all terminal numbers, the location of the DC and AC power supply, and the location of any booster relays or common dropping resistors. Loop diagrams shall be provided for all analog and digital loops.

.2 Detailed installation diagrams showing the instrument installation details and orientation for how the instrument and all associated devices (such as probes, antennas, panels) including the wiring. Installation details shall provide enough angles and views to sufficiently convey all details of the installation and demonstrate that the installation shall conform to the Manufacturer's requirements. Maintenance access shall be called out on the drawings with available dimensions and if equipment is required to perform maintenance or repair (scissor lift, ladder, gas monitor, additional PPE, etc.)

.3 Detailed terminal layout drawings of all junction boxes, Local Control Panels, and Marshalling panels supplied in this Project. All panels identified on the Drawings require detailed terminal layout drawings. Panels include, but are not limited to, LCP panels, PLC panels, cabinets, and enclosures where wiring installations are made. Drawings will have overall panel dimensions, subpanel layout, and terminal connection information indicating device tag and wire numbers.

.4 Detailed Network device and equipment layout drawings, including but not limited to controllers, switches, UPS Systems, and other network and communications devices.

.2 Field Instruments:

.1 Submit complete documentation of all field instruments using ISA-S20 data sheet formats. Submit either a complete BOM or Index that lists all instrumentation equipment ordered by the loop numbering system as set out in the Final Design.

.2 Submit separate data sheets for each instrument including:

.1 Plant Equipment Number, descriptor, and ISA tag number per the Drawings.

.2 Product (item) name used in the Final Design.

.3 Manufacturer's complete model number.

.4 Location of the device.

.5 Input/output characteristics.

.6 Range, size, and graduations in engineering units.

.7 Physical size with dimensions, enclosure NEMA classification, and mounting details.

.8 Materials of construction for enclosure and wetted parts.

.9 Instrument or control device sizing calculations.

.10 Certified calibration data for all flow metering devices.

.11 Two-wire or four-wire device type as applicable.

.12 Recommended calibration schedule.

.13 All other required information specific to the asset type as per Appendix 18H – Asset Registry.

.3 Submit index and data sheets in electronic format as well as hard copies on 8½" x 11" (A size) formats. Electronic format shall be in Microsoft Excel or Word. Submit electronic copy on USB flash drive. The City will provide templates for this in order to import data smoothly in the OWAM.

.4 Panel Details.

.1 Cabinet assembly and layout drawings to scale. The assembly drawing shall include a BOM on the drawing with each panel component clearly defined. The BOM shall be cross-referenced to the assembly drawing as shown in the example drawing in the Automation Design Guide Appendix.

.5 Panel control schematics, wiring, and interconnection diagrams detailing the electrical connections of all equipment in and on the panel. Diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, terminal blocks and numbering, and purpose of terminals for external connections.

.6 Heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling.

.7 All control panels shall be constructed in conformance with UL 508 and CEC Part 2 and bear the cUL or CSA seal confirming the construction. Include seal in panel submittal.

.8 Point-to-point I/O wiring diagrams depicting wiring within the panel and connections to external devices. Field device wiring shall include the device ISA-tag and a unique numeric identifier. Equipment external to the control panel and related external connections do not need to be shown on the point-to-point I/O wiring diagrams. The diagrams shall identify all device terminal points that the system connects to. Wiring labeling used on the drawings shall match the Final Design. I/O wiring shall be numbered with rack number, slot number, and point number. Two-wire and four-wire equipment shall be clearly identified, and power sources noted. Submit final wire numbering scheme. Point-to-point drawings shall be 279 mm x 432 mm (11 x 17 inch) (B size).

.9 Loop wiring diagrams: detailed loop wiring diagrams showing requirements for each loop shown in the Final Design. The loop drawings shall be prepared in accordance with City Standards. Loop drawings shall be 279 mm x 432 mm (11 x 17 inch) (B size).

.10 The loop drawings shall include the following:

.1 Identification of the loop and loop components as set out in the Final Design.

.2 Word description of loop functions within the title. If the space provided for the title is inadequate, use a supplemental note. Identify any special features or functions of shutdown and safety circuits.

.3 Indication of the interrelation to other instrumentation loops, including overrides, interlocks, cascaded set points, shutdowns, and safety circuits.

.4 All point-to-point interconnections with identifying numbers or colors of electrical cables, conductors, and individual pneumatic and hydraulic tubing. This identification of interconnections includes junction boxes, terminals, bulkheads, ports, and grounding connections.

.5 General location of devices including field, panel, auxiliary equipment, rack, termination cabinet, local control panels, PLC panels, electrical room, and I/O cabinet.

.6 Energy sources of devices, including electrical power, air supply, and hydraulic fluid supply. Identify voltage, pressure, and other applicable requirements. For electrical sources, identify either the circuit or the disconnect numbers.

.7 Process lines and equipment sufficient to describe the process side of the loop and provide clarity of control action. Include what is being measured and what is being controlled.

.8 Actions and fail-safe positions (electronic, pneumatic, or both) of control devices including controllers, switches, control valves, solenoid valves, and transmitters. Actions and fail-safe positions shall be identified in accordance with ISA-5.1 “Instrumentation Symbols and Identification”.

.11 The following information shall be provided on loop drawings, in a tabular format, to meet this requirement:

.1 Process equipment, lines, and their identification numbers, source, designation, and flow direction.

.2 Reference to supplementary records and drawings, including installation details, P&IDs, location drawings, wiring diagrams or drawings, and instrument Specifications.

.3 Specific location of each device, including elevation, area, panel subdivision, rack or cabinet number, and I/O location.

.12 Cross reference between loops that share a common discrete component including dual indicators.

.13 References to equipment descriptions, Manufacturers, model numbers, hardware types, Specifications, data sheets, and purchase order numbers.

.14 Signal ranges and calibration information, including set point values for switches, and alarm and shutdown devices.

.15 Software reference numbers, including I/O addresses, control block types and names, network interfaces, and point names.

.16 Engraving or legend information that identifies the instrument or accessory.

.17 Accessories, tagged or otherwise identified, including regulators, filters, purge meters, manifold valves, and root valves.

.18 References to Manufacturer's documentation including schematics, connection details, and operating instructions.

.19 Color code identification for conductors or tubes that use numbers for differentiation.

2. PRODUCTS

2.1 Performance and Design Criteria

.1 Instrumentation and equipment shall be designed for service life requirements set out in Appendix 18D – City Standards and under conditions specified herein, including, but not limited to, corrosive atmospheres and intermittent or continuous operation.

.2 Provide equipment specifically designed for reliable operation in an emergency and after extended periods of non-operation.

.3 All wearing parts and items requiring adjustment shall be readily accessible. Equipment shall be located, mounted, and guarded as to protect it from accidental damage or from deterioration due to environmental exposure.

.4 Submit certification that the instrument Manufacturer approves the selection of materials of primary elements which are in contact with the specified process fluid shall be inert to the effects of the process fluid.

.5 All instrumentation and equipment shall be designed to meet the specified conditions and to operate at Winnipeg elevations.

.6 Instrumentation equipment shall be the standard product offering of the Manufacturer.

.7 Ensure compatibility of all signals, power supplies, and interconnected devices. Provide isolation, shielding, grounding, and protection as required for a properly functioning installation. Any equipment, hardware, or testing required to achieve this result shall be included in the Project.

.8 Bus Networks and Segment Drawings:

.1 The final bus networks and segment/loop drawings shall be updated and provided following the submission of Shop Drawings and procured equipment suppliers. Allow for all necessary and appropriate installation requirements.

.2 Provide all the necessary allowance for all cables, conduits, and connections to equipment and control panels, and between equipment components, as set out in the Final Design.

.9 Summary:

.1 All equipment supplied shall be selected for its superior quality and intended performance.

.2 Unless specified otherwise, electric power supply to loop powered instruments shall be 24 VDC and to AC powered instrumentation and controls shall be 120 VAC.

.3 Signal Characteristics:

.1 Analog signals shall be 4-20 mA DC with HART and will conform to the compatibility requirements of ISA Standard S50.1. Circuits shall be Type 2 - 2 wire. Transmitters shall have a load resistance capability conforming to Class L. Transmitters and receivers shall be fully isolated.

.2 Pulse frequency signals shall use DC pulses whose repetition rate is linearly proportional to the process variable over a 10:1 range. Pulses may be generated by contact closures or solid-state switches. Power source shall be less than 30 VDC.

.3 Discrete signals shall be two-state logic signals; Alarm signals shall utilize 120 VAC sources. Provide interposing relays as required.

.4 Profibus signals shall conform to the Profibus technical guidelines as developed by PROFIBUS International.

.4 Environmental Conditions:

.1 Equipment shall be provided for the following environmental conditions:

.1 Temperature: 2 to 40 ºC.

.2 Relative Humidity: 10 to 90 percent.

.3 Enclosure Rating: NEMA Type 12.

.5 Metering Accuracy:

.1 System metering accuracy, as compared to the actual process value, shall be determined from the value read at the principal readout device including the recorder, totalizer, and human machine interface device. The requirements for overall system accuracy shall not preclude any requirements specified herein for individual devices.

.2 For systems whose primary measuring device, transmitter, and receiver are furnished under this Section, the accuracies shall be within the following limits:

.1 Pressure: 1.0 percent of measured span.

.2 Flow: 2.0 percent of actual flow rate between 10 and 100 percent of scale.

.3 Temperature: 1.0 percent of measured span.

.4 Position: 2.0 percent maximum travel.

.5 Thermal dispersion flow metering: 1.0 percent of full scale between 10 and 100 percent of scale.

.6 Differential producing primary element type metering: 2.0 percent of full scale between 15 and 100 percent of scale.

.6 Appurtenances:

.1 Signal converters, signal boosters, amplifiers, special power supplies, special cable, and special grounding and isolation devices shall be furnished and installed as required for proper performance of the equipment.

.2 All direct process connected instrumentation shall be provided with a 3-way valve manifold for isolation and calibration.

.7 Programming Devices:

.1 All instrument interrogation/configuration devices required to service instruments on Parcel A shall be provided to the City at Handover and these shall be in addition to all instrument interrogation/configuration devices required to service instruments on Parcel B, which shall be provided complete and in like-new condition.

2.2 Configuration, Components and Features

.1 Mounting Hardware:

.1 All instrumentation and equipment furnished under this Section shall be provided with all manufactured supplied mounting hardware to mount the device according to the mounting requirements indicated in the individual device Specification or the instrument data sheet.

.2 Lightning/Surge Protection:

.1 General:

.1 Provide surge/transient protection system containing surge/transient protection devices (SPDs) on all services entering all PCS control panels, marshalling cabinets, automation equipment panels, servers, and workstations.

.2 Acceptable Manufacturers:

.1 Weidmuller.

.2 Phoenix Contact.

.3 Or approved equivalent.

.2 AC Power SPDs:

.1 Provide SPD on AC power feed into the protected system, rated for normal operation current ± 50%.

.2 SPDs shall provide duplicated and redundant protection networks based on MOVs with electronic monitoring and remote indication of service availability.

.3 SPDs shall comply with CSA C22.2 No. 0, UL1449 and let through voltages as follows:

.1	Voltage (nom.)	Let through (L N G, N G, L L).
.2	120/208	400 V.
.3	220/380	700 V.
.4	600	1100 V.

.4 Internal line noise filters shall be CSA approved.

.5 Panel board protectors shall be Category B/C low as per IEEE C62.41.2-2002; 6 kV/3 kA impulse rated.

.3 Data Communication SPDs:

.1 Manufacturers' confirmation of device suitability for application shall be provided.

.2 Devices shall provide full hybrid GDT plus secondary semiconductor electronic protection devices.

.3 Hybrid SPDs shall be rated for minimum 10 kA (8/20 micro-seconds) peak impulses.

.4 SPD leakage current on communication circuits shall be 10 FA maximum at normal operating voltage.

.5 SPDs shall be encapsulated or otherwise protected from casual interference, and all SPD components shall be within one (1) housing per loop.

.6 Means shall be provided for individual loop identification that shall positively identify that loop and be transferable to any replacement device. Adhesive labels will not be permitted.

.7 SPD common grounding shall be provided automatically with mounting and is not to require additional grounding connections after mounting. Grounding can be via dedicated bulbar or via DIN rail, both shall be insulated from chassis steelwork until connected at the dedicated system grounding point.

.4 Tubing and Fittings:

.1 All instrument take-offs and branch connections less than 50 mm shall be Type 316 stainless steel.

.2 All instruments shut off valves and associated fittings shall be supplied in accordance with the piping Specifications and all instrument installation details. The materials for fittings and valves shall be compatible with process fluids. Where metallic fittings and valves are compatible, wetted materials shall be Type 316 stainless steel.

.3 The materials for instrument tubing shall be compatible with process fluids. Where metallic tubing is compatible, tubing shall be fully annealed ASTM A269 Seamless Type 316 SS grade free of scratches having the following dimensional characteristics as required to fit the specific installation:

.1 6 mm to 12 mm O.D. by 0.89 mm wall thickness.

.2 16 mm to 25 mm O.D. by 1.25 mm wall thickness.

.3 25 mm O.D. by 1.65 mm wall thickness.

.4 32 mm O.D. by 1.65 mm wall thickness.

.5 38 mm O.D. by 2.11 mm wall thickness.

.6 51 mm O.D. by 2.41 mm wall thickness.

2.3 Finishes

.1 Equipment Finish:

.1 Provide materials and equipment with Manufacturer's standard finish system. Provide Manufacturer's standard finish colour, except where specific colour is indicated. If Manufacturer has no standard colour, finish equipment with ANSI 61-gray colour.

.2 Touch-up Painting:

.1 Touch-up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching the type, colour, consistency, and type of surface of the original finish as close as possible.

2.4 Identification

.1 Each instrument and controlled device provided shall be identified on instrument data sheet and each instrument shall be provided with a permanent identification tag in accordance with the City’s Standards. Where primary elements and transmitters are physically separated, an identification tag for both devices shall be provided. All field-mounted elements and transmitters shall have engraved lamacoid identification tags. Panel, sub-panel, and rack-mounted devices shall have engraved lamacoid identification tags securely fastened to the device.

.2 Identification tags shall contain tag numbers in accordance with the Final Design.

.3 Provide tags for all instruments.

2.5 Spare Parts:

.1 Provide spare parts that are identical to and interchangeable with similar parts installed and in accordance with Schedule 18 Technical Requirements.

.2 Provide a list of recommended spares and expendable items in sufficient quantities and pricing to sustain the Instrumentation and Control System for a period of two (2) years after completion.

.3 Provide a component part list. The component part list shall include a complete parts list for the entire Instrumentation and Control System, and shall have the following features:

.1 All components shall be grouped by component type, with the component types identified in a similar manner to the component identification code used in Appendix 18A – Process Functional Requirements, in accordance with Appendix 18D – City Standards.

.2 All components shall be listed with their exact and complete Manufacturer's part number, including all options or accessories.

.3 All components shall be identified with their complete tag number indicated in the Final Design.

.4 All components without tag numbers shall be grouped within component types by Manufacturer's part number. Exact quantities shall be listed for each part number.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Provide Factory Acceptance Test and shop test results prior to delivery to the site. Factory Acceptance Test and shop test procedures shall satisfy the following minimum requirements:

.1 Visual inspection of equipment, instruments, control panels, and graphic displays.

.2 Validation of each input loop and output loop by simulated signals for analog inputs and by shorting discrete inputs. Validation shall include:

.1 Monitoring state changes on operator interface screens based on the inputs state change.

.2 Observation of the automation system programming application software with the associated processor outputs state change.

.3 Outputs triggered by operator interface software devices (pushbuttons, sliders, and manually-entered values).

.4 Calibration and operation of instruments on or in the control panels.

.5 Repair of loops which do not pass validation and re-test the system.

.3 Calibration:

.1 Instruments shall be factory pre-calibrated. Provide a printed record of the factory calibration parameters for "smart" devices.

.2 Prior to calibration completely program "smart" transmitters including entries of the appropriate range and tag number.

.3 Instruments shall be calibrated by Manufacturer approved instrument technician.

.4 Calibrate instruments to either 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 Perform the following applicable calibration for each instrument and its associated signal conditioning equipment:

.1 Calibrate in line flow meters by a draw-down test.

.2 Calibrate vacuum and pressure instruments either by manometer or accurate test instrument and hand test pump.

.3 Calibrate gas detectors using standard gas sample.

.4 Calibrate temperature instruments against a standard lab constant-temperature bath.

.5 Calibrate all other instruments (including pH and DO analyzers) according to Manufacturer’s recommended procedure.

.6 Test equipment for calibration shall be certified and valid at time of calibration.

.7 Provide a printed calibration record for each instrument.

.8 Provide Manufacturer specific hardware, adapters, and tools, required for the calibration of the instrument.

.4 The instrumentation equipment provided shall be installed in accordance with the Manufacturer’s instructions, the applicable Standard Details, and any related requirements of the Final Design.

.5 Instrumentation provided shall be calibrated and tested by a qualified professional. The calibration shall be recorded in a report and submitted to the Engineer of Record for review and incorporation in the instrument checkout tag.

.6 Complete equipment checkout, functional and operational testing activities for Instrumentation and Controls equipment in accordance with Section 17907 – Instrumentation and Controls Testing.

END OF SECTION

POWER SUPPLIES AND CONDITIONING EQUIPMENT

1. GENERAL

1.1 Summary

.1 This Section covers supply and installation of instrumentation and control power supplies and conditioning equipment for the Work.

1.2 Standards

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 107.1 - Power Conversion Equipment.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 - Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Power Supplies:

.1 Hammond.

.2 Or approved equivalent.

.2 Automation System Power Supplies:

.1 Weidmuller.

.2 Sola.

.3 Or approved equivalent.

.3 Conditioning Equipment:

.1 Sola.

.2 Or approved equivalent.

2.2 Configuration, Components and Features

.1 Power Supplies:

.1 Provide all DC power supplies as required for all instrument circuits. Power supplies shall be regulated, purposed built for PLCs, and be complete with an overvoltage protection module.

.2 Provide redundant configurations for power supply equipment serving more than one (1) instrument loop, so that failure of a single unit will not disable all or any shared part of the instrumentation and communication system. Provide diode isolation for redundant direct current supply units and ground the negative terminal of the power supply.

.1 During loss of power, the power switchover shall be instantaneous such that attached equipment do not lose power and shutdown.

.3 Power supplies and transmitters feeding circuits that run in non-armoured cable in cable tray to meet the requirements for Class 2 circuits as defined by the CEC.

.4 Provide all DC power supplies rated to 28 VDC, adjustable plus or minus 5 percent, and set to provide 26.4 V on the panel direct current bus. Minimum size is 10 A.

.2 Automation System Power Supplies:

.1 Power supply shall be 24 VDC with minimum 5.5 A at 60°C with 120 VAC input, LED power indicator and CSA Class 2 listed.

.2 Provide redundant configurations for power supply equipment serving an Ethernet/IP network, so that failure of a single unit shall not disable all or any part of the communication network.

.3 Conditioning Equipment:

.1 Isolation Transformers:

.1 Provide triple shielded isolation transformers for AC powered instrumentation loads containing solid state circuitry.

.2 Hybrid Filters:

.1 Provide series powerline filters for AC powered instrumentation loads containing solid state circuitry or microprocessors.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

END OF SECTION

INSTRUMENTATION AND CONTROLS TESTING

1. GENERAL

1.1 Summary

.1 This Section specifies the testing and commissioning requirements for the Instrumentation and Control Systems.

1.2 Standards

.1 International Society of Automation (ISA):

.1 ISA 51.1 - Process Instrumentation Terminology.

.2 National Electrical Manufacturer Association (NEMA):

.1 NEMA ICS 1 - Instrumentation Control and Systems General Requirements.

1.3 Definitions

.1 Terminology used in this Section conforms to the following definitions:

.2 Interpret specialized terms not explicitly defined herein as specified in ISA 51.1 and NEMA ICS 1.

.3 Loop Testing:

.1 Testing, checking, and correcting deficiencies of instrumentation and control signal generation, transmission, reception, and response. Testing activities shall be iterative due to failsafe switch interrogation.

.2 Sequential testing of all I/O between field devices and automation system by using the actual process variable or injection of the appropriate range of field signals in the I/O from a calibrated testing instrument.

.3 Verification of automation system loop output associated with each I/O on automation system HMI in response to each value of field signals injected by calibrated testing instrument.

.4 Measurement (using appropriate calibrated testing instrument) and verification of automation system output signal sent back to associated field device in response to associated field signal injection.

.4 The following terms are used for the purpose of describing quality assurance and testing requirements:

.1 Factory Acceptance Tests: operation, programming, configuration, and testing of assembled system that may be witnessed by City's Representative and performed at the Manufacturer's factory prior to shipping equipment to site. Complete factory acceptance tests prior to commencing Equipment Checkout.

.2 Shop Tests: testing of assembled system prior to it shipping to site. Complete shop test prior to commencing Equipment Checkout.

.3 Site Acceptance Tests: testing of installed system prior to or as part of Equipment Checkout.

1.4 Submittals

.1 Provide submittals in accordance with Section 01300 - Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System.

.2 Submit testing and commissioning schedule outlining all activities and tests.

.3 Submit a report with the completed tests and applicable testing forms.

.4 Submit details of all test procedures and instruments including I/O interface summary, together with technician’s names responsible for carrying out the test.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Testing:

.1 Perform calibration in accordance with Section 16020 – Electrical Testing and Section 17908 – Automation System Testing:

.1 All supplied instruments shall be factory pre-calibrated. Provide a printed record of the factory calibration parameters for all devices.

.2 Prior to on-site calibration, completely program all "smart" transmitters including entries of the appropriate range and tag number.

.3 Instruments shall be set up and calibrated by a qualified professional and working under the supervision 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.

.2 Prior to instrument commissioning, perform the following applicable calibration for each instrument and its associated signal conditioning equipment:

.1 Calibrate all in-line flow meters by a weight-tank or volumetric test.

.2 Calibrate all vacuum and pressure instruments by manometer or accurate test instrument and hand test pump.

.3 Calibrate analytical instruments using the Manufacturer's recommended procedure and standardized samples.

.4 Calibrate temperature instruments against a standard lab constant temperature bath.

.3 Provide a printed calibration record for each instrument.

.4 Test equipment for calibration shall be certified and valid at time of calibration.

.5 After all devices within a loop have been connected, check the loop for correct functioning and interaction with other loops.

.6 Check the operation of all final control elements including solenoid valves, actuators, and the like by manual control before checking with automatic control.

.7 Check the electrical and pneumatic failsafe operations of all final control elements including solenoid valves and actuators.

.8 Test all tubing for leaks in compliance with ISA 1.0.01. Isolate all instruments when tubing is being tested to protect against over-pressure.

.9 Carry out all tests, sign and date all test reports.

.10 Provide two (2) weeks written notice to the Designer and the City prior to energizing any system.

.11 Provide a Qualified Professional to remove covers for inspection and to perform tests as requested by the City Representative.

.12 Demonstrate to City proper calibration and correct operation of instruments and gauges.

.13 Ensure all instrument calibration and testing is complete and all appropriate testing forms have been completed and submitted.

.14 Provide the following:

.1 Verify signal levels and wiring connections to all instrumentation and control equipment.

.2 Verify and adjust under the Final Design service conditions the instruments and control equipment.

.3 Submit loop testing forms for each loop number (with wiring and calibration testing forms).

.4 Field Quality Control:

.1 Inspection:

.1 All panels, consoles, and cabinets shall be inspected by a Qualified Professional. Inspection shall include, but not be limited to the following:

.1 Nameplates and tags.

.2 Wire sizes and colour coding.

.3 Terminal block spare requirements.

.4 Proper wiring practices and grounding as per code requirements.

.5 Enclosure flatness, finish, and colour.

.2 Submit documentation verifying that the inspections have been completed.

.2 Tests:

.1 All special testing materials and equipment shall be provided. Where it is not practical to test with real process variables, provide suitable means of simulation. These simulation techniques shall be subject to the approval of the City.

.2 The term calibration used herein shall be understood to include the following: All continuous elements and systems shall have multi- point calibrations performed and transmitter output verification at five (5) process points compared to a standard method acceptable. Factory calibration data sheets shall be provided for instruments that are calibrated at the factory. Field calibration reports shall be provided for instruments that require calibration using standards in the field. Field calibration shall use the most rigorous method indicated in the specific Manufacturer manual. All instruments shall be field verified (checked) using five points as indicated herein. Field calibration report shall be provided for instruments that are field verified for record purposes.

.3 Test Documentation:

.1 Documentation for testing of the Instrumentation and Control System shall include:

.1 Check-off sheet(s) for each loop and an instrument calibration sheet for each active instrumentation element (except simple hand switches and lights). Check-off and data sheets shall form the basis for the tests and this documentation.

.2 Each loop check-off sheet shall cite the following information and provide spaces for sign-off on individual items and on the completed loop:

.1 Project name.

.2 Unit process.

.3 Loop number.

.4 Loop description.

.5 Installation check.

.6 Termination check.

.7 Calibration check.

.8 Adjustment check.

.9 Space for comments.

.10 Space for loop sign-off and date.

.2 For each element: tag number, description, Manufacturer and model number, installation bulletin, and Specification sheet number.

.3 Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:

.1 Project name.

.2 Unit process.

.3 Loop number.

.4 Tag number.

.5 Manufacturer.

.6 Model number.

.7 Serial number.

.8 Calibration range.

.9 Calibration data: input, output, and error at 0 percent, 10 percent, 50 percent, 90 percent, and 100 percent of span.

.10 Switch setting, contact action, and deadband for discrete elements.

.11 Space for comments.

.12 Space for sign-off and date.

.5 Progress Tracking of Loop Testing:

.1 Provide I/O interface summary (Microsoft Excel .xlsx format) for each system or sub-system in accordance with the City Standards. Spreadsheets shall include the following for each I/O point:

.1 Signal number/tag.

.2 Annotation description.

.3 Complete physical I/O channel designation and addressing or communication I/O register designation.

.4 True/False status designations for digital I/O.

.5 Alarm thresholds and states.

.6 Process range; engineering units and any multipliers; and raw signal range count for analog I/O.

.7 Signals: Fixed point and scaled at the controller with minimum four (4) significant implied digits of scaling (e.g., 0 to 1400) at controller for a pH range of 0 to 14 at operator interface.

.8 Provide operator interface scaling to display decimal digits required.

.2 Maintain a summary list of all completed tests and all outstanding tests and publish this summary at the end of each testing day.

.6 Instrumentation Loop Testing:

.1 Before commencing loop testing, ensure all instrumentation has been satisfactorily calibrated.

.2 Each instrument loop shall be tested as an integrated system. Check operation from field instruments to transmitter to receiving components to either the control panel or the facility control system operator interface station. Test signals shall be injected at the process impulse line connection where the measuring technique permits, and otherwise at the most primary signal access point.

.3 After devices within a loop have been connected, check the loop for correct functioning and interaction with other loops.

.4 Check the operation of final control elements including solenoid valves and actuators by manual control before checking with automatic control.

.5 Check the electrical and failsafe operations of final control elements including solenoid valves, and actuators.

.6 Check alarm functions, thresholds, and states.

.7 If the output control or monitoring device fails to indicate properly, complete corrections to the loop circuitry or device.

.8 Testing of loops with an interface to a programmable control system shall include verification of processor input/output assignment and verification of operation of the input/output system and processor. Inspect the data table or register in the processor memory to verify proper operation.

.9 Perform continuity testing of cables and leak testing of tubing and record results in a form.

.10 The Engineer of Record and City's Representative shall select up to 5 percent of the cables to be re-tested in their presence. Submit re-test results as specified in testing form. If any of the tests fail, complete repairs and re-test all cables as per above. Repeat continuity testing on 5 percent of a new set of randomly selected cables in the presence of the Engineer of Record and City's Representative.

.11 Correct loop circuitry and repeat the test until the instruments operate as intended. Make as many corrections, modifications, or adjustments as required to ensure proper function.

.12 The tests shall be repeated until devices and instruments operate as intended.

.13 Perform tests and record results on testing forms. Basic testing form templates have been provided. Develop additional and/or more detailed testing forms as necessary to suit more complex instrumentation.

.14 Sign and date test reports.

.7 Checkout Tags:

.1 Instrument checkout tag size shall be 90 mm x 215 mm, orange-coloured tag stock and include metal reinforced eye. A sample tag detail is listed in Standard Details.

.2 Upon receipt affix an instrument checkout tag to each instrument. The tag must remain with the instrument.

.3 Maintain the tag by signing and dating each section of the tag as the instrument is received, calibrated, installed, and checked out. Perform tests and either record test results or make cross-reference to the appropriate testing form in the "Remark" Section.

.8 Field Device Checklist:

.1 The following is a minimum checklist for all field-mounted devices:

.1 Cables and the individual conductors are tagged and identified.

.2 Cables are terminated on approved termination blocks.

.3 Conductors are terminated in an approved manner on termination blocks and at connection points on the device.

.4 Provide plug and receptacles for connection of field devices.

.5 Termination boxes and junction boxes are identified and tagged.

.6 Cables are supported and strapped.

.7 Field Instruments (including flow meters and level transmitters) are tagged and identified.

.8 Instruments are bonded to ground, and signal shields are only bonded to ground at the host controller (Signal shields are continuous and not bonded to any other signal shield in the field or field JB).

.9 Instruments are adequately supported.

.10 Instruments are located free of mechanical damage.

.11 Instruments are new.

.12 Instruments are free of dents, scratches, cracks, breaks, defects, and damage.

.13 Instruments are rated for the environment in which they are placed (indoor, corrosive, hazardous, outdoor, etc.).

.14 Flexible connections or fittings are used to connect to the instruments.

.15 Fittings for connections are watertight and secure.

.16 Instrument control wiring is separated from power wiring.

.17 Instrument control cable is either shielded and twisted or configured in an approved manner to minimize electromagnetic and electrostatic interference.

.18 Instruments are tested, calibrated, and adjusted to operate within prescribed parameters.

.19 ‘Loop check sheets’ and ‘instrument calibration sheets’ have been completed for each device.

.20 Exact Instrument location has been signed off with the Engineer of Record.

.21 Wiring at different voltage levels within the same junction box or termination box are segregated by an effective barrier.

.22 A minimum clearance of 40 mm is provided between the wireway and any point of wire termination.

3.2 Functional Testing

.1 Loop Tests:

.1 Prepare, complete, and submit two (2) types of testing forms as follows:

.1 For those functions that can be demonstrated on a loop-by-loop basis, the form shall include:

.1 Project name.

.2 Unit process.

.3 Loop number.

.4 Loop description.

.5 For each loop component: tag number, description, Manufacturer, and data sheet number.

.6 Space for sign-off and date for the qualified professional and the Engineer of Record.

.2 For those functions that cannot be demonstrated on a loop-by-loop basis, the testing form shall indicate a listing of the specific tests to be conducted. With each test description the following information shall be included:

.1 Specification page and paragraph of function demonstrated.

.2 Description of function.

.3 Space for sign-off and date for the qualified professional and the Engineer of Record.

.2 Testing Forms:

.1 Review and complete all Instrumentation and Controls System testing forms in accordance with Section 17905 – Instrumentation General Requirements.

.3 Site Integrated Testing (SIT):

.1 Design Builder shall submit the SIT plan for Professional of Record approval.

.1 The SIT plan provided by Design Builder shall include:

.1 Scope of the test, including hardware, software, programming, configuration, documentation etc.

.2 Tests to confirm interoperability of systems involved.

.3 Any functional test to be re-performed after interface to package control system.

.4 Supplement submittal documentation as needed to provide adequate records of testing and commissioning activities in accordance with accepted industry practice.

.2 Issue submittals for Professional of Record review and acceptance in accordance with the project schedule.

.4 Site Acceptance Testing:

.1 Testing must not commence until the instrumentation loop testing has been completed and documented.

.2 Testing consists of installing and debugging the automation system control logic program, verifying the interface points between the automation system and field devices and equipment, and exercising the automation system controls. Testing shall be performed on one (1) automation system processor at a time.

.3 Provide a Qualified Professional to immediately correct any deficiencies encountered during testing.

.4 Verify and adjust under service conditions the instruments and control equipment.

.5 Verify signal levels and wiring connections to instrumentation and control equipment.

.6 Submit loop testing form for each loop number (with wiring and piping testing form and calibration testing forms).

.5 Closed Loop Testing:

.1 Tests to demonstrate stable operation of each loop under operating conditions. Testing activities to include adjustment of loop tuning parameters.

.1 Tuning parameters: gain (or proportional band), integral time constant, and derivative time constant for each control loop, adjusted to provide 1/4-amplitude damping.

.2 The loop response to a step disturbance shall be provided for each loop. Two (2) graphs shall be made for cascaded control loops; one showing the secondary loop response with its set point in manual, and the second showing overall loop response.

.3 Control loops with "batch" features shall be adjusted to provide optimum response following start-up from an integral action saturation condition.

.4 Graph recording shall be provided showing the response and made at sufficient speed and amplitude to show 1/4 amplitude damping. Label to show loop number and title, and settings of parameters and set point.

.5 Where a loop is controlled under the direction of an automation system processor, perform the necessary adjustment of loop tuning parameters and set points. Record the loop response, adjusted final elements, and assure total integrated loop performance as specified.

3.3 Systems Operational Testing

.1 Prior to Systems Operational Testing, ensure that instrument calibration and Functional Testing are complete and the appropriate testing forms have been completed and submitted.

.2 Re-verify all function checks and adjust the instruments and control equipment under operational conditions.

.3 Re-verify all loop-loop and closed loop tests performed under the functional test phase of the Instrumentation and Controls System requirements.

.4 Adjust, modify, and re-calibrate all instruments to meet the requirements of the Technical Requirements.

END OF SECTION

AUTOMATION SYSTEM TESTING

1. GENERAL

1.1 Summary

.1 This Section covers the testing and commissioning requirements for the automation system for the Work.

.2 Conduct and document all testing identified herein.

1.2 Submittals

.1 Provide submittals according to Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System.

2. PRODUCTS

2.1 General

.1 Provide any specialized tools and services, including fiber optic and wired network analysis and testing equipment. Provide process simulation software to facilitate factory testing of the application programs.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Factory Acceptance Tests

.1 In advance of Factory Acceptance Tests, inspect and test automation system components to ensure they are fully functional and ready for factory acceptance tests.

.2 All cabinets, panels, and assemblies, which form part of the automation system, shall be inspected, and Shop Tested to verify that they are in conformance with Appendix 18A.

.3 All PLC cabinets shall be tested to verify PLC program to I/O connection.

.4 All tests shall be itemized, and the results documented. Documentation shall be submitted to the Engineer of Record for review and certification.

3.3 Equipment Checkout

.1 Site Integrated Testing:

.1 Conduct hardware verification tests for functionality of the backbone communication cabling infrastructure associated with the automation system.

.2 Conduct end-to-end hardware data communication system tests for all equipment that interface with the automation system and the automation system network. Verification and interface tests with the automation system hardware will include:

.1 Electrical equipment, including metering.

.2 Automation equipment.

.3 Stand-alone vendor package control panels that communicate with automation system.

.4 PCS equipment.

.5 Building Management System (BMS).

.6 Building systems, including Fire Alarm System, Security Access Control, and CCTV.

.7 All other stand-alone control systems.

.8 All communication system tests will meet and exceed Manufacturer's standards and IEEE standards for the specific form of communication.

.3 Conduct end-to-end automation system software tests using the automation system software to verify the correct operation of all communication points, I/O points and associated indications, HMI Views, alarms, and workstation displays. Verification and interface tests with the automation system software will include:

.1 Electrical equipment, including metering.

.2 Automation equipment.

.3 Vendor package control panels that communicate with automation system.

.4 PCS equipment including:

.1 Server redundancy tests.

.2 Power failure and recovery.

.3 Network security.

.4 Network latency.

.5 Wi-Fi coverage in all plant areas.

.6 Graphic display latency.

.7 Alarm management.

.8 System user credentials.

.9 Historian functionality.

.10 Reporting functions and trend displays.

.11 Control Loops (PID settings/values).

.12 End device to PLC/HMI verification.

.5 Miscellaneous Systems.

.6 Building systems, including Fire Alarm System, Security Access Control, and CCTV.

.7 Building Management System (BMS).

.8 Interface and functionality of enterprise systems, including the computerized work management system, and the lab information management system.

.9 All other stand-alone control systems.

.2 PLC (Control Logic) Verification Testing:

.1 General:

.1 Conduct control logic verification testing in accordance with the Commissioning Plan and to meet the requirements of the Final Design. Coordinate the integrated system verification tests with the automation system software configuration developed by the automation system integrator. The control logic verification testing shall include testing of the interfaces from the automation system to all systems and sub-systems within the Facility.

.2 Record all final control descriptions in As-Built Documents.

.2 Component/Equipment Verification and Testing:

.1 Level 1 – Equipment Verification Forms:

.1 Provide component verification forms.

.2 Perform all tests and measurements, and record results on the component verification forms.

.3 For proof of control logic utilize a simulator as part of the factory acceptance testing.

.2 Level 2 – Point Verifications:

.1 Prove all wiring and loops between the various components.

.2 Confirm that the loop test has been completed and record on the verification forms.

.3 Level 3 – Subsystem Verifications:

.1 All subsystem verification and testing shall be performed.

.2 All related components verification shall be completed prior to executing subsystem verifications.

.3 Subsystem verifications shall be detailed on verification forms.

.4 The verification tests are intended to prove the integrity of the hardware and software for each individual subsystem. Tests shall include but not be limited to the following:

.1 Operation of system in “Local” mode (Operator Initiated).

.2 Operation of system in “Remote” mode (by the automation system).

.3 Emergency Manual Mode (automation system failed).

.4 Safe operation or shutdown in response to a power failure.

.5 Maintain process control performance as set out in Appendix 18A and the Final Design.

.3 Panel Device Checklist:

.1 The following is a minimum checklist for all field-mounted devices:

.1 Cables and the individual conductors are tagged and identified.

.2 Cables are terminated on approved termination blocks.

.3 Conductors are terminated in an approved manner on termination blocks and at connection points on the device.

.4 All Instrumentation Field Devices and wiring are tested and checked.

.5 Wiring at different voltage levels within the same controls panel are segregated by an effective barrier.

.6 A minimum clearance of 40 mm is provided between the wireway and any point of wire termination.

.4 Functional Readiness Tests:

.1 Prior to Functional Testing, ensure that the requirements of Section 17907 – Instrumentation and Controls Testing are completed. Coordinate all testing activities with the automation system integrator.

.2 Prior to Functional Testing, the entire installed automation system is to be certified by the Engineer of Record that it is ready to be put into service.

.3 Prior to functional testing, ensure that all electrical, instrumentation, and automation system checkout testing, adjustments, and calibrations are complete.

3.4 Functional Testing

.1 Perform testing of each of the field devices, Fieldbus network segments, and Ethernet network segments. These tests shall include, but not be limited to functional tests, resistance checks, capacitance checks, DC voltage checks, and AC measurement (waveform) checks.

.2 Site Acceptance Tests:

.1 Include the following:

.1 Verify and test of each of the field devices, Fieldbus network segments, and Ethernet network segments. These tests shall include, but not be limited to functional tests, resistance checks, capacitance checks, DC voltage checks, and AC measurement (waveform) checks. Check test results against expected design values recommended by the Manufacturer and approved by the Engineer of Record.

.2 Carry out field testing to confirm the automation system configuration and HMI graphics are in accordance with the Final Design, including but not limited to process control descriptions.

.3 Verify all electrical, instrumentation, and automation system component calibration and provide adjustments necessary to meet the requirements of the Final Design.

.4 Designer to provide forms for documentation.

.3 All tests to be itemized and the results documented. Documentation shall be submitted to the Engineer of Record for review and certification.

3.5 Systems Operational Testing

.1 Include the following:

.1 Testing under nominal and peak hydraulic and contaminant loading conditions to verify performance of the automation system and provide adjustments necessary to meet the requirements of the Final Design.

.2 Re-test and tune automation system configuration and HMI graphics to be in accordance with the Final Design.

.3 Verify all electrical, instrumentation, and automation system component calibration and provide adjustments necessary to meet the requirements of the Final Design.

.4 All tests shall be itemized, and the results documented. Documentation shall be submitted to the Engineer of Record for review and certification.

END OF SECTION

CONTROL PANELS

1. GENERAL

1.1 Summary

.1 This Section specifies supply and installation of control panels and enclosures for the Work.

.2 Additional control panel requirements are specified in the Standard Details.

1.2 Standards

.1 Canadian Standards Association (CSA):

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

.2 CSA C22.2 No. 286 - Industrial Control Panels and Assemblies.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 - Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Performance Criteria

.1 Provide outside finishes on all enclosures in ANSI 61 Grey.

.2 The enclosures shall be suitable for carrying the weight of the equipment mounted within the panel and on the doors without any warping.

.3 Provide NEMA type 12 gasketed enclosures in electrical rooms and control rooms.

.4 All enclosures for mounting outside of electrical rooms and control rooms shall be NEMA Type 4X, Type 316 stainless steel, corrosion resistant except where otherwise specified.

.5 All enclosures for mounting in electrically hazardous areas shall be suitably rated for the defined electrical hazard level in the area.

.6 Design enclosures for equipment in and around classified areas including sumps and odour control room according to Section 01450 – Area Exposure Designations.

.7 Where possible, locate panels away from areas with the potential for dripping, splashing, spray, excessive heat, excessive cold, or flooding.

.8 Provide auxiliary heating or cooling systems for panels where ambient conditions will cause panel internal temperatures to exceed published limits for the equipment contained with the panel.

.9 Provide and install circuit breakers, fuses, terminal blocks, and relays as required in the Final Design.

.10 Provide RF shielding to cabinetry sufficient to ensure unaffected operation of the electronic devices housed within the cabinet upon the operation of a 5 watt 850 to 900 MHz handheld radio placed at a distance of 500 mm from the cabinet with the cabinet doors closed and locked.

.11 Panels and junction boxes shall be the same or of superior quality and construction to the enclosures specified in this Section and shown in the DBA Drawings. Acceptable Products: Hammond, Hoffman.

.12 Provide a duplex receptacle in each control panel powered from the UPS.

2.2 Configuration, Components and Features

.1 Operator Device Enclosures:

.1 Acceptable operator device enclosures for mounting of pushbuttons, pilot lights, and selector switches in electrical rooms and/or control rooms include:

.1 Allen Bradley 800T series.

.2 Or approved equivalent.

.2 Acceptable operator device enclosures for mounting of pushbuttons, pilot lights, and selector switches outside of electrical rooms and control rooms include:

.1 Allen Bradley 800H series.

.2 Or approved equivalent.

.2 Control Panel Enclosures:

.1 Enclosure shall be fabricated from minimum 14-gauge steel panels complete with necessary stiffening to form a rigid free-standing lineup. The structures shall be suitable for carrying the weight of the equipment mounted inside the panel and on the doors and withstand seismic forces.

.2 Enclosure shall come complete with inner panel for mounting equipment. Inner panel shall be made from minimum 14-gauge steel panel and shall be capable of carrying the weight of the equipment mounted on it.

.3 Provide front access only. Doors shall be key-lockable and fitted with 3-point heavy-duty latching assemblies. Provide a continuous piano hinge. Each door shall be capable of opening minimum 120 degrees from closed position. NEMA 4X panels shall have padlockable door latches.

.4 Finish the interior of the enclosure with white paint.

.3 Terminal Blocks:

.1 Terminal blocks shall be complete with mounting rail, end blocks, and label carriers.

.2 Acceptable Products:

.1 Rail: Weidmuller TS35.

.2 Ground Block: Weidmuller WPE4.

.3 Terminal Block: Weidmuller WDU4.

.4 Fused Terminal Block: Weidmuller WSI 6/2 c/w LED indicator.

.5 Label Carrier: Weidmuller SCHT series.

.6 Bus Jumper: Weidmuller WQV series.

.7 Or approved equivalent.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Panel Wiring:

.1 Provide wiring inside the panels according to the following:

.1 Wiring for power distribution shall be a minimum of #12 AWG tinned stranded copper; insulation rated TEW (105°), 600 V.

.2 Control wiring shall be a minimum of #16 AWG tinned stranded copper; insulation rated TEW (105°), 600 V.

.3 Wiring for DC analog signals shall be a minimum of #18 AWG tinned stranded copper; insulation rated at 600 V, shielded pairs.

.2 Tag each wire at both ends with a heat shrink sleeve that is machine printed in accordance with Section 16010 – Electrical General Requirements.

.3 Wiring systems with different voltage levels or types shall be suitably segregated within the panel, according to the Canadian Electrical Code.

.4 Run all wiring in enclosed plastic wireways.

.1 Acceptable Manufacturer:

.1 Panduit.

.2 Or approved equal.

.2 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 wireway.

.5 Provide a minimum clearance of 40 mm between wireways 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.

.7 Label instrumentation and control conductors as follows:

.1 Label instrumentation and control conductors with the information provided on the instrument loop drawings, motor control schematics, and schematic and wiring diagrams.

.2 Identify spare conductors using the destination identifier, i.e., the panel location and terminal identifier of the opposite end of the conductor are combined to form the conductor tag.

.8 Field wiring shall enter panels from the bottom or side in dry process areas. Side entry of wiring to panels shall be subject to Engineer’s approval.

.9 Field wiring shall enter panels only from the bottom in wet or potentially wet process areas, and wherever process or HVAC pipes or vessels are located above.

.10 Top entry of wiring to panels shall be allowed only in dry areas, electrical rooms, control rooms, automation rooms, and server rooms. Top entry of wiring to panels shall be subject to Engineer’s approval.

.11 Armoured cables to terminate into enclosures through a Teck connector rated for the environmental conditions of the respective process area where the panel is located. Within the enclosure, each armoured cable's inner jacket shall be maintained to group the cable's conductors together to a point within 100 mm of the first conductor's termination.

.12 Un-armoured cables shall terminate into enclosures through a strain relief connector rated for the environmental conditions of the respective process area where the panel is located. Within the enclosure, each cable's outer jacket shall be maintained to group the cable's conductors together to a point within 100 mm of the first conductor's termination.

.4 Panel Grounding:

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

.2 Provide grounding lugs for each panel, suitable for termination of up to #2 AWG copper grounding conductor.

.3 Provide in each marshalling panel an isolated grounding bus bar 6 x 25 x 600 mm, equipped with necessary lugs for accepting two #2 AWG external grounding conductors.

.4 Firmly bond all panel mounted devices on or within the panels to ground. Provide supplementary bonding conductors for backplanes and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for devices as case mounted instruments and meters.

END OF SECTION

PROCESS TAPS AND PRIMARY ELEMENTS

1. GENERAL

1.1 Summary

.1 This Section covers supply and installation of process taps and primary elements for the Work.

1.2 Standards

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 14 – Industrial Control Equipment.

.2 CSA C22.2 No. 25 – Enclosures for Use in Class II, Division 1, Groups E, F, and G Hazardous Locations.

.3 CSA C22.2 No. 30 – Explosion-proof Equipment.

.4 CSA C22.2 No. 157 – Intrinsically Safe and Non-incendive Equipment for Use in Hazardous Locations.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 - Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Diaphragm Seals:

.1 Ashcroft.

.2 Or approved equivalent.

.2 In-Line Pressure Sensors:

.1 Red Valve.

.2 Or approved equivalent.

.3 Manifolds not associated with Pressure Transmitters:

.1 Anderson Greenwood.

.2 Century Valves.

.3 Or approved equivalent.

.4 Manifolds associated with Pressure Transmitters:

.1 Trans-West manifolds with Siemens pressure transmitters as per Appendix 18E – Standardized Goods.

2.2 Performance and Design Criteria

.1 All devices supplied under this Section shall be the product of a single Manufacturer, with the exception of Standardized Goods as per Appendix 18E - Standardized Goods.

2.3 Configuration, Components and Features

.1 Process Taps:

.1 Provide pressure gauge and transmitter, annular flow element, and thermowell tapping requirements in accordance with Division 15.

.2 Provide isolation, gauge, and root valves, where specified in accordance with Division 15 and with Standard Details.

.2 Primary Elements:

.1 Provide all primary elements required for a complete design of a fully automated process area. Provide all Instrument Specification Sheets (ISS; refer to Section 17994 – Instrument Specification Sheets) for each instrument.

.2 When applicable, provide drip pots (pigtail siphon) installed below the pressure elements measuring gas. Provide seamless, stainless steel drip pots.

.3 Refer to Section 17995 – Automation Measurement Devices when primary elements and indicators are combined.

.4 Provide thermowells with RTDs (Thermal element) when required and provide the ISS for each instrument. Size thermowell based on pipe diameter and install based on Division 15 standard installation details.

.5 In-line flow devices, including magmeters, pressure sensors, and annubar flow elements shall be installed as part of the electrical Work.

.6 Materials of primary pressure elements that are in contact with specified process fluid shall be inert to the effects of the process fluid.

.7 Provide pressure elements with a process connection as specified on ISS.

.8 Temperature elements shall be platinum 100 Ω with an alpha of 0.00385.

.3 Diaphragm Seals:

.1 Diaphragm seals shall be required for all pressure measurements of dirty fluids and chemical lines.

.2 Provide all diaphragm seals required and provide the ISS (refer to Section 17994 – Instrument Specification Sheets).

.3 When diaphragm seals are specified with a pressure gauge, or a pressure switch provide the assembly filled with ethylene glycol and calibrated by the Manufacturer. When capillary tubing is provided for remote diaphragm seals, cover the tubing with a stainless steel sheath and properly support the capillary tubing in a 4 inch instrument channel.

.4 In-line Pressure Sensors:

.1 Line sized, in-line pressure sensors are required for all pressure measurements of sludge lines and slurry lines.

.2 Provide all in-line pressure sensors required and provide the ISS (refer to Section 17994 – Instrument Specification Sheets).

.3 Provide ethylene glycol filled assembly calibrated by the Manufacturer when in-line pressure sensors are specified with a pressure gauge, pressure switch, transmitter, or in combination. When capillary tubing is provided, cover the tubing with a stainless steel sheath and properly support the capillary tubing in a 4 inch instrument channel. In-line pressure sensors installed by Division 15.

.4 Provide line sized annular ring, flow through type pressure sensors, with stainless steel body, a sensing element compatible with the corrosive and abrasive nature of the fluid being measured.

.5 Acceptable Products:

.1 Red Valve Series 42/742.

.2 Or approved equivalent.

.6 Provide stainless steel nipples extending to a tee from the pressure sensor. Mount the gauge on one (1) leg of the tee. If a pressure indicator/transmitter/switch is shown on the Drawings, mount on the other side of the tee. Otherwise, plug the tee.

.7 Supply annular type pressure sensors and diaphragm isolators with their initial fill of fluid.

.5 Manifolds:

.1 Manifolds shall be three-valve bar-stock type as specified. Machine manifold body from ASTM, Type 316 stainless bar stock. Design manifolds for direct mounting to differential pressure transmitters in place of the flanges normally furnished. Fabricated manifolds or manifolds employing needle or soft seat valves are not permitted.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

END OF SECTION

CONTROL VALVES AND ACTUATORS

1. GENERAL

1.1 Summary

.1 This Section covers supply and installation of control valves and actuators for the Work.

.2 Supply installation and testing of electrical and/or pneumatic powered actuators and accessories for controlled devices including various valves, weirs, and gates dampers. In the case of controlled valves, supply of actuator and accessories complete with the valve body shall be in accordance with Divisions 11 and 15.

.3 Sizing and selection of modulating control valve components.

.4 Size and match powered actuators to controlled devices.

1.2 Standards

.1 Design Builder shall comply with the standards set out in this Section.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 - Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Complete assembly and installation drawings, wiring and schematic diagrams, together with detailed Specifications and data covering materials used, parts, devices and other accessories forming a part of the equipment furnished. Drawings for each unit shall include, but not be limited to, overall dimensions, materials, installation details, mounting and support requirements, factory calibration data (including printouts), and power and signal wiring requirements.

.3 Provide installation, operation, and maintenance data as specified in Appendix 18F – O&M.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Rotork. This product was standardized by the City via RFP 331-2014.

.2 Provide in accordance with the WSTP electrical and automation standard.

2.2 Performance Criteria

.1 Provide actuators of NEMA 4X construction, suitable for use in an industrial environment.

.2 Provide device and actuator as a matched set from the same Manufacturer.

.3 Tag the control devices, accessories, and actuators to indicate operating characteristics. Tag the actuator inlet and outlet ports for electric or pneumatic services. Electric actuators shall be CSA approved.

.4 Fill out all Instrumentation Specification Sheets for all actuators and the ancillary electrical and instrumentation for the selected supplier.

.5 Provide a remote hardwired hand switch for all motorized, pneumatic, and solenoid valves with 3 position functionality 'R/O/C' where; 'R' position (Remote Mode) allows the Plant Control System control over the valve position, 'O' position (Manual Open) drives the valve to the Open position and 'C' position (Manual Close) drives the valve to the Closed position.

2.3 Configuration, Components and Features

.1 Pneumatic Diaphragm Actuators – General:

.1 Provide diaphragm quarter turn and linear actuators capable of continuous duty over the full operating range.

.2 Design Builder shall include actuator fail positions for actuators. The actuators shall fail to the closed position when the control function fails or when pressure is removed from the actuator diaphragm.

.3 Each actuator shall be capable of operating in any horizontal or vertical orientation.

.4 When manual actuation is specified, each actuator shall be fit with a hand wheel and gear actuator to enable manual override control of the valve.

.5 House all internal components in a drip- and corrosion-proof cast iron enclosure.

.2 Pneumatic Diaphragm Quarter Turn Actuators, Modulating Type (PDQM):

.1 Diaphragm operators shall be suitable for mounting on quarter turn valves intended for modulating service.

.3 Pneumatic Diaphragm Linear Actuators, Modulating-Type (PDLM):

.1 Diaphragm operators shall be suitable for mounting on sliding-stem valves and dampers requiring linear actuation intended for modulating service.

.4 Pneumatic Diaphragm Quarter Turn Actuators, Open/Close-Type (PDQO):

.1 Diaphragm operators shall be suitable for mounting on quarter turn valves intended for on/off service.

.2 Provide a solenoid valve, an airset, and accessories for each actuator.

.3 Provide two (2) needle valves (snubbers) for each actuator. The needle valves shall control instrument air flows such that the actuator travels a full stroke within a time

range adjustable from one to thirty (1 to 30) seconds with separate adjustments for each direction of travel.

.5 Pneumatic Piston Actuators – General:

.1 Provide piston actuators of the type specified in Division 11 or 15. Two (2) types of quarter-turn pneumatic piston actuators are available: rack and pinion or linkage. Actuators shall be capable of continuous duty over the full operating range.

.2 Unless specified otherwise, the actuators shall fail in the last position when the control function fails or when pressure is removed from the actuator diaphragm.

.3 When manual actuation is specified, fit each actuator with a hand wheel to enable manual override control of the valve. Where actuators are mounted 3 m above surrounding levels, include manual operation for the chain using a hand wheel.

.4 Each actuator shall be capable of operating in any horizontal or vertical orientation.

.5 House internal components in a drip- and corrosion-proof cast iron enclosure.

.6 Where valves are intended to fail open or closed, provide spring loaded actuators. Where they are intended to fail to last operating position, provide double acting actuators.

.7 Provide an equalizing valve in the control lines of double acting actuators.

.6 Pneumatic Piston Quarter Turn Actuator, Modulating Type (PPQM):

.1 Piston actuators shall be suitable for mounting on quarter turn valves or dampers intended for modulating service.

.7 Pneumatic Piston Quarter Turn Actuator, Open/Close Type (PPQO):

.1 Piston operators shall be suitable for mounting on quarter turn valves or dampers intended for on/off service. Sector types are not permitted.

.2 Provide actuator accessories, including limit switches and position switches.

.3 Provide two (2) needle valves (snubbers) for each actuator. The needle valves shall control instrument air flows such that the actuator travels a full stroke within a time range of one to thirty (1 to 30) seconds with separate adjustments for each direction.

.8 Damper Actuators:

.1 Type: heavy duty, electric valve actuator suitable for high duty cycle operation. Acceptable Manufacturers: Auma, Belimo, Rotork or Schischek.

.2 Operation: 90-degree Stroke, fully modulating.

.3 Minimum design operating torque: 75 Nm.

.4 Control Signals: 4-20 mA.

.5 Power: 120 V/1 ph/60 Hz.

.6 Features: mechanical position input control, position transmitter, open/close limit switches, position indicator, manual override feature complete with manual operator.

.9 Current to Pneumatic (I/P) Converters:

.1 Provide I/P converters as set out by the Final Design.

.2 Supply all required hardware for mounting the I/P converter on the controlled device.

.3 I/P converter shall be of NEMA 4X construction or as specified in the Instrument Specification Sheet.

.4 I/P converter shall operate with instrument quality, control air at an operating pressure range of 20 to 200 kPa and fitted with output gauges.

.10 Valve Positioners:

.1 Provide positioners pre-mounted to each actuator. Do not mount the positioner upside down.

.2 Each positioner shall service the entire operating range of the actuator. The equipment position shall be fed back to the positioner through a mechanical linkage.

.3 Positioner shall operate with instrument quality, oil-free control air.

.4 Mount a pressure gauge on the positioner to measure air output.

.11 Electro-Mechanical Actuators:

.1 Provide electric actuators of type specified on the Instrument Specification Sheets.

.2 Unless otherwise specified, design actuators shall fail to the last position when the control function or power fails.

.3 Unless otherwise specified, all electric actuators shall be supplied with Profibus communications. Where a specified actuator is not available with Profibus, the actuator shall be supplied with the hardwired signals as specified at the end of this section.

.4 Unless otherwise specified, electric actuators shall be 230 V,1 Phase, 60 Hz for service where required torque is less than 115 Nm and 600 V, 3 Phase, 60 Hz for service with torque above 115 Nm. Provide each actuator with a high torque, reversible motor capable of continuous duty over the full operating range.

.12 Electric Quarter Turn Actuators, Open/Close Type (EMQO) and Modulating Type (EMQM):

.1 Provide electric operators suitable for mounting on quarter turn valves or dampers intended for ON/OFF or modulating service as required.

.2 Provide each actuator with built-in motor overload protection.

.3 Fit each actuator with a hand wheel which will enable manual override control of the valve.

.4 Design actuators to be capable of operating in a horizontal or vertical orientation.

.5 Provide external mechanical indication of valve position. Provide an external visual position indicator.

.6 House all internal components in a moisture- and corrosion-resistant NEMA 4X enclosure. All internal components shall be permanently lubricated.

.7 Motors for open-close duty shall be rated at 20% intermittent duty cycle or higher. Motors for modulating duty shall be rated for continuous duty.

.8 For remote indication provide the actuator with two SPDT travel limit switches, 10A, 125 VAC, cUL listed/CSA approved. The travel limit switches shall be adjustable.

.9 Provide the actuator with two SPDT torque limit switches, 10A, 125 VAC. The torque limit switches shall be factory preset and field adjustable.

.10 Provide adjustable mechanical limit stops to ensure over-turning of the valve does not occur.

.11 The actuator speed shall be field adjustable.

.12 Provide a terminal board for field wiring. Include contacts to indicate the open/closed status of the valve.

.13 Electric Linear Actuators, Open/Close Type (EMLO) and Modulating Type (EMLM):

.1 Electric actuators for gates shall be comprised of an electric motor and one or two gear boxes, depending on the gate design.

.2 Provide a sufficiently sized motor to seat and unseat gates and, if necessary, for control to traverse from full open to full closed position in small increments, in response to control signals.

.3 The actuator shall impart a travel speed of 2.5 m/hr to modulating gates and 18.0 m/h to open/close gates unless otherwise specified on the Instrument Specification Sheets. The actuator speed shall be field adjustable.

.4 For actuated gates, select actuators that are fully compatible with the gate. Mount actuator at operating height on the frame.

.5 Design actuators to accept 3 Phase, 60 Hz power. Protect motors against reversed phase rotation.

.6 Actuators shall accept a 4-20 mA control signal for remote proportional control of gate opening.

.7 The drive train shall be rated for heavy duty, continuous service. Connect the actuator drive shaft to gear box shaft(s) through a removable flexible mechanical coupling. Where the actuator is fitted to two stems, ensure that the gearing in each gearbox allows both stems to move identically.

.8 House the internal components of actuators and related gear boxes in weather- and corrosion-proof metal enclosures. House all electrical components in NEMA 4X enclosures. All electrical and mechanical components shall be capable of continuous operation in an ambient temperature range of 15°C to plus 40°C.

.9 Fit actuators with a capstan hand wheel operator. Fit hand wheel assemblies with a clutching mechanism which prevents hand wheel operation during normal motor operation. Provide a 1:1 gearing ratio with respect to the main drive shaft for the hand wheel.

.10 Fit removable safety guards over all moving drive train components between the actuator and each gear box.

.11 Provide adjustable limit switches on each actuator to define the upper and lower limit of the stroke.

.12 High torque switches shall protect the equipment and the structure against excessive gate travel. Provide high torque protection at the lower and upper ends of the stroke.

.13 Provide a controller enclosure to contain a motor contactor complete with overload protection. Provide line, load, and external control terminal strips.

.14 Fit each actuator with an electronic positioner to control gate position in response to a continuous 4-20 mA DC input signal.

.15 Provide a local operating station with a Local-Off-Remote switch and an Open-Close-Auto switch.

.14 Position Switches and Indicators:

.1 Actuator position switches shall include two (2) form C, 2-amp contacts in an NEMA 4X (minimum) rated enclosure.

.2 Cams shall be fastened to a splined shaft and adjustable without set screws.

.3 Provide a visual indicator with beacon type display showing red when the controlled device is in the closed position and green in the open position.

.4 Supply all required hardware for mounting of position monitor in accordance with the specified valve/actuator orientation.

.5 Valves shall have external position indication.

.6 Enclosures shall be suitable for the environment to which they are exposed.

.15 Minimum Monitoring and Control Signal Requirements:

.1 Profibus communications shall be provided for all actuators as specified.

.2 Open Close actuator signals.

.1 Momentary Open Command (Remote dry contact).

.2 Momentary Close Command (Remote dry contact).

.3 Open Status (Dry contact for remote indication).

.4 Closed Status (Dry contact for remote indication).

.5 Computer Mode (Dry contact for remote indication).

.6 Remote dry contacts shall be rated 5 A at 120 VAC minimum.

.3 Modulating actuator signals.

.1 All status signals specified for Open-Close actuators.

.2 Input signal: 4-20 mA signal (or 3-15 PSI).

.3 Output signal: 4-20 mA signal.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

END OF SECTION

INSTRUMENT AIR SYSTEMS

1. GENERAL

1.1 Summary

.1 This Section covers supply and installation of air and pneumatic signal transmission systems for the Work.

.2 Additional application requirements are detailed in the Instrument Installation Detail Drawings.

.3 Requirements for mechanical equipment and piping are specified in Division 15.

.4 Provide the system to conform to the requirements of Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System.

1.2 Standards

.1 American National Standards Institute (ANSI):

.1 ANSI Z21.80 / CSA-6.22 – Line Pressure Regulators.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 - Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Submit a mark-up of this Specification; the applicable drawings detailing either any deviations or modifications proposed for installation of tubing and ancillary components.

2. PRODUCTS

2.1 Materials

.1 Pneumatic and Process Connections:

.1 Pipe, fittings, valves, tubing, and tube fittings required under this Section shall be Swagelok and rated for the service in which they are to be employed. Tubing and fittings shall be made of Type 316 stainless steel. Plastic tubing shall not be used.

.2 Dimensions:

.1 Process connections: 12 mm O.D. (nominal) tubing.

.2 Output/signal: 10 mm O.D. (nominal) tubing.

.3 Air supply 12 mm pipe (nominal) to isolation valves and 10 mm O.D. tubing (nominal) from isolation valves to end devices (e.g., valves).

.4 Specifications for the air piping systems are detailed in Division 15 including pipe and isolation valves.

.3 Provide a continuous support channel or raceway for all tubing and conform to Section 16191 – Fastenings and Supports.

2.2 Configuration, Components and Features

.1 Air Sets:

.1 Provide all pneumatic actuator assemblies with an air set.

.2 Air set shall be complete with filter regulator and output gauge.

.3 Acceptable Product:

.1 Fisher 67C.

.2 Or approved equivalent.

.2 Solenoid Valves:

.1 Provide 2-way direct acting, 3-way direct acting/2 position, 4-way direct acting/2 position, and 4-way pilot operated/2 position solenoid valves as needed and provide the Instrument Specification Sheets in Section 17994 – Instrument Specification Sheets.

.2 Solenoid enclosures in hazardous locations shall not be allowed.

.3 Provide manual overrides on coils.

.4 Standard coil voltage: 120 VAC.

.5 Pipe size, body materials, and operating pressure range.

.6 Maximum operating pressure: 850 kPa instrument air.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Provide all installation requirements for valve and instrument air supply.

.4 Group instruments logically together. Orient instrument air and process connection isolation valves to provide consistent handle indication of normal open/closed status.

.5 Complete final location of field instruments to provide sufficient clearance for access to all maintenance settings; to provide unobstructed viewing of instrument indicators and to permit instrument calibration and maintenance during normal operation of the Wastewater Treatment Plant.

.6 Slope tubing installations 20 mm per 2 m of run down to process connection.

.7 Support tubing in channel or raceway if exposed or in proximity (within 1 m) to rotating equipment or high traffic (use reaching height of 2.4 m off ground for walkable areas and corridors) areas otherwise, do not exceed 1 m between tubing supports.

.8 Field bend all turns with a minimum bending radius of 50 mm.

.9 Avoid non-terminal connections in tubing runs.

.10 Use Teflon tape on all threaded fittings. Do not apply tape on the first two threads.

.11 Terminate tubing at devices with fittings or 90° bends, to allow removal of tubing without disturbing the device mounting.

.12 Complete the final 300 mm (nominal) of air tubing to instruments or control valves installed in process equipment with flexible reinforced neoprene hose. Support the tubing at the hose connection. Locate the hose connection to facilitate unrestricted removal of the instrument or control valve and to minimize transmission of process equipment vibration into the tubing.

END OF SECTION

ELECTRIC MOTOR ACTUATORS AND APPURTENANCES

1. GENERAL

1.1 Summary

.1 This Section specifies supply, installation and testing of electric powered actuators and accessories for controlled devices such as valves, gates, and dampers.

.2 Sizing and selection of modulating control valve and actuator components.

.3 Coordinate with the valve, gate, and damper supplier to size and match powered actuators to controlled devices.

1.2 Standard

.1 International Standards Organization (ISO):

.1 5210, Industrial Valves – Multi Turn Actuator Attachment.

.2 5211, Industrial Valves – Part Turn Actuator Attachment.

.2 National Electrical Manufacturers Association (NEMA).

.3 Underwriters Laboratories (UL):

.1 1709, UL Standard for Safety, Rapid Rise Fire Tests of Protection Materials for Structural Steel.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Submit Shop Drawings for complete actuator assemblies and accessories prior to delivery. Submittals to include:

.1 Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number and service where used.

.2 Complete catalog information, descriptive literature, Specifications, identification of materials of construction, and cross-sectional details.

.3 Submit the following data complete, grouped together, and separated by divider, for each set of valves with the same combination of features and accessories:

.1 Dimensional outline drawing showing valve body, trim, actuator, and accessories.

.2 Identification of materials of construction, cross-sectional views and details; for valves, components, and accessories.

.3 Power and control wiring diagrams, including terminals and numbers.

.4 Complete motor nameplate data.

.5 Sizing calculations for open-close, throttling and modulating valves.

.6 Valve pressure and temperature ratings.

.7 List of Configuration Parameters: Include the following for each piece of equipment and component which contains adjustable or programmable settings:

.1 List of either switchable settings or programmable settings complete with:

.1 Switch/parameter tag No. or I.D. or address.

.2 Range of possible settings.

.3 Factory default setting.

.4 Blank column for recording final field setting.

.2 Description of each adjustable parameter complete with description of each allowable value.

.3 Submit a completed ISA S20.50 Instrument Specification Sheet for each device.

2. PRODUCTS

2.1 General

.1 Provide materials and equipment that are new and of a quality equal to that specified.

.2 Provide all actuator mounting hardware and accessories mounted on the device prior to shipment.

.3 Provide actuators of NEMA 4X construction or better, suitable for use in an industrial environment. Provide hazardous area approvals where required for classified areas.

.4 Provide device and actuator as a matched set from the same supplier or Manufacturer wherever possible.

.5 Size operators and actuators to operate valve for the full range of pressures and velocities.

.6 Size actuators for drip-tight shutoff and breakaway at full valve pressure rating, unless otherwise specified.

.7 Tag the control devices, accessories, and actuators to indicate operating characteristics. Tag the actuator inlet and outlet ports for electric services. Electric actuators must be CSA or cUL approved.

.8 Provide electrical enclosures rated for the area classification.

2.2 Actuator Types

.1 Manual Operator:

.1 General:

.1 Operator force shall not exceed 178 N under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 178 N.

.2 Operator shall be either self-locking type or equipped with self-locking device.

.3 Position indicator on quarter-turn valves.

.2 Operator:

.1 Galvanized or painted handwheel.

.2 Lever operator allowed on quarter-turn valves 100 mm and smaller.

.3 Crank on gear type operators.

.4 Chain wheel operator with tiebacks, extension stem, floor stands, and other accessories to permit operation from normal operation level.

.5 Valve handles shall take a padlock.

.6 Wheels shall take a chain and padlock.

.2 Electric Motor Actuators - Single Phase:

.1 General:

.1 Use only when specifically permitted in the Electric Motor Actuated Valve Schedule.

.2 Full 90-degree rotation of quarter-turn valves.

.3 Suitable for the area classification.

.4 Valve shall remain in last position on loss of operator power unless indicated otherwise.

.2 Actuator shall be sized to provide torque required to operate valve at 90 percent of nominal voltage.

.3 The required fuse protection size is not to exceed 5A Time Delay.

.4 Actuator Power Supply: 120V ac, single-phase, 60 Hz unless indicated otherwise.

.5 Enclosure:

.1 CSA/NEMA 250, Type 4 except where indicated otherwise or where area classification requires higher rating such as Class I, Zone 1 or Zone 2.

.2 Entire unit enclosure shall be double O-ring sealed and watertight.

.6 Gearing:

.1 Actuator gearing shall be totally enclosed in grease-filled cast iron gear case.

.2 Provide single stage worm gearing designed to operate in any vertical or horizontal position, except inverted. Single stage worm gearing shall be designed to allow gear disassembly without releasing valve stem thrust or taking valve out of service.

.7 Drive Unit:

.1 Motors and controls shall conform in all respects to applicable NEMA and CSA standards.

.2 Integral reversible motor.

.3 Size for 1.5 times required operating torque.

.4 Duty Cycle: 100%.

.5 Manual Override Handwheel: Include an automatic clutch to positively disengage handwheel any time drive motor control is energized.

.6 Complete with visual position indicator visible from normal walkway.

.7 Operation: Drive valve to fully OPEN or CLOSED position while OPEN or CLOSED external contact is made. Motor shall stop in mid travel when no input is received.

.8 Limit switches wired internally to stop motor at fully OPEN and fully CLOSED positions.

.9 120 VAC heater sized to prevent condensation and frost inside enclosure, where required.

.10 Motor thermal protection to sense motor temperature and de-energize motor in case of overheating.

.8 Actuators Without Integral LOCAL/REMOTE Selector Switch:

.1 Provide terminals for individual field adjustable 5 A, 120 VAC rated SPDT dry contact closed and open limit switch outputs for remote indication. Contacts shall maintain correct status while actuator is powered or not, without use of batteries.

.2 Provide terminals to accept remote OPEN (maintained) and CLOSE (maintained) 120 VAC control signals. Signal power shall be used to drive actuator motor.

.3 Acceptable Manufacturers:

.1 Rotork.

.9 Actuators With Integral LOCAL/REMOTE Selector Switch:

.1 Provide LOCAL/REMOTE and OPEN/CLOSE selector switches integral to actuator. Provide means to locally stop actuator in both local and remote modes.

.2 Provide terminals for individual field adjustable 5 A, 120 VAC rated SPDT dry contact closed and open limit switch outputs for remote indication. Contacts shall maintain correct status while actuator is powered or not, without use of batteries.

.3 Provide terminals to accept remote OPEN (maintained) and CLOSE (maintained) 24 VDC control signals when in REMOTE mode. Signal power source to be external to actuator.

.4 Provide terminals for 120 VAC external power source for actuator and all internal controls.

.5 Acceptable Manufacturers:

.1 Rotork, ROMpak Series.

.3 Electric Motor Actuators - Three Phase:

.1 General:

.1 Controls integral with the actuator and fully equipped as specified in AWWA 542.

.2 Stem protection for rising stem valves.

.3 Actuator ambient temperature range -40°C to 70°C and up to 100% relative humidity.

.4 Design that allows gear case to be opened for inspection and disassembly without releasing stem thrust or taking valve out of service.

.5 Equipped with side-mounted handwheel for manual operation. Include automatic clutch to positively disengage handwheel when drive motor control is energized.

.6 Design handwheel operator such that failure of motorized gearing shall not prevent hand operation of valve.

.7 Circuitry shall ensure motor turns in correct direction irrespective of supply polarity connected to power terminal; valve and operator to suffer no damage due to incorrect power connection.

.8 Instantaneous reversal protection whereby automatic time delay circuit limits current surges when actuator is signaled to instantaneously reverse direction.

.9 Anti-hammer protection whereby electronic torque limitation switches off actuator when a preset load is reached due to obstruction or end of travel.

.10 Bi-metal thermostat embodied in motor control transformer windings to prevent overheating due to extensive use.

.11 Jammed valve motor protection whereby logic circuit protects motor from overheating by de-energizing motor if valve does not move after developing maximum torque.

.12 Actuators shall include optoisolators. Optoisolators shall interface with remote control inputs to protect logic circuits from high voltage transients appearing at actuator terminals.

.13 Actuator shall include diagnostic module which shall store and enable download of historical actuator data to permit analysis of changes in actuator or valve performance. Retrieval of this information shall be demonstrated in the field.

.2 Actuator Operation:

.1 Suitable for either full 90-degree rotation on quarterturn valves or for use on multiturn valves.

.2 Manual override handwheel.

.3 Valve position indication.

.4 Operate from fully CLOSED to fully OPEN positions, and vice versa, in a minimum of 60 seconds, unless indicated otherwise.

.5 Nonintrusive Electronics: Local controls, diagnostics, and calibration, including limit and torque switch settings, shall be accomplished non-intrusively. Electronic valve position display with capability to show continuous torque output. If applicable, provide two hand-held configuration units for every 10 actuators provided, two minimum.

.1 Nonintrusive here is defined as not requiring opening or disassembly of the valve, actuator, or coupler.

.3 Open-Close/Throttling Service:

.1 Capable of 60 starts per hour.

.2 Size with a minimum of 1.5 safety factor based on the maximum unseating and seating torque of the valve at its AWWA pressure classification. Safety factor shall be demonstrated and documented in Shop Drawings submittals and at time of commissioning under real service conditions using actuator software and torque display on actuator. Motor stall torque not to exceed capacity of valve.

.3 Actuator suitable for throttling operation of valve at intermediate positions.

.4 Controls and Indicators:

.1 PROFIBUS DP interface, unless otherwise noted.

.2 LOCAL-OFF-REMOTE selector switch, pad lockable in each position.

.3 Integral OPENSTOPCLOSE momentary pushbuttons with seal-in circuits to control valve in LOCAL position.

.4 Remote OPEN-STOP-CLOSE momentary control dry contact inputs in REMOTE position. Integral seal-in circuits for remote OPEN and CLOSE commands; valve travel stops when remote STOP contact opens.

.5 Auxiliary contact that closes in REMOTE position.

.6 OPEN and CLOSED indicating lights.

.5 Integral reversing motor starter with built-in overload protection. Control transformer for 120V or 24V control voltage.

.6 Valve shall remain in last position on loss of operator power.

.4 Modulating Service:

.1 Size motors for continuous duty.

.2 Actuators shall be sized with minimum 2.0 safety factor based on maximum unseating and seating torque of valve at its AWWA pressure classification. Safety factor shall be demonstrated and documented at time of commissioning under real service conditions using actuator software. Motor stall torque not to exceed torque capacity of valve.

.3 Feedback potentiometer and integral electronic positioner/comparator circuit shall maintain valve position.

.4 Controls and Indicators:

.1 PROFIBUS DP interface, unless otherwise noted.

.2 LOCAL-OFF-REMOTE selector switch, pad lockable in each position.

.3 Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in LOCAL position.

.4 Auxiliary contact shall close in REMOTE position.

.5 OPEN and CLOSED indicating lights.

.5 Valve shall close upon loss of signal unless indicated otherwise.

.6 Equipment shall have either an AC motor with solid state reversing starter or a DC motor with solid state reversing controller and built-in overload protection. Nonsolid state compliant equipment shall not be acceptable. Controller capable of 1200 starts per hour.

.7 Equipment shall have a duty cycle limit timer and adjustable band width, to prevent actuator hunting.

.8 Valve position output converter controlled by a modulating analog signal with feedback signal in proportion to valve position, either through a PROFIBUS DP interface or 4-20 mA signals.

.5 Actuator Power Supply:

.1 600 VAC, three-phase, 60 Hz unless indicated otherwise.

.2 Control power transformer, 24-volt, or 120-volt secondary.

.6 Enclosure:

.1 Unless indicated otherwise, provide enclosure as defined in NEMA 250, Type 6P.

.2 Enclosure shall either contain 120V space heaters or be nonbreathing to prevent condensation.

.7 Fire Protection:

.1 Where indicated in Electric Motor Actuated Valve Schedule, provide actuator with intumescent coating system for fire protection.

.2 Coating shall provide minimum 30 minutes protection at 1093 degrees C and meet or exceed requirements of API 607 and UL 1709.

.3 Coating shall provide complete access to all actuator components and permit dismantling and re-assembly of actuator without disturbing coating.

.8 Limit Switches:

.1 Single-pole, double-throw (SPDT) type, field adjustable, with contacts rated for 5 amps at 120 volts ac.

.2 Each valve actuator shall have a minimum of two transfer contacts at end position, one for valve fully OPEN and one for valve fully CLOSED.

.3 Housed in actuator control enclosure.

.9 Product Standardization:

.1 Refer to Appendix 18E for standardized good.

.2 If a product is standardized by the City, no alternates or substitutes shall be accepted.

.3 All requests for purchase and quotation shall reference the related RPF to receive standardized pricing that the City has negotiated with the vendor.

.4 Manufacturer and Series:

.1 Rotork; IQ3.

2.3 Spare Parts

.1 Provide spare parts that are identical to and interchangeable with similar parts installed and in accordance with Schedule 18 Technical Requirements and the following:

.1 One (1) spare actuator for each type and size.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Preparation

.1 Prior to installation of the valve and gate actuators, field measure and check all equipment locations, pipe alignments, and structural installations. Ensure that sufficient space and accessibility is available for electric actuators.

.2 Where conflicts are identified, initiate the necessary modifications.

3.3 Installation

.1 Install actuators, related panels, and wiring as recommended by the Manufacturer.

.2 Install control valves as described in other Divisions.

.3 Set limit switches to indicate valve positions and equipment status as required and indicated on Drawings.

.4 Provide stem-mounted stainless-steel devices and hardware to actuate limit switches.

.5 Arrange limit switch contacts to close when valve is fully open, unless otherwise noted.

3.4 Field Testing and Commissioning

.1 Provide testing and commissioning in accordance with Division 1 and other requirements specified elsewhere.

.2 Factory test each actuator assembly prior to shipment.

.3 Automatic valves shall be tested in conjunction with control system testing. Set all opening and closing speeds, limit switches, as required or recommended by the Contract Administrator.

.4 The Manufacturer's Representative shall be required to commission the electric actuators to verify the installation and make final travel limits and torque adjustments.

END OF SECTION

MISCELLANEOUS INSTRUMENTATION

1. GENERAL

1.1 Summary

.1 This Section covers supply and installation of miscellaneous field instruments for the Work.

1.2 Standards

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 25 – Enclosures for Use in Class II, Division 1, Groups E, F, and G Hazardous Locations.

.2 CSA C22.2 No. 30 – Explosion-proof Equipment.

.3 CSA C22.2 No. 157 – Intrinsically Safe and Non-incendive Equipment for Use in Hazardous Locations.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Shop Drawings for each unit shall include, but not be limited to, overall dimensions, materials, installation details, mounting and support requirements, factory calibration data (including printouts), and power and signal wiring requirements.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers for equipment that is not a Standardized Good:

.1 Allen Bradley.

.2 General Electric.

.3 Micro Switch.

.4 Toshiba.

.5 Edwards.

.6 Federal Signal.

.7 Or approved equivalent.

2.2 Performance and Design Criteria

.1 Each device shall be a pre-assembled packaged unit. Upon delivery to the site, each device shall be ready for installation with only final piping and electrical connections required.

.2 When the device has Foundation Fieldbus support, ensure power is from the segment (bus).

.3 The systems shall be installed to measure the specified process at the ranges and conditions indicated on the Instrument Specification Sheets (ISS) provided in Section 17994 – Instrument Specification Sheets of Appendix 18A and the Final Design. The devices shall be installed at the locations as set out by the Final Design.

.4 Instruments shall be selected based on their application, mounting, and electrical classification for the area.

.5 The system design shall be based on the process ranges and service requirements listed in the ISS, in accordance with Section 17994 – Instrument Specification Sheets.

.6 For a transmitter, it shall be factory calibrated to the calibration ranges indicated in the ISS. Transmitters to be calibrated using NIST approved bench calibration procedures. Calibration data shall be stored digitally in each transmitter. Each transmitter shall be programmed with the City instrument tag designation indicated on the ISS of the Final Design. Factory calibration data shall be submitted as described elsewhere in this Specification.

.7 Metering Accuracy:

.1 System metering accuracy when specified, refers to the overall measuring system accuracy and shall be determined by comparing the actual process variable value to the process variable value displayed at the PCS. System requirements shall not preclude any requirements specified herein for individual devices.

.2 For systems where the primary measuring element and transmitter are furnished under this Section, the accuracy is specified in the individual instrument Specification or as indicated on the ISS, in accordance with Section 17994 – Instrument Specification Sheets.

2.3 Configuration, Components and Features

.1 General:

.1 The following does not constitute a complete Specification, but merely outlines the general scope and special features of the instrumentation and equipment required.

.2 All instrumentation, control, and electrical devices provided under this Section shall be CSA approved and shall bear the CSA approvals seal as detailed in Section 17905 – Instrumentation General Requirements.

.3 Certify ISO 9000/9001 compliance.

.4 Sensing units shall be mounted so that interference to the sensing function is not caused by surrounding structures. The sensor shall preferably be mounted on its own

support. The support shall be purpose-built to manufactures recommendations and facilitate maintenance and adjustment and located to provide optimal performance.

.5 Isolation valve shall be installed.

.2 Alarm Beacons:

.1 Alarm beacons shall be individual or stacked strobe type fixtures suitable for indoor, outdoor, or hazardous area use as required. Each beacon or group of beacons shall be provided with wall mounting hardware. Beacon lens color is indicated in the ISS or loop diagrams.

.2 Mounting and installation hardware to be Type 316 stainless steel.

.3 Emergency Stop Switches:

.1 Switches shall be heavy-duty, oil tight type with mushroom type plunger operators. Switch legends shall be engraved on the switch faceplate. Contact configuration shall include at least one (1) N/O and one (1) N/C contact, rated 10 A at 120 VAC. Plunger operators shall be red in color and shall be maintained type, which require the switch to be physically pushed or pulled to change status.

.2 The receptacle shall be a male connector with integral leads for each pole. Number of poles shall be equal to the number of switch terminal connections for external wiring (to a maximum of ten (10) poles per connector). Each connector shall be installed in a knockout or hub, with leads connected to the switch terminals. Receptacles shall be as indicated in the Installation Standards.

.3 Each emergency stop switch shall be provided with a NEMA Type 4X control enclosure and all required mounting hardware to securely mount the switch to the wall. Mounting and installation hardware shall be Type 316 stainless steel. Each switch shall be provided with a nameplate indicating the switch service.

.4 Door/Hatch Switches:

.1 Switches shall be independent and separate from access control door hardware.

.2 Switches shall be mechanical type with a flexible actuating arm. Switches shall be provided with DPDT contacts rated 5 A at 120 VAC. All necessary mounting hardware shall be provided to allow the switches to be installed at the locations indicated on the Drawings.

.3 Mounting and installation hardware shall be Type 316 stainless steel.

.5 Instrument Shutoff Valves:

.1 Instrument shutoff valves shall be provided and installed for instrumentation. Shutoff valves shall be compatible with the measured process and shall be selected in accordance with the Material Classification Data Sheets. Unused ports of multi-port gauge valves shall be plugged. An instrument shutoff valve schedule shall be submitted

indicating the quantity, material, size, and associated instrument. Valves referenced in the SOP or SWP must be identified and tagged.

.6 Digital Panel Indicators:

.1 Digital indicators shall be designed for semi flush mounting in a panel. The indicator shall be easily read at a distance of 3 m in varying control room lighting environments. Accuracy shall be plus or minus 0.1 percent. The indicator shall be scaled in engineering units, with the units engraved on the display face or on the associated nameplate. The indicator shall have a selectable decimal point and shall provide over range indication.

.7 Edgewise Panel Indicators:

.1 Edgewise indicators, designed for panel mounting, shall have nominal 5 by 15 cm face dimensions. Indicators shall have nominal 11 cm scale length, and the indicator accuracy shall be plus or minus 2.0 percent of full scale. Major scale divisions shall be equally spaced and in whole integers. Scale ranges shall be as set out in the Final Design. Scale units (L/sec and kPa) shall be engraved on the scale face or on the indicator nameplate.

.8 Selector Switches:

.1 Selector switches shall be heavy duty, oil tight type with gloved hand or wing lever operators. Position legends shall be engraved on the switch faceplate. Switches for electric circuits shall have silver button or sliding contacts, rated 10 A continuous at 120 VAC.

.2 Contact configuration shall be as set out in the Final Design. Switches used in electronic signal circuits shall have contacts suitable for that duty.

.3 Wing lever operator switches approved Manufacturers:

.1 Allen-Bradley.

.2 Square D.

.3 Or approved equivalent.

.4 All other selector switches approved Manufacturers:

.1 Allen-Bradley.

.2 General Electric “CR”.

.3 Micro Switch “Type PT”.

.4 Or approved equivalent.

.9 Indicating Lights:

.1 Indicating lights shall be LED, approximate dimensions of 3 cm diameter, push to test, with low voltage lamps easily replaceable from the front.

.2 Legends shall be engraved on the lens of the light or on a legend faceplate.

.10 Push Buttons:

.1 Push buttons shall be heavy-duty, oil tight, of flush type construction, with legends engraved on the faceplate. Contacts shall be rated 10 A continuous at 120 VAC.

.11 Power Supplies:

.1 All regulated DC power supplies for instrument loops shall be designed and arranged so that loss of one supply does not affect more than one (1) instrument loop or system. Power supplies shall be provided with an input voltage variation of plus or minus 10 percent, and the supply output shall be fused or protected against short circuiting. Output voltage regulation shall be as required by the equipment supplied.

.2 Power supplies serving multiloops may be provided if a backup power supply is so designed that either the primary or the backup supply can be removed, repaired, and returned to service without disrupting instrument system operation.

.3 Multiloop supplies shall be selectively fused so that a fault in one (1) instrument loop shall be isolated from the other loops in the same supply. Fuses shall be clearly labeled and located for easy access.

.4 Multiloop supply systems shall be oversized by 10 percent for future loads.

.5 Failure of a multiloop supply shall be indicated on the respective instrument panel or enclosure and communicated to the PCS.

.12 Relays:

.1 The use of relays shall be generally avoided where possible in favor of direct control from the PCS. Relays are permitted where required for critical control and safety applications where direct PCS control is not practical.

.2 Where relays are required, they shall be plug in socket base type with dustproof plastic enclosures. Relays shall be CSA recognized and will have at least double pole, double throw contacts. Control circuit relays shall have silver cadmium oxide contacts rated 10 A at 120 VAC. Electronic switching relays shall have gold plated or gold alloy contacts suitable for use with low level signals.

.3 Relays used for computer input, alarm input, or indicating light service shall have contacts rated at least 3 A.

.4 Time delay relays shall have dials or switch settings engraved in seconds and shall have timing repeatability of plus or minus 2.0 percent of setting. Time delay relays shall

only be used when using PLC timing is not reasonably practical or provide insufficient safety.

.5 Latching and special purpose relays shall be as required for the specific application.

.6 All relays shall be provided with an integral pilot light to indicate energized condition. All required mounting rails and sockets shall be provided and installed with the relays.

.13 Electronic Signal Booster/Isolators:

.1 Electronic signal boosters and isolators shall have all solid-state circuitry and complete electrical isolation between the power supply and the input and output signals. Each booster and isolator shall have zero and span adjustment.

.2 Accuracy shall be plus or minus 0.15 percent of span.

.14 Power Transducers:

.1 Power transducers shall be true RMS sensing, combination W/VAR transducers, which produce separate output signals for each respective parameter. Nominal input voltage shall be 120 VAC, with nominal current input of 0-5 A. Output signals shall be isolated 4-20 mA loop powered type. Power metering shall be intelligent devices integrated with Schneider MCC Modbus Network.

.2 Transducers shall be mounted in either a local panel or electrical gear low voltage metering compartment.

.15 Fieldbus Components:

.1 Except where an instrument is deemed as critical service or is required for safety reasons, the DB shall provide instruments with Profibus communications capability and incorporate instruments into the Profibus network segments for the respective process areas.

.2 Profibus network segment design parameters are defined elsewhere in this document.

.16 Density Transmitters

.1 Where density transmitters are specified, the standard of acceptance shall be Valmet TS 4G CSA or Toshiba LQ employing microwave measuring technology.

.2 Devices incorporating a nuclear source such as nuclear density gauges and nuclear density transmitters are not acceptable.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

END OF SECTION

SIGNAL CONDITIONING MODULES

1. GENERAL

1.1 Summary

.1 This Section covers supply and installation of signal conditioning modules for the Work. Signal conditioning modules shall not be used in place of PCS I/O modules designed and selected for the range of input and output signal types for this project. Signal conditioning modules should only be considered where unforeseen circumstances arise such as impedance matching, circuit loading, leakage currents, ground loop errors, etc.

1.2 Standards

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 205 – Signal Equipment.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Action Instruments – rail mounted.

.2 Or approved equivalent.

2.2 Configuration, Components and Features

.1 Equipment Components:

.1 All devices supplied under this Section shall be the product of a single Manufacturer.

.2 Signal Conditioning Modules:

.1 Provide, when required, signal conditioning modules that comply with the following requirements:

.1 Analog signal inputs: 4 to 20 mA into 250 Ohms.

.2 Analog signal outputs: 4 to 20 mA into 600 or 1000 Ohms.

.2 Rate modules for continuous operation in an ambient temperature of 0 to 80 °C. Ambient temperature effect shall not exceed plus or minus 0.01 percent per °C within that range.

.3 Span and zero adjustments shall be made by front accessible multi-turn potentiometers.

.4 Galvanically isolate signal and power supply terminals from the case.

.5 Isolator shall provide galvanic isolation of milli-ampere transmission signals from transmitters with inadequately isolated output circuits.

.6 Isolator shall derive its operating power from the signal input circuit.

.7 Input and output signals shall be 4 to 20 mA, with an error not exceeding 0.1 percent of span. Input resistance shall not exceed 550 ohms with an output load of 250 ohms.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

END OF SECTION

INTRINSICALLY SAFE BARRIERS

1. GENERAL

1.1 Summary

.1 This Section covers supply and installation of intrinsically safe barriers for the Work.

1.2 Standards

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 157 – Intrinsically Safe and Non-incendive Equipment for Use in Hazardous Locations.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Intrinsic Safety barriers:

.1 MTL Type MTL3042.

.2 Pepperl & Fuchs Z series.

.3 Stahl 9001/01-252-100-141.

.4 Or approved equivalent.

.2 Intrinsic Safety Relays:

.1 Pepperl & Fuchs Model KFD0-RO-Ex2.

.2 Or approved equivalent.

2.2 Configuration, Components and Features

.1 Intrinsic Safety Barriers and Relays:

.1 Provide intrinsic safety barriers for two-wire transmitters of the active, isolating, loop powered type as required by code.

.2 Provide dual type intrinsic safety relays for process switches.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

END OF SECTION

TEMPERATURE AND VIBRATION MONITORING SYSTEM

1. GENERAL

1.1 Summary

.1 These Specifications cover the minimum requirement for the design, manufacturing, testing, supply, and delivery of the temperature and vibration protection system for a pump-shaft-motor assembly, including all the temperature and vibration sensors. All required components and necessary accessories for reliable continuous operation of the system shall be provided even if not all details are expressively stated in Schedule 18 or Appendix 18A.

.2 Temperature and vibration protection system are required where specified in other divisions to protect pump-shaft-motor assemblies.

.3 The temperature and vibration protection system continuously monitors various points on the pump-shaft-motor assembly, generates alarms, and shuts downs the protected process equipment if temperature or vibration exceeds the adjustable upper limits.

.4 The temperature and vibration protection system continuously monitors all the temperature and vibration points and sends the real time data via an Ethernet/IP data communication link to automation system for further processing and trending.

.5 Refer to and coordinate with Specification Section 16223 – Electric Motors up to 250 kW and Section 16228 – LV Variable Frequency Drives for additional requirements.

1.2 Standards

.1 All design, material, equipment required within the Final Design, manufacturing, and testing shall be in accordance with the latest IEC, DIN, VDE, ANSI, or equivalent. The equipment shall be approved by CSA or an accredited and recognized agency.

.2 Design Builder shall comply with the standards set out in this Section:

.1 Operating Temperature IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-14: -25 to 70˚C.

.2 Relative humidity: IEC 60068-2-30: up to 95 % (without condensation).

.3 Vibration: Per IEC 60068-2-6.

.4 Shock, operating, non-operating: IEC 60068-2-27.

.5 Electrostatic discharge immunity: IEC 61000-4-2.

.6 Radiated and Conducted RF immunity: IEC 61000-4-3, IEC 61000-4-6.

.7 API standard 670, Machinery Protection Systems.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Rockwell Automation XM Series.

.2 Dynamix 1444 Series.

.3 Wilcoxon.

.4 Or approved equivalent.

2.2 Performance and Design Criteria

.1 Temperature and Vibration Monitoring System description:

.1 The temperature and vibration protection system shall consist of the following components:

.1 Temperature Monitoring System.

.2 Vibration Monitoring System.

.2 Each pump-shaft-motor assembly for motors greater than or equal to 50 hp shall be provided with a dedicated temperature and vibration protection and monitoring system panel, which shall be located on the floor next to each motor, on the upper floor.

.3 The panels shall be NEMA 4X Type 316 stainless steel.

.4 Each temperature and vibration protection and monitoring panel shall be 120 VAC powered from its respective VFD control power, and its power status shall be monitored by the fail and trouble signals above.

.5 The temperature and vibration protection and monitoring shall follow fail-safe wiring. Presence of control voltage shall represent normal operating condition.

.6 Provide an Ethernet cable to connect the monitoring system to the automation system network.

.7 Temperature and vibration protection and monitoring system failure and trouble alarms shall be provided and communicated to the automation system via Ethernet/IP.

.8 Provide all Drawings for the temperature and vibration monitoring system to City Standards (i.e., loop drawings required for each Temperature and Vibration Element signal [i.e., one (1) loop for TI and VI, one loop for TSH and Vibration Switch High (VSH), one (1) loop for TSHH and Vibration Switch High High (VSHH) for each axis indicated], Control Wiring Schematics, Panel Fabrication Details, and Terminal Block Diagrams).

2.3 Configuration, Components and Features

.1 Temperature Monitoring System:

.1 The temperature monitoring sensors shall be 3-wire, 100 ohm, platinum type RTD, quick disconnect type except for motor winding.

.2 All motors shall be provided with eight (8) platinum 3-wire RTDs, PT100, 6 in motor, (2 per phase winding) and two (2) for the bearings. All RTDs shall be wired to a terminal block located in the RTDs and transducer's termination box.

.3 All pumps shall be provided with two (2) platinum 3-wire RTDs, PT100 for the bearings. All RTDs shall be wired to a terminal block located in the RTDs and transducer's termination box.

.4 Pump shaft shall be provided with a platinum 3-wire RTD, PT100 for each bearing. All RTDs shall be wired to a terminal block located in the RTDs and transducer's termination box.

.5 Coordinate with individual equipment suppliers the exact number of temperature monitoring points and follow their recommendation.

.6 An Alarm and Trip level shall be configurable for each RTD input point to generate an alarm and trip if the corresponding temperature levels are exceeded.

.7 Ethernet/IP communications shall be provided for all temperature monitoring points (RTDs), including:

.1 TExxxA1 - motor winding RTD phase A.

.2 TExxxA2 - motor winding RTD phase A.

.3 TExxxA3 - motor winding RTD phase B.

.4 TExxxA4 - motor winding RTD phase B.

.5 TExxxA5 - motor winding RTD phase C.

.6 TExxxA6 - motor winding RTD phase C.

.7 TExxxA7 - motor Drive-End (DE) bearing RTD.

.8 TExxxA8 - motor Non-Drive-End (NDE) bearing RTD.

.9 TExxxA9 - shaft bearing(s) RTDs (the exact number to be confirmed).

.10 TExxxA10 - pump DE bearing RTD.

.11 TExxxA11 - pump NDE bearing RTD.

.8 A common hardwired signal shall be provided for Pump Trip on High-High Temperature. This Common TSHH shall be triggered by High-High Temperature (TSHH) on any of the Temperature Elements. The trip shall be accomplished by using a normally closed 120 VAC, 2 A rated dry contact Common TSHH signal, hardwired to the VFD as a "Pump Trip on High High Temperature".

.2 Vibration Monitoring System:

.1 Tri-axial sensors (vibration elements) for each pump-shaft-motor assembly shall be supplied. The tri-axial sensors shall be threaded type, installed into pre-threaded locations at the machine bearing locations.

.2 All cables between the machine assembly and the vibration panels shall be supplied and installed.

.3 Technical information regarding the cables shall be provided and shall be included within the Operations and Maintenance Manual.

.4 All of the warning and alarm system set points shall be operator tunable from the plant control system. These signals shall be communicated to the plant control system via Ethernet. The NDE 'z' axis VSH and VSHH for both Motor and Pump are not required. A common hardwired signal shall be provided for Pump Trip on High High Vibration. This Common VSHH shall be triggered by excessive vibration (VSHH) on any of the four 'X' axis bearing vibration elements. The trip shall be accomplished by using a normally closed 120 VAC, 2 A rated dry contact Common VSHH signal, hardwired to the VFD as a "Pump Trip on High High Vibration".

.5 Ethernet/IP communications shall be provided for all vibration monitoring points.

.1 Designation is as follows: Motor NDE X-axis Vibration Indication – VixxxA1 (where xxx denote the specific motor tag number, i.e., VI100A1 indicates motor M100A).

.2 For motor-shaft-pump assembly, provide all vibrational indicators and signal points required, including:

.1 Motor NDE Y-axis Vibration Indication - VIxxxA2.

.2 Motor DE X-axis Vibration Indication - VIxxxA3.

.3 Motor DE Y-axis Vibration Indication - VIxxxA4.

.4 Motor DE Z-axis Vibration Indication - VIxxxA5.

.5 Pump DE X-axis Vibration Indication - VIxxxA6.

.6 Pump DE Y-axis Vibration Indication - VIxxxA7.

.7 Pump DE Z-axis Vibration Indication - VIxxxA8.

.8 Pump NDE X-axis Vibration Indication - VIxxxA9.

.9 Pump NDE Y-axis Vibration Indication - VIxxxA10.

.10 Shaft X-axis Vibration Indication - VixxxA11.

.11 Shaft Y-axis Vibration Indication - VIxxxA12 .

.12 Motor NDE X-axis Vibration Switch High - VSHxxxA1.

.13 Motor NDE Y-axis Vibration Switch High - VSHxxxA2.

.14 Motor DE X-axis Vibration Switch High - VSHxxxA3.

.15 Motor DE Y-axis Vibration Switch High - VSHxxxA4.

.16 Motor DE Z-axis Vibration Switch High - VSHxxxA5.

.17 Pump DE X-axis Vibration Switch High - VSHxxxA6.

.18 Pump DE Y-axis Vibration Switch High - VSHxxxA7.

.19 Pump DE Z-axis Vibration Switch High - VSHxxxA8.

.20 Pump NDE X-axis Vibration Switch High - VSHxxxA9.

.21 Pump NDE Y-axis Vibration Switch High - VSHxxxA10.

.22 Shaft X-axis Vibration Switch High - VSHxxxA11.

.23 Shaft Y-axis Vibration Switch High - VSHxxxA12.

.24 Motor NDE X-axis Vibration Switch High High - VSHHxxxA1.

.25 Motor NDE Y-axis Vibration Switch High High - VSHHxxxA2.

.26 Motor DE X-axis Vibration Switch High High - VSHHxxxA3.

.27 Motor DE Y-axis Vibration Switch High High - VSHHxxxA4.

.28 Motor DE Z-axis Vibration Switch High High - VSHHxxxA5.

.29 Pump DE X-axis Vibration Switch High High - VSHHxxxA6.

.30 Pump DE Y-axis Vibration Switch High High - VSHHxxxA7.

.31 Pump DE Z-axis Vibration Switch High High - VSHHxxxA8.

.32 Pump NDE X-axis Vibration Switch High High - VSHHxxxA9.

.33 Pump NDE Y-axis Vibration Switch High High - VSHHxxxA10.

.34 Shaft X-axis Vibration Switch High High - VSHHxxxA11.

.35 Shaft Y-axis Vibration Switch High High - VSHHxxxA12.

.36 Vibration Panel Fail - XSFxxxA1.

.37 Vibration Panel Trouble - YSFxxxA1.

.3 Self-Diagnostics:

.1 Each component of the temperature vibration protection system shall be continuously self -supervised.

.2 If any component of the temperature and vibration protection system fails a normally closed (NC) alarm, contact shall be activated and the display will indicate the self-supervision failure code and an LED for the internal fault.

2.4 Equipment and System Controls

.1 Temperature/Vibration Monitoring Software:

.1 Provide, install, and configure all necessary software components to allow for the temperature/vibration system real time monitoring.

.2 Provide, install, and configure all necessary software components to allow for the temperature/vibration system historical data collection and storage.

.3 Provide, install, and configure all necessary software components to allow for the temperature/vibration system historical data retrieval and trending, including graphical screens.

.2 Temperature/Vibration System Configuration:

.1 Set up complete vibration system configuration, including but not limited to the following:

.1 All temperature and vibration points to monitor the actual temperature and vibration.

.2 All temperature and vibration points to generate an alarm and trip signal to be available on individual dry contacts for customer use.

.3 One common signal from all temperature/vibration trip signals to shut down the corresponding VFD.

.4 Ethernet communication configuration to transmit all the above points to the automation system.

.5 Historical data storage.

.6 Historical data retrieval and trending; provide all graphical screens for the data trending.

.7 Temperature/vibration 'System Failed' shall be available on an individual dry contact for customer use.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 The temperature vibration monitoring system shall be installed near the motor-shaft-pump assembly.

.4 Provide and install all required monitoring software to provide a fully functioning temperature and vibration monitoring system for all pumps.

.5 Testing:

.1 Provide all testing and commissioning services to test, configure, and verify operation of each temperature and vibration channel in the temperature and vibration monitoring system.

.2 Verify full operation of the monitoring software.

.3 Provide the test and configuration report.

END OF SECTION

INSTRUMENTATION CABLES

1. GENERAL

1.1 Summary

.1 This Section specifies supply and installation of instrumentation cables.

1.2 Standards

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 239 - Control and Instrumentation Cables.

.2 CSA C22.2 No. 0.3 - Test Methods for Wires and Cables.

.2 ODVA Pub. 00148R0 - Ethernet/IP Media Planning and Installation Manual.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Performance and Design Criteria

.1 Analog Signals:

.1 Use TPSH or instrument Teck cable for all low-level analog signals, including 4-20 mA, 1-5 VDC, 0-10 VDC, and pulse type circuits 24 VDC and under.

.2 Use RTD cable for connections between RTDs and transmitters or CDAC RTD inputs.

.2 Digital Signals:

.1 Use TPSH cable for all input and output signals 24 VDC and under and terminate in the Marshalling Panels.

.2 Use Teck cable or wire and conduit for power to instruments, for power to instruments with 120 V signals.

2.2 Configuration, Components and Features

.1 Twisted Pair Shielded Cables:

.1 TPSH cables constructed as follows:

.1 Two copper conductors, stranded, tinned, minimum #16 AWG, PVC insulated, twisted in nominal intervals of 50 mm.

.2 Insulated for 600 V, 90°C.

.3 100% coverage aluminum foil or tape shield and bare stranded, tinned copper drain wire, minimum #16 AWG for each pair.

.4 Overall shield and bare stranded tinned copper drain wire for multi-pair cables.

.5 Overall flame-retardant PVC jacket rated to -40°C and meeting low gas emission and FT 4 flame test requirements set forth in CSA-C22.2 – No. 0.3 for all cables. PVC jacket shall be grey in colour.

.6 The entire cable assembly shall be suitable for pulling in conduit. Cables located in cable tray and/or otherwise run exposed shall be armoured and jacketed-type.

.2 Continuously number code each pair of multi pair TPSH cables.

.3 Provide number of pairs as indicated in Design Builder's Design.

.2 RTD and Multi Conductor Shielded Cable:

.1 RTD cables constructed as follows:

.1 Three or more copper conductors, stranded, tinned minimum #16 AWG.

.2 PVC insulated for 600 V.

.3 100% coverage aluminum foil or tape shield.

.4 Separate bare stranded, tinned copper drain wire.

.5 Overall armoured and flame-retardant PVC jacket as specified for TPSH cables.

.2 Individually shield and continuously number code for each triad of multi triad cables. Provide an overall shield, a bare stranded tinned copper drain wire, and an overall flame-retardant PVC jacket for the cable assembly.

.3 Provide number of triads as indicated in Design Builder's Design.

.3 Ethernet Shielded Cable:

.1 Provide shielded Ethernet cables as indicated in Design Builder's Design.

.4 Teck Cables:

.1 Provide Teck cables in accordance with Section 16122 – Wires and Cables with the exception that instrument Teck cables shall be identified by a grey outer jacket.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Installation

.1 Install instrumentation cables in aluminum conduit systems or in cable trays (refer to Section 16114 – Cable Tray Systems). Use a minimum of 300 mm length of liquid tight flexible conduit to connect the field sensors to conduit.

.2 Where instrumentation cables are installed in cable trays, provide barriers in the tray to separate instrumentation cables from power cables.

.3 Where instrumentation cable is installed in conduit or duct, seal ends with duct sealing compound.

.4 At each end of the run leave sufficient cable for termination.

.5 Cable splices in any of the instrumentation cable runs shall not be permitted.

.6 Where splices are made to coaxial cables, use standard coaxial cable connectors.

.7 Ground cable shields at one end only, unless otherwise specified by the equipment Manufacturer.

.8 For the Ethernet cable maintain continuity for the shield and drain wire throughout the entire network. Ground the cabling at one end (point) only, for the rest of the network, insulate the shield and drain from ground in accordance with ODVA standards.

.9 Protect all conductors against moisture during and after installation.

.10 Terminate armour with connectors approved for use by the Manufacturer.

.11 Surface Installation for Teck Cables:

.1 Install individual runs of Teck cable or multiple runs as specified herein.

.2 Fasten Unistrut to the ceiling or wall as indicated in Design Builder's Design.

.3 Secure cables to Unistrut with cable clamps.

.4 Provide corrosion resistant clamps; hot dip galvanized, stainless steel, or PVC coated.

.5 Install Unistrut supports with a maximum spacing of 1 m.

.6 One (1) or two (2) surface mounted cables shall be strapped using one-hole straps and stand-off spacers. Fastening, strapping, and support materials shall be compatible with the area conditions.

.1 Acceptable Product:

.1 T&B 1275AL series.

.2 Or approved equivalent.

.7 Three (3) or more cables shall be installed in cable tray or channel tray.

.12 Conductor Terminations:

.1 Provide all equipment with terminal blocks to accept conductor connections.

.2 Equip instrumentation conductors terminated at equipment terminals other than terminal blocks with self-insulated, locking type terminators. Size as required to fit conductors and screw terminals.

.1 Acceptable Product:

.1 Burndy YAE-2.

.2 STA-KON.

.3 Or approved equivalent.

.13 Testing:

.1 Test all cables for isolation from ground and between conductors. Resistance shall not be less than those recommended by the cable Manufacturer.

.14 Fire Barriers:

.1 Provide openings in fire rated walls and floors, for cables to run through. Install firestopping for wall and floor penetrations.

END OF SECTION

AUTOMATION WIRES AND CABLES

1. GENERAL

1.1 Summary

.1 This Section specifies automation wires and cables.

1.2 Standards

.1 Canadian Standards Association (CSA):

.1 CSA C22.1 - Canadian Electrical Code, Part I - Safety Standard for Electrical Installations.

.2 CSA C22.2 No .0.3 - Test Methods for Electrical Wires and Cables.

.3 CAN/CSA-C22.2 No. 38 - Thermoset-Insulated Wires and Cables.

.4 CAN/CSA-C22.2 No. 131 - Type TECK 90 Cable.

.5 CAN/CSA-C22.2 No. 174 - Cables and Cable Glands for use in Hazardous locations.

.6 CAN/CSA-C22.2 No. 239 - Control and Instrumentation Cables.

.7 CAN/CSA-C22.2 No. 214 - Communications Cables.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Conduits

.1 See Conduit, Conduit Fasteners, and Conduit Fittings – Electrical for general conduit requirements.

2.2 Wires in Conduit

.1 Wire: to CAN/CSA-C22.2 No. 38.

.2 Conductors:

.1 Size as indicated.

.2 Copper conductors.

.3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90.

.1 Insulation Voltage Rating:

.1 Circuits 120 V and less: 600 V.

.4 Wire Colour Coding:

.1 Utilize the following wire colours for the types of voltage/signals indicated:

.1 120 VAC Line: Black.

.2 120 VAC Control: Red.

.3 120 VAC Neutral: White.

.4 24 VDC Supply: Blue.

.5 24VDC Control: Blue.

.6 24VDC Common: Brown.

.7 4-20mA Signal: White (+), Black (-).

.8 Protective Earth: Green.

.9 Signal Ground: Green/Yellow.

.10 Profibus: Red/Green.

2.3 TECK90 Multi-Conductor Cable

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene (XLPE), rated type RW90.

.1 Insulation Voltage Rating: 600 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: polyvinyl chloride material.

.7 Fastenings:

.1 One-hole aluminum straps to secure surface cables 50 mm and smaller. Two-hole aluminum straps for cables larger than 50 mm.

.2 Either channel type or cable tray supports for two (2) or more cables.

.8 Cable Connectors / Fittings:

.1 Minimum requirements: Watertight, approved for TECK cable.

.2 Hazardous Locations:

.1 CSA approved.

.2 Watertight type with:

.1 An elastomeric bevelled bushing.

.2 A funnel entry, splined gland nut.

.3 A non-magnetic, stainless steel grounding device with dual grounding action.

.4 A taper threaded hub.

.5 A hexagonal body and gland nut.

.3 Integral seal type with metal-to-metal contact construction.

.4 Sealing of multi-conductor cable shall be accomplished with a liquid-type polyurethane compound.

.5 The fitting shall:

.1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.

.2 Allow the possibility of disconnection such that neither the environmental seal, the electrical bonding, nor the explosion proof seal are disturbed.

.6 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily removable armour stop (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.

.3 Approved products:

.1 Thomas & Betts Star® Teck XP series.

.2 Or approved equal.

2.4 ACIC/CIC Control Cable

.1 Cable: to CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.

.2 Conductors: copper, stranded, size as indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene (XLPE) rated type RW90.

.1 Voltage: As noted.

.4 Shielding as indicated on the drawings:

.1 ISOS – Individually shielded pairs with overall shield.

.2 OS – Overall shield.

.5 Armour Type: Aluminum Interlocked.

.6 RoHS compliant.

.7 Fastenings:

.1 One-hole aluminum straps to secure surface cables 50 mm and smaller. Two-hole aluminum straps for cables larger than 50 mm.

.2 Channel type supports for two (2) or more cables at 1000 mm centres.

.3 Threaded rods: 6 mm dia. To support suspended channels.

.8 Cable Fittings:

.1 Minimum requirements: Watertight, approved for TECK cable.

.2 Hazardous Locations:

.1 CSA approved.

.2 Watertight type with:

.1 An elastomeric bevelled bushing.

.2 A funnel entry, splined gland nut.

.3 A non-magnetic, stainless steel grounding device with dual grounding action.

.4 A taper threaded hub.

.5 A hexagonal body and gland nut.

.3 Integral seal type with metal-to-metal contact construction.

.4 Sealing of multi-conductor cable shall be accomplished with a liquid-type polyurethane compound.

.5 The fitting shall:

.1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.

.2 Allow the possibility of disconnection such that neither the environmental seal, the electrical bonding, nor the explosion proof seal are disturbed.

.6 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily removable armour stop (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.

.3 Approved products: Thomas & Betts Star® Teck XP series or approved equal.

2.5 Ethernet Cable – Shielded, 300V Non-Armoured, Low-Bend Radius for Use Only in Automation Panels Patch Cords and Between Ganged Automation Panels

.1 Requirements:

.1 Cable: Industrial Grade Cat 6, 300V, Shielded, Ethernet cable.

.2 Shield Design: Overlapped aluminum-clad foil, sheathed in a braided screen of tin-plated copper wires.

.3 Conductors: 4 pair, 24 AWG, copper, solid.

.4 Insulation: Polypropylene.

.5 Operating temperature: 40°C to 85°C.

.6 Installation temperature: -40°C to 85°C.

.7 c(UL)us, CMG, RoHS compliant.

.8 Traction stress maximum: 100 N.

.9 Minimum bending radius: 24 mm single bend/40 mm multiple bends.

.10 Manufacturer: Siemens 6XV1878-2A or approved equal.

2.6 Ethernet Cable – Shielded, 600 V, Non-Armoured

.1 Requirements:

.1 Cable: Industrial Grade Cat 6, 600 V, Shielded.

.2 Shield Design: 100% coverage Foil Shielded.

.3 Conductors: four (4) pair, Bonded pair, 23 AWG, copper, solid.

.4 Insulation: Polypropylene.

.5 Operating temperature: -40°C to 75°C.

.6 Installation temperature: -25°C to 75°C.

.7 Flame test: CSA FT4.

.8 cUL, CMR, RoHS compliant.

.9 Traction stress maximum: 177.928 N.

.10 Minimum bending radius: 101.600 mm.

.11 Manufacturer: Belden 7953A or approved equal.

2.7 Ethernet Cable – Unshielded, 300 V, Armoured

.1 Requirements:

.1 Cable: Industrial Grade, Enhanced Cat 6 Cable, 300V, Solid, Unshielded, Aluminum Interlocked Armor.

.2 Conductors: 4 Pair, Bonded pair, 23 AWG, copper, solid.

.3 Conductor insulation: PO-Polyolefin.

.4 Outer jacket: Industrial Grade PVC.

.5 Temperature rating: -40°C to 75 °C.

.6 Flame test: CSA FT4.

.7 Approvals: CMG, CSA or approved equivalent.

.8 Manufacturer: Belden, 121872A or approved equal.

.9 Or approved equal.

2.8 PROFIBUS DP Cable – Armoured, Non-Hazardous Indoor Installation Only

.1 Requirements:

.1 Cable: to CAN/CSA-C22.2 No. 214.

.2 Type: Profibus DP Class A.

.3 Impedance: 150 Ohm nominal, 135 to 165 Ohm at frequency of 3 to 20 MHz.

.4 Cable capacitance: < 30 pF per meter.

.5 DC Resistance: ≤ 110 Ohm per km.

.6 Conductors: Copper, Solid, 0.326 mm^2 corresponding to 22 AWG.

.7 Conductor insulation: Red and green in colour.

.8 Geometry: 1 twisted pair, shielded.

.9 Shielding: Aluminum foil (tape) and tinned copper braid.

.10 Inner sheath: PVC, violet in colour.

.11 Armour: Continuously corrugated Aluminum armour.

.12 Outer jacket: PVC.

.13 Temperature rating: -30°C to 60°C.

.14 Voltage rating: 300 V.

.15 Flame test: CSA FT4.

.16 Approvals: CMG, CSA or equivalent.

.17 Manufacturer: Belden 183079A or approved equal.

2.9 PROFIBUS DP Cable – Armoured, Hazardous Location

.1 Requirements:

.1 Type: Profibus DP Class A.

.2 Impedance: 150 Ohm nominal, 135 to 165 Ohm at frequency of 3 to 20 MHz.

.3 Cable capacitance: ≤ 30 pF per meter.

.4 DC Resistance: ≤ 110 Ohm per km.

.5 Conductors: Copper, Solid, 0.326 mm^2 corresponding to 22 AWG.

.6 Conductor insulation: Red and green in colour.

.7 Geometry: one (1) twisted pair, shielded.

.8 Shielding: Aluminum/Polyester foil (tape) / 38 AWG tinned copper braided.

.9 Inner sheath: PVC, violet in colour.

.10 Armour: Interlocking aluminum armour.

.11 Outer jacket: PVC, violet in colour.

.12 Temperature rating: -40°C to 90°C.

.13 Voltage rating: 30 0V.

.14 Flame test: CSA FT4.

.15 Hazardous Location: HL-ABCD CSA or equivalent.

.16 Approvals: ACIC, CMG CSA or equivalent.

.17 Manufacturer: Turck 101550875 or approved equal.

2.10 PROFIBUS PA Cable – Non-Armoured

.1 Type: ISA/SP-50 Type A.

.2 Impedance: 100 Ohm nominal at 31.25 kHz.

.3 Cable capacitance: < 80 pF per meter.

.4 DC Resistance: < 44 Ohm per km.

.5 Conductors: Copper, Solid, 0.8 mm^2 corresponding to 18 AWG.

.6 Conductor insulation: Brown and blue in colour.

.7 Geometry: one (1) twisted pair, shielded.

.8 Shielding: Aluminum/Polyester foil (tape) / 38 AWG tinned copper braided.

.9 Outer jacket: PVC, orange in colour.

.10 Temperature rating: -40°C to 105°C

.11 Voltage rating: 600 V.

.12 Flame test: CSA FT4.

.13 Approvals: CIC/TC, CMG, CSA or equivalent.

.14 Manufacturer: Turck 101550785 or approved equal.

2.11 PROFIBUS PA Cable – Armoured

.1 Type: ISA/SP-50 Type A.

.2 Impedance: 100 Ohm nominal at 31.25 kHz.

.3 Cable capacitance: < 80 pF per meter.

.4 DC Resistance: < 44 Ohm per km.

.5 Conductors: Copper, Solid, 0.8 mm^2 corresponding to 18 AWG.

.6 Conductor insulation: Brown and blue in colour.

.7 Geometry: one (1) twisted pair, shielded.

.8 Shielding: Aluminum/Polyester foil (tape).

.9 Inner sheath: PVC, black in colour.

.10 Armour: Interlocked aluminum armour.

.11 Outer jacket: PVC, orange in colour.

.12 Temperature rating: -40°C to 105°C

.13 Voltage rating: 300 V.

.14 Flame test: CSA FT4.

.15 Hazardous Location: HL-BCD CSA or equivalent.

.16 Approvals: ACIC, CMG CSA or equivalent.

.17 Manufacturer: Turck 101550929 or approved equal.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Do not splice cables. A continuous length shall be required for all feeds.

.4 Install in accordance with Manufacturer's recommendations, observing requirements for minimum bending radius and pulling tensions.

.5 Exercise care in stripping insulation from wire. Do not nick conductors.

3.2 Installation of Wires in Conduit

.1 Install in conduit.

.2 Ensure conduit is dry and clean prior to pulling wire. If moisture is present, thoroughly dry conduits. Vacuum as required.

.3 Utilize wire-pulling lubricant.

3.3 Installation of TECK cable 0-600V

.1 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.

.2 Perform an insulation-resistance test on each conductor, prior to termination, utilizing a megohmmeter with a voltage output of 1000 volts DC. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 50 megaohms and deviations between parallel conductors. Conductors with insulation resistance values, at one (1) minute, less than 25 megaohms, and that deviate from other similar conductors by more than 50% will be rejected.

3.4 Installation of Control Cables

.1 Install control cables in conduit or cable tray as indicated.

.2 Provide separation of cables from sources of noise, including other cables.

.1 For analog signals, provide separation distances as follows:

.1 120 VAC, 8 AWG and smaller: 100 mm.

.2 120 VAC, >8 AWG: 300 mm.

.3 600 VAC power: 300 mm.

.4 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.

.5 Medium Voltage: 450 mm.

.2 For control signals < 50V, provide separation distances as follows:

.1 120 VAC, 8 AWG and smaller: 50 mm.

.2 120 VAC, >8 AWG: 300 mm.

.3 600 VAC power: 300 mm.

.4 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.

.5 Medium Voltage: 450 mm.

.3 For 120 VAC control signals, provide separation distances as follows:

.1 120 VAC, 8 AWG and smaller: none.

.2 120 VAC, >8 AWG: metal barrier or 150 mm.

.3 600 VAC power: metal barrier or 150 mm.

.4 VFD or other high harmonic cable: 150 mm in metallic conduit/300 mm other raceway.

.5 Medium Voltage: 450 mm.

.4 Advise the Contract Administrator if these separations cannot be achieved.

.3 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.

.4 Ground shields at one end only. Where possible, ground shields at the end where power is supplied to the cable. Utilize shield grounding bar in panels, where present, to ground overall shields. Individual pair shields shall be grounded on appropriate terminals.

.5 Shield drain wires, at the ungrounded end, shall be taped back to the cable. Do not cut the shield drain wire off.

.6 CIC cable shall not be installed in cable tray. Protection in conduit shall be required over the entire length.

.7 ACIC cable may be installed in cable tray, provided that:

.1 There is a barrier separating power and control cables within the tray, or

.2 The cable tray does not contain power cables, unless specifically authorized by the Contract Administrator in writing, and

.3 The ACIC cable voltage rating is equal or greater than the highest voltage contained in the cable tray.

3.5 Installation of Ethernet Copper Cables

.1 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.

.2 Provide separation of Ethernet cables from sources of noise, including other cables.

.1 Provide separation distances as follows:

.1 Instrumentation/Control < 50: 50 mm.

.2 120 VAC, 8 AWG and smaller: 100 mm.

.3 120 VAC, >8 AWG: 300 mm.

.4 600 VAC power: 300 mm.

.5 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.

.6 Medium Voltage: 450 mm.

.2 Notify the Contract Administrator in writing if these separations cannot be achieved.

.3 Ethernet cables may be installed in cable tray, provided that:

.1 There is a barrier separating power and control cables within the tray, or

.2 The cable tray does not contain power cables, unless specifically authorized by the Contract Administrator in writing, and

.3 The cable voltage rating is equal to or greater than the highest voltage contained in the cable tray.

.4 Prior to placing an Ethernet copper network into service, perform Ethernet copper cable test utilizing IEEE approved testing equipment and provide complete test results to the Contract Administrator for review.

.1 Submit product datasheets of proposed testing equipment to the Contract Administrator for review prior to performing the test.

.5 Provide a lightning protection device whenever copper Ethernet cables are routed outside.

3.6 Installation of PROFIBUS Cables

.1 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.

.2 Provide separation of Profibus cables from sources of noise, including other cables.

.1 Provide separation distances as follows:

.1 Instrumentation/Control < 50: 50 mm.

.2 120 VAC, 8 AWG and smaller: 100 mm.

.3 120 VAC, >8 AWG: 300 mm.

.4 600 VAC power: 300 mm.

.5 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.

.6 Medium Voltage: 450 mm.

.2 Notify the Contract Administrator in writing if these separations cannot be achieved.

.3 Ground cable shields at every device, not at one end only.

.4 Where cables must cross, they should always do so at right angles.

.5 Provide a lightning protection device whenever Profibus cables are routed outside.

.6 Provide and install cable terminations as indicated on the drawings.

.7 Estimate trunk and spur cable lengths before they are installed and compare to the lengths shown on the drawings. Where actual lengths will be longer by more than 20% from lengths shown on the drawings, or where actual lengths will be longer than Profibus installation guideline maximums, inform the Contract Administrator. Total trunk cable length shall be longer than the longest spur cable length for Profibus PA to minimize wave reflections.

.8 Do not mix different classes of cable or different Manufacturers in the same segment.

.9 When installing the cables:

.1 Do not use excessive pulling force beyond the Manufacturer’s Specifications.

.2 Do not bend the cables beyond the Manufacturer’s Specifications.

.3 Do not twist the cables.

.10 Prior to placing a Profibus network into service, perform bus analysis of each segment utilizing an approved bus testing equipment and provide complete test results to the Contract Administrator for review.

.1 Submit product datasheets of proposed bus testing equipment to the Contract Administrator for review prior to performing bus testing.

3.7 Terminations and Splices

.1 Wire nuts shall not be permitted, except in the following circuits:

.1 Lighting circuits.

.2 Receptacle circuits.

.2 Exercise care in stripping insulation from wire. Do not nick conductors.

.3 Strictly follow Manufacturer's instructions with regards to tool size and application methods of terminations and compounds.

.4 Where screw-type terminals are provided on equipment and instrumentation, terminate field wiring with insulated fork tongue terminals.

.5 Manufacturer: Thomas and Betts, Sta-Kon, or approved equal.

3.8 Reuse of Existing Wiring

.1 Except where specifically identified or approved, reuse of existing wiring is not permitted.

.2 Ensure all existing wiring is tagged prior to disconnection of equipment.

.3 Tag spare wires as “Spare” and indicate the location of the other end of the wire.

3.9 Installation in Conduit

.1 Utilize cable grips, appropriately selected to accommodate the type and geometry of the cable.

.2 Utilize cable pulling lubricant, compatible with the cable and conduit.

3.10 Cable Identification

.1 Install cable tags at both ends of cable.

3.11 Testing

.1 Perform an insulation resistance test on all new and existing power conductors that are being terminated as part of the Work.

.2 Perform TIA-568-C.2 for category 6 cabling and connecting hardware on all ethernet cables. The installation shall not be considered complete if it fails any of the tests even if communication is occurring.

.3 Perform bus analysis and waveform capture of all Profibus network segments and verify that there are no errors. The PROFIBUS installation shall not be considered complete if it has communication errors even if communication is occurring.

END OF SECTION

FIBRE OPTIC NETWORK

1. GENERAL

1.1 Summary

.1 This Section specifies requirements for the Fibre Optic Network.

.2 Function of Fibre Optic Network is to transmit digital data between network nodes.

.3 Provide a Fibre Optic Network based on Referenced Standards for use in the site automation networks.

1.2 Standards

.1 National Electrical Code (NEC):

.1 OFCR-LS; Sunlight Resistant (SUN RES).

.2 Institute of Electrical & Electronic Engineers (IEEE):

.1 IEEE-383/IEEE-1202 Flame Test Suitable for Direct Burial.

.3 Telecommunications Industry Association (TIA); Electronics Industry Association (EIA):

.1 568, Commercial Building Telecommunications Cabling Standard.

.2 569-D, Telecommunications Pathways and Spaces.

.3 607-C, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

.4 Canadian Standard Association (CSA):

.1 CSA C22.1 - Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations, most current adopted edition.

.2 CSA C22.2 No.2556 - Wire and Cable Test Methods.

.3 CSA C22.2 No. 230 - Tray Cables.

.4 CSA C22.2 No. 232 - Optical Fiber Cables.

.5 CSA C22.2 No 262 - Optical Fiber Cable and Communication Cable Raceway Systems.

.5 American National Standard (ANSI/NETA):

.1 ANSI/NETA ATS, Standard for Acceptance Testing Specification for Electrical Power Equipment and Systems.

.6 Manitoba Hydro:

.1 Manitoba Electrical Code (most current adopted revision).

.2 Manitoba Hydro Inspection Notices.

.7 City of Winnipeg:

.1 Automation Design Guide.

.2 Electrical Design Guide.

.3 Winnipeg Electrical By-Law.

.4 Information Bulletins.

1.3 Abbreviations

.1	dB	decibel
.2	EIA	Electronic Industries Association
.3	m	meter
.4	MHz	megahertz
.5	µ, micro	x 10^{-6}
.6	n, nano	x 10^{-9}

1.4 Submittals

.1 Provide submittals in accordance with Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Manufacturer’s statement that installer is certified to perform installation Work.

.3 Subsystem detail design documents:

.1 Bill of Materials for Fibre Optic Network Components: Component number, Manufacturer, model number, component description, and quantity.

.4 Cable schedule showing:

.1 Cable identification.

.2 Fibre counts for each cable and identification of used and spare fibre pairs.

.3 Cable length and attenuation and planned number of splices. Splices, if any, shall be minimized. Splices require Contract Administrator approval.

.5 Contractor Qualifications:

.1 Fibre Optic Network Contractor: Minimum of five (5) years' experience providing, integrating, installing, and commissioning of similar systems.

.2 Fibre Optic Network Subcontractor's Site Representative: Minimum of five (5) years' experience installing similar systems.

.3 Acceptance of Fibre Optic Network Subcontractor neither exempts the Subcontractor and Contractor from meeting Contract requirements, nor does it give prior acceptance of subsystems, equipment, materials, and services.

.6 Factory Test Reports:

.1 Copy of Ethernet cable installer's factory certified installation certificate. Certificate shall have the name of the person who completed the training course and that person shall supervise all cable installation and termination for compliance with Manufacturer recommendations.

.2 Copy of fibre optic cable installer's factory certified installation certificate. Certificate shall have the name of the person who completed training course and that person shall supervise all cable installations and terminations for compliance with Manufacturer recommendations.

.7 Installer Credentials:

.1 Submit the fibre installer's Corning Certificate.

1.5 Environmental Requirements

.1 Optical Fibre Cable and Cable Splice Centers:

.1 Outside, Underground/Submerged: -20 to 40°C.

.2 Outside, Overhead: -40 to 80°C.

.3 Outside, Aboveground in Conduit: -40 to 75°C.

.4 Inside: 0 to 40°C.

.2 Equipment:

.1 Outside, Aboveground: -40 to 75°C.

.2 Control Rooms, Equipment Rooms and Telecommunications Closets: 30 to 55% relative humidity, 18 to 24°C.

.3 Other Interior Areas: 0 to 100% relative humidity, 5 to 35°C.

2. PRODUCTS

2.1 Fibre Optic Cable

.1 Fibre Requirements:

.1 Multimode.

.2 Comply with the standards on References Section.

.3 Fibre Core Diameter: 50 µm.

.4 Fibre Category: OM3.

.5 Wavelengths: 850 nm / 1300 nm.

.6 Maximum Attenuation: 3.0 dB/km / 1.0 dB/km.

.2 Cable Requirements:

.1 Type: Loose Tube, double jacket, chemical resistant, non-conductive.

.2 Application: Aerial, Direct Buried, Duct, Tray Rated.

.3 Flame Rating: LSZH (OFN-LS).

.4 Product Type: Dielectric.

.5 Temperature Range(operation): -50 to +75°C.

.6 Fibre Count: 24.

.7 Fibres per Tube: 12.

.8 Tape: Water-swellable.

.9 Inner Jacket: FRNC/LSZH Material.

.10 Tensile Strength Elements: Dielectric strength members.

.11 Outer Jacket: FRNC/LSZH Material.

.12 Max. Tensile Strength, Short-Term: 4500 N.

.13 Max. Tensile Strength, Long-Term: 1500 N.

.14 Compressive Loading: 2400 N/cm.

.15 Impact Resistance: 11.8 N*m.

.16 Min. Bend Radius Installation: 264 mm.

.17 Min. Bend Radius Operation: 176 mm.

.18 Nominal Outer Diameter: 17.6 mm.

.19 Chemical Resistance: RoHS.

.20 Approvals: CSA FT-4-ST1.

.3 Manufacturer and Model:

.1 Corning 036TUL-T3680D2M.

.2 Or approved equal.

2.2 Fibre Optic Panel

.1 Enclosure:

.1 Corrosive Location:

.1 Single Door, Single Access Panel:

.1 Free Standing, NEMA 4X.

.2 Additional Security Doors:

.1 TS 35 DIN Rail Mountable, 445 mm x 483 mm (17.5” x 19”).

.2 TS 35 DIN Rail Mountable, 711 mm x 483 mm (30” x 19”).

.3 Frame:

.1 Tapped Hole, 44RU Main Frame.

.2 100 mm (4”) Frame Reducing Brackets.

.3 Additional 2000 mm (79”), Taped Hole, 44RU Rack Rail Pair.

.4 Door Mounted Folding Laptop Shelf.

.5 Dimension: 2000 mm x 800 mm x 800 mm (79” x 31” x 31”).

.2 Ordinary Location:

.1 Partial Door, Single Access Panel:

.1 Free Standing, NEMA 12.

.2 Partial Doors on Front Only:

.1 Lockable, 1500 mm x 600 mm (59” x 24”).

.2 Lockable, 500 mm x 600 mm (20” x 24”).

.3 Tapped Hole, 44RU Frame.

.4 Door Mounted Folding Laptop Shelf.

.5 Dimension: 2000 mm x 600 mm x 800 mm (79” x 24” x 31”).

.2 Partial Door, Dual Access Panel:

.1 Free Standing, NEMA 12.

.2 Partial Doors on Front and Rear:

.1 Lockable, 1500 mm x 600 mm (59” x 24”).

.2 Lockable, 500 mm x 600 mm (20” x 24”)

.3 Tapped Hole, 44RU Frame.

.4 Door Mounted Folding Laptop Shelf.

.5 Dimension: 2000 mm x 600 mm x 800 mm (79” x 24” x 31”).

.3 Single Door, Swingout Panel:

.1 Wall Mount, NEMA 12.

.2 Single door, lockable, double hinged.

.3 Tapped Hole, 12RU Frame.

.4 Dimension: 635 mm x 600 mm x 550 mm (25” x 24” x 22”).

.2 DIN Rail Mount Kit:

.1 TS 35 mm (1.4”), slotted.

.2 Depth adjustable, 2RU, 483 mm (19”) Rack Mount.

.3 When used to mount terminals, rails shall be mounted on straight raisers (rail support / mounting feet) so that the top of the terminals are at the same height as the top of the adjacent wiring duct.

.4 Raisers (rail support / mounting feet) shall not be used when rail hosts heavy components beyond DIN ratings.

.3 Terminals:

.1 Quantity:

.1 Accommodate present and spare indicated needs.

.2 One wire per terminal for field wires entering/exiting enclosures.

.3 Maximum of 2 wires on each side of a terminal for internal enclosure wiring.

.4 Installed Spare Terminals: As shown on the drawings.

.2 General:

.1 Connection Type: Screw compression clamp.

.2 Compression Clamp:

.1 Complies with DIN-VDE 0611.

.2 Hardened steel clamp with transversal grooves that penetrate wire strands providing a vibration-proof connection.

.3 Guides strands of wire into terminal.

.3 Screws: Hardened steel, captive, and self-locking.

.4 Current Bar: Copper or treated brass.

.5 Insulation:

.1 Thermoplastic rated for -55 to 110°C.

.2 Two funneled shaped inputs to facilitate wire entry.

.6 Mounting:

.1 Standard DIN rail.

.2 Terminal block can be extracted from an assembly without displacing adjacent blocks.

.3 End Stops: Minimum of one at each end of rail.

.7 Jumpers: Allow jumper installation without loss of space on terminal or rail.

.8 Marking System:

.1 Terminal number shown on both sides of terminal block.

.2 Markings shall be machine printed. Handwritten markings are not allowed.

.3 Terminal strip numbers shown on end stops.

.4 Mark terminal block and terminal strip numbers as shown on panel control diagrams and loop diagrams.

.9 Terminal blocks shall be designed for the size of the wires to be connected to them. Terminal blocks used for analog, digital, and power cables shall be identified and physically separated from each other.

.10 Drawings and templates supplied shall not detail all hardware components. Hardware components that are typically not detailed include but are not limited to labels, stoppers, rail lifters, end plates, and separators. The supplier shall supply and install such components when required.

.11 Loose Spare Requirements:

.1 Provide either thirty (30) or three (3) percent, whichever quantity is less, of each type of terminal used on the Project.

.3 Terminal Block Types:

.1 Control wiring:

.1 General:

.1 Connection type: Screw connection.

.2 Mounting: TS 35 mm DIN rail.

.3 Approval: CSA.

.2 Manufacturer and Series:

.1 Weidmuller W-series.

.2 Or approved equal.

.3 Standard of Acceptance:

.1 Terminal Block, Feed-through:

.1 Rated Voltage: 800V AC.

.2 Rated Current: 32 A.

.3 Wire Size: 26 to 10 AWG.

.4 Colour: Dark Beige Body.

.5 Width: 6.1 mm.

.6 Standard of acceptance: Weidmuller WDU 4.

.2 Terminal Block, Ground:

.1 Wire Size: 26 to 10 AWG.

.2 Colour: Green and yellow body.

.3 Width: 6.1 mm.

.4 Grounding: Electrically grounded to mounting rail.

.5 Standard of acceptance: Weidmuller WPE 4.

.3 Terminal Block, Knife Disconnect:

.1 Rated Voltage: 300V AC.

.2 Rated Current: 10 A.

.3 Wire Size: 22 to 10 AWG.

.4 Colour: Dark Beige body, orange switch.

.5 Width: 6.1 mm.

.6 Standard of acceptance: Weidmuller WTR 4.

.4 Terminal Block, Fused:

.1 Rated Voltage: 300V AC.

.2 Rated Current: 10 A.

.3 Wire Size: 22 to 10 AWG.

.4 Colour: Black body.

.5 Width: 6.1 mm.

.6 Fuse: 5 mm x 20 mm.

.7 Standard of acceptance: Weidmuller WFS 4.

.5 Terminal Block, Double Level, Fused:

.1 Rated Voltage: 300V AC.

.2 Rated Current: 10 A.

.3 Wire Size: 26 to 12 AWG.

.4 Color: Dark Beige Body.

.5 Width: 8 mm.

.6 Fuse: 5 mm x 20 mm.

.7 Standard of acceptance: Weidmuller KDKS 1/35 DB.

.2 Power wiring over 6.3 A:

.1 General:

.1 Connection type: Screw connection.

.2 Mounting: TS 35 mm DIN rail.

.3 Approval: CSA.

.2 Manufacturer and Series:

.1 Weidmuller W-series.

.2 Or approved equal.

.3 Standard of Acceptance:

.1 Terminal Block, Feed-through:

.1 Rated Voltage: 600V AC.

.2 Rated Current: 85 A.

.3 Wire Size: 18 to 6 AWG.

.4 Colour: Dark Beige body.

.5 Width: 11.9 mm.

.6 Standard of acceptance: Weidmuller WDU 16.

.2 Terminal Block, Fused:

.1 Rated Voltage: 150V AC.

.2 Rated Current: 16 A.

.3 Wire Size: 20 to 6 AWG.

.4 Color: Dark Beige body.

.5 Width: 11.9 mm.

.6 Fuse: 6.3 mm x 32 mm.

.7 Standard of acceptance: Weidmuller WSI 6/2 GZ/DEF63.

.4 Power Supply:

.1 Approvals: CSA.

.2 Watt Rating: 120W.

.3 Input: 100-240 VAC, 45-65 Hz.

.4 Output: 24V DC.

.5 Mounting: TS 35 DIN rail.

.6 Capable of parallel operation.

.7 Temperature derating: linear derating to half power from 60°C to 70°C

.8 Output ripple: < 50 mV peak-to-peak.

.9 Efficiency: 88 percent or greater.

.10 Status lights:

.1 DC OK LED: active, green.

.11 Status contacts:

.1 Power supply failure, qty 1 normally open (Form A), contact closed during normal operation.

.12 Environmental:

.1 Temperature, operating: -10 to 60°C.

.2 Humidity, operating max 90%, non-condensing.

.13 Manufacturer and series:

.1 SolaHD SDN-P Series.

.2 Or approved equal.

.5 Uninterruptible Power Supply:

.1 Approvals: CSA.

.2 Watt Rating: 500W.

.3 Input: 100-240 V AC, 45-65 Hz.

.4 Output: 120V AC.

.5 Mounting: TS 35 DIN rail, shelf, or panel mount.

.6 Environmental:

.1 Temperature, operating: 0 to 60°C.

.2 Humidity, operating max 90%, non-condensing.

.6 Overcurrent Protection:

.1 Panel-mounted devices and all control circuits shall be protected by appropriately sized fuses or circuit breakers.

.7 Duplex Receptacle:

.1 Approvals: CSA.

.2 Heavy duty Specification grade, two-pole, three-wire grounding type with screw type wire terminals suitable for No. 10 AWG.

.3 High strength, thermoplastic base colour.

.4 Colour:

.1 Non-essential powered receptacles: White.

.2 UPS-powered receptacles: Orange.

.5 Contact Arrangement: contact shall be made on two sides of each inserted blade without detent.

.6 Rating: 125 V, configuration 5-15R, 15 A.

.7 One-piece mounting strap with integral ground strap, rivetless construction.

.8 Mounting: TS 35 DIN Rail.

.9 Enclosure: Outlet box, 115 mm x 75 mm x 55 mm (4.5” x 3” x 2”), with faceplate.

.10 Receptacles shall be of one Manufacturer throughout the project.

.11 Manufacturers and products:

.1 Arrow Hart 5262 Series.

.2 Bryant 5262 Series.

.3 Hubbell 5262 Series.

.4 Or approved equal.

.8 Ethernet Switches and Patch Cables

.1 See Specification Sections 17935 and 17936.

2.3 Fibre Optic Closet Connectors (CCH)

.1 Function: The CCH provides a rack-mount housing for fibre cassettes. The cassettes shall be complete with pre-terminated patch plates and pigtails. The CCH shall be installed inside plant Network Panels and Network Patch Panels.

.2 Splice Cassette:

.1 24 fibres.

.2 Pre-terminated patch plate with LC duplex connectors. Connectors shall have zirconium ferrule inserts.

.3 OM3.

.4 Single Fibre Splicing.

.5 3 m pigtail.

.3 Rack-mount housing:

.1 General requirements:

.1 RoHS Compliant.

.2 Suitable for installation on standard 483 mm (19”) rack.

.2 48 Strand Maximum Housing:

.1 Capacity: up to 48 strands via 2 cassettes.

.2 Dimension: 44 mm x 482.6 mm x 434.34 mm (1.75” x 19” x 17”), 1RU.

.3 96 Strand Maximum Housing:

.1 Capacity: up to 96 strands via 4 cassettes.

.2 Dimension: 88.9 mm x 482.6 mm x 434.34 mm (3.5” x 19” x 17”), 2RU.

.4 144 Strand Maximum Housing:

.1 Capacity: up to 144 strands via 6 cassettes.

.2 Dimension: 133.35 mm x 482.6 mm x 434.34 mm (5.25” x 19” x 17”), 3RU.

.5 288 Strand Maximum Housing:

.1 Capacity: up to 288 strands via 12 cassettes.

.2 Dimension: 177.8 mm x 482.6 mm x 434.34 mm (7” x 19” x 17”), 4RU.

.4 Manufacturer and Models:

.1 Corning CCH-01U, CCH-02U, CCH-03U, CCH-04U.

.2 Corning CCH-CS24-E4-P00TE, Splice Cassette.

.3 Or approved equal.

2.4 Fusion Splice Protector

.1 Heat shrinkable splice shall protect the fusion splice on fibres securely.

.2 Requirements:

.1 Multifibre or single fibre sleeve, 40 or 60 mm length.

.2 Fibre Diameter: 50 µm.

.3 Heating Time: 64 Sec. for single fibre sleeve and 80 sec. for multi fibre sleeve.

.3 Manufacturer and Model:

.1 Corning, 2806031-01.

.2 Or approved equal.

2.5 Patch Cables

.1 In accordance with requirements of EIT/EIA 568, Section 12.5.

.2 Features:

.1 Low Loss.

.2 2 fibres, LC duplex to LC duplex.

.3 50 µm Multimode (OM3).

.4 Wavelengths: 850 nm / 1300 nm.

.5 Zip Cord Tight buffered cable.

.6 Riser, 2.0 mm legs.

.7 Insertion loss, typical: 0.1 dB.

.8 Insertion loss, max.: 0.15 dB.

.9 Outer jacket material: LSZH/FRNC.

.10 Length: as required to suit installations without tension, minimum 10% of total cable distance of slack for all given runs.

.3 Manufacturer:

.1 Corning E050502T5120001M and E050502T5120003M for 1 and 3 m.

.2 Or approved equal.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Installation

.1 Coordinate network cable installation with contractor's and City's activities at site. Provide at least five (5) business days notice before requiring access to facility to either work in existing Network Panels or install new.

.2 Install all underground network cabling in conduit or duct as indicated. Size conduit for the number of cables contained and observe the cable Manufacturers recommended bending radius.

.3 All network cabling within buildings shall be installed in cable tray. Conduit runs are not permitted.

.4 Rod and swab out existing ducts prior to installing new cables. Inspect existing raceways and boxes for allowable bending radius prior to installing cable and notify the Contract Administrator of any condition which would prevent the proper installation of the cable.

.5 Install cable without splices between network components.

.6 Follow Manufacturer's installation practices.

3.3 Conduit System

.1 Contractor shall ensure the installed conduit system conforms with fibre optic system requirements, including:

.1 Conduit size and number.

.2 Access Holes and Pull Boxes shall be located and sized to ensure cables can be installed without exceeding Manufacturer's limitations.

.3 Outlet Boxes shall be sized to coordinate with outlet cover plates. Outlet boxes shall have adequate volume for the quantity of cables installed in the box and to ensure the bend radius of each cable conforms with the Manufacturer's Specifications.

.2 Expansion Plugs: Seal conduits to stop ingress of water and grit with fabricated expansion plugs.

3.4 Fibre Optic Cable

.1 Installation by Corning certified installer. Provide Corning certification as a shop drawing. If the fibre approved and provided for the Project is made by a different Manufacturer, provide credentials from that specific Manufacturer stating the installer is certified to install the fibre provided.

.2 Install cables in accordance with Manufacturer's requirements.

.3 Install cable directly from shipping reels. Ensure that cable is not:

.1 Dented, nicked, or kinked.

.2 Subjected to pull stress greater than Manufacturer's Specification.

.3 Subjected to a bend radius less than the Manufacturer's Specification.

.4 Subjected to treatment that may damage fibre strands during installation.

.4 Cables Per Conduit: One cable maximum.

.5 If the link loss calculation indicates that the total cable system attenuation equals or exceeds the total link loss budget, rerouting may be allowed, if approved by Contract Administrator.

.6 Splices: Install fibre optic cables in unspliced lengths between fibre centers.

.7 Identification: Identify cable on both ends and in access holes and pull points it goes through. Identify with tags in accordance with Division 16. Use waterproof tags.

.8 Sealing: Seal cables shall stop ingress of water and grit with fabricated expansion plugs.

.9 Connect cables between destinations in cross-over configuration.

.10 Ground armoured cabling as close as practical to where the cables enter the building at one end only.

.11 Provide a 2 m coil for fibre cables terminating within cabinets. Coil neatly within the bottom of the cabinet.

3.5 Field Quality Control

.1 Test components of installation in accordance with standards and specifications.

.2 Provide equipment, instrumentation, supplies and skilled staff necessary to perform testing.

.3 Advise the Contract Administrator in writing at least forty-eight (48) hours in advance of each test. Contract Administrator shall have option to witness and participate actively in tests.

.4 Document test results for each cable to confirm that all installed fibres meet standards. Submit all test reports to the Contract Administrator to document the results of all of the testing requirements and the state and conditions of the tests.

.5 Document results of repeater and transceiver tests. Submit results to the Contract Administrator.

3.6 Tests and Inspection

.1 In accordance with Schedule 18 Technical Requirements.

.2 Conduit:

.1 Testing and Sealing of Spare Conduits.

.2 Conduit Testing:

.1 Blow full-diameter mouse through each spare conduit to verify they are unrestricted over full length.

.2 If any conduit is not unrestricted over full length, advise the Contract Administrator in writing.

.3 Documentation: Document and submit testing results to the Contract Administrator for review prior to installing cable.

.3 Cable Inspection:

.1 Compare cable, connector, and splice data with drawings and specifications.

.2 Inspect cable and connections for physical and mechanical damage.

.3 If required, use cleaner solution specially formulated for fibre connectors to clean the fibre connectors. Follow cleaning kit Manufacturer’s instruction.

.4 Cable Testing:

.1 Field test all fibres for end to end attenuation of an installed link as per TIA-568-C.0 Test all spare fibres from patch panel to patch panel.

.2 The total link attenuation shall be less than its corresponding networking equipment loss budget.

.3 All tests shall be bi-directional.

.4 Perform cable length measurement, fibre fracture inspection and construction defect inspection using an Optical Time Domain Reflectometer (OTDR). The OTDR signal shall be analyzed for excessive connection, splice and cable backscatter by viewing the reflected power/distance graph.

.1 OTDR images shall be included in the test report.

.5 Perform connector and splice integrity test using an OTDR. The OTDR signal shall be analyzed for excessive connection, splice and cable backscatter by viewing the reflected power/distance graph.

.6 Perform cable attenuation loss measurement with an optical power loss test set. Attenuation loss, of each fibre, in dB/km shall be within Manufacturer's recommendation.

.7 Perform connector and splice attenuation loss measurement from both ends of the optical cable with an optical power loss test set. Attenuation loss shall be within Manufacturer's recommendation.

.8 Until cable and connector requirements are met, replace and retest all cables that do not have specified number of fibres that meet attenuation standards. The installation shall not be considered complete until all requirements are met in all fibres even if communication is occurring.

.9 Submit a test report summary and all associated test data to the Contract Administrator at the completion of the testing.

END OF SECTION

NETWORK EQUIPMENT

1. GENERAL

1.1 Summary

.1 Install and configure the extension of the control and supervisory network. Refer to the Automation Design Guide for further explanation of the different network functionality.

.2 Supply, install, and commission two new fibre cables from the existing Area P Control Room to the Primary Scum Dewatering Building Network Panel.

.3 Supply, install, and commission the new Network Panel as shown on the drawing including all network equipment within the Biosolids package as shown on the drawings.

.4 Supply, install, and commission 5 new Profibus Networks as shown on the drawings.

.5 All work provided on the network shall adhere to the requirements of the Automation Design Guide.

1.2 Standards

.1 Comply with latest edition of the codes and standards applicable.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Updated network architecture drawings with tags and device configurations.

2. PRODUCTS

2.1 Ethernet Cables

.1 Provide for network connections.

2.2 Ethernet Patch Cables

.1 Requirements:

.1 Cat-6, shielded.

.2 Jacket Colour: Blue.

2.3 Ethernet Switch – Control, Server, and Supervisory Networks

.1 Requirements:

.1 Input voltage: 24 VDC, redundant dual inputs.

.2 Ethernet Ports:

.1 10/100/1000 BaseT(X), quantity as indicated on the drawings.

.2 100/1000 BaseSFP, quantity as indicated on the drawings.

.3 SFP modules:

.1 1000Base (1 Gigabit) SX, LC Connector, 0.5 km, minimum of four per switch, or as indicated on the drawings.

.4 Console port: USB.

.5 Supported industrial protocols:

.1 PROFINET.

.2 EtherNet/IP.

.3 Modbus/TCP.

.6 Redundancy Protocols:

.1 RSTP.

.2 MSTP.

.3 The switch shall be capable of operating in a network that has connections to parallel redundant network paths.

.7 Management Protocols:

.1 RMON.

.2 RARP.

.3 DHCP Server/Client.

.4 DHCP Option 66/67/82.

.5 BootP.

.6 Syslog.

.7 LLDP.

.8 Security Protocols:

.1 HTTP.

.2 HTTPS.

.3 Telnet.

.4 SSH.

.9 Additional required supported protocols:

.1 IGMPv1/v2/v3.

.2 GMRP.

.3 GVRP.

.4 TFTP.

.5 SNTP.

.6 SMTP.

.7 SNMP Inform.

.8 SNMPv1/v2c/v3.

.9 IEEE 1588 PTPv2.

.10 IPv6.

.11 NTP Server/Client.

.10 Broadcast storm protection.

.11 Support for Port Trunking.

.12 Fanless design.

.13 DIN rail mount.

.14 Alarm relay dry contact: 1 A @ 24 VDC.

.15 IEEE 802.3x for Flow Control.

.16 Configuration via Web Browser.

.17 Operating temperature range: -10 to 60°C.

.18 Ambient Relative Humidity range: 5 to 95% (non-condensing).

.19 Enclosure: metal, IP30 protection.

.2 Manufacturer and Model:

.1 Moxa EDS-G512E-4GSFP with a minimum of four SFP-1GSXLC modules per switch.

.2 Moxa EDS-G516E-4GSFP with a minimum of four SFP-1GSXLC modules per switch.

.3 Or approved equal.

.3 The use of Virtual Local Area Networks (VLANs) is not permitted.

2.4 Profibus Remote Master (Profibus DP/Modbus TCP Gateway)

.1 Requirements:

.1 This product was standardized by the City .

.2 All requests for either purchase or quotation shall be referenced, to receive standardized pricing that the City has negotiated with the vendor.

.3 Operating temperature range: 0 to 60°C.

.2 Manufacturer and Model:

.1 Schneider Electric Profibus Remote Master (PRM) TCSEGPA23F14F.

.2 No alternates or substitutes will be accepted.

2.5 Profibus Head Station Backplane

.1 Requirements:

.1 The fixed backplane HS + 2 Sub fits 1 Head Station and 2 modules of any type and shall be extendible with standard backplane units on the right side.

.2 Manufacturer and Model:

.1 Procentec COMbricks 101-200023.

.2 Or approved equal.

2.6 Profibus Repeater Head Station

.1 Requirements:

.1 Headstation for permanent PROFIBUS monitoring.

.2 No bus address required.

.3 Can monitor one PROFIBUS network.

.4 Power supply: 10.8 to 26.4 VDC, max 800 mA.

.5 Ports: Ethernet 10/100 Mbps, RJ45 connector.

.6 Supported protocols: HTTP, FTP, SMTP, TELNET, DHCP, SNMP.

.7 Internal Web Server.

.8 Compatible Backplane Units, 101-200023, 101-200012.

.9 Approvals: CSA or equivalent.

.2 Manufacturer and model:

.1 Procentec COMbricks 101-20011B.

.2 Or approved equal.

2.7 Profibus Repeater Power Supply Module

.1 Requirements:

.1 Power module provides additional power to the backplane when Head Station cannot power all inserted modules.

.2 Power supply: 12- 30 VDC, 2 Amps max.

.3 Provides 6A to backplane.

.4 Approvals: CSA or equivalent.

.2 Manufacturer and model:

.1 Procentec Combricks 101-230010.

.2 Or approved equal.

2.8 Profibus DP Repeater, 2 Channel

.1 Requirements:

.1 Supported protocols: DP-V0, DP-V1, DP-V2, FDL, MPI, FMS, PROFIsafe and any other FDL based protocol.

.2 No bus address required.

.3 Transmission speed: Max 12 Mbps.

.4 Transmission speed auto detection.

.5 Integrated termination facility.

.6 Maximum 31 devices per channel.

.7 Screw terminations and DB9 connector for each channel.

.8 Operating temperature range: 0 to 60°C.

.9 Approvals: CSA or equivalent.

.2 Manufacturer and Model:

.1 Procentec Combricks 101-201102

.2 Or approved equal.

2.9 Profibus DP/PA Link Module

.1 Requirements:

.1 Supported protocols: DP-V0, DP-V1, DP-V2, FDL, MPI, FMS, PROFIsafe and any other FDL based protocol.

.2 No bus address required on DP (Link has address 1 on PA).

.3 Fully transparent.

.4 PA transmission speed: 31.25 kbps.

.5 DP transmission speed: 9.6 kbps to 12 Mbps (including 45.45 kbps).

.6 Maximum 32 devices.

.7 Trunk voltage: 10 to 27 VDC (customizable and Non-Ex).

.8 Trunk current: 500 mA.

.9 Current consumption: 10 mA.

.10 Screw terminals for each channel.

.11 PA termination: Automatic.

.12 Operating temperature range: 0 to 60°C.

.13 Approvals: CSA or equivalent.

.2 Manufacturer and model:

.1 Procentec Combricks 101-201610.

.2 Or approved equal.

2.10 Profibus PA Segment Protector

.1 Requirements:

.1 Connects several Field Devices to the network Trunk cable and provides short circuit protection.

.2 Short Circuit Protection.

.3 Mounting: DIN Rail.

.4 Degree Of Protection: IP20.

.5 Operating Temperature: -50 to +70°C.

.6 Minimum Input Voltage: 10V.

.7 Voltage drop main cable/outputs: 1.3V.

.8 Spur Device Current: 43mA maximum (one device per spur).

.9 Spur Short Circuit Current: 58 mA maximum.

.10 Terminating resistor: removable external type 100 Ω +/- 10%.

.11 No. Of Ports: 6 and 12.

.12 Approvals: CSA or equivalent.

.2 Manufacturer and Model:

.1 PEPPERL+FUCHS, R2-SP-IC6, R2-SP-IC12, with M-FT terminating resistor.

.2 Or approved equal.

2.11 Profibus DP Protector Module

.1 Requirements:

.1 This module protects Profibus/DP network against lightning strikes and surges.

.2 Max. Continues operating DC Voltage: 6.0 V.

.3 Nominal Current: 1A.

.4 Operating Temperature: -40 to +80°C.

.5 CSA approved.

.6 Mounting: DIN Rail.

.7 Approvals: CSA or equivalent.

.2 Manufacturer and Model:

.1 DEHN, BXT ML4 BD HF 5 Module, part number: 920 371.

.2 DEHN, BXT BAS Protection Module Base, part number: 920 300.

.3 Or approved equal.

2.12 Profibus PA Protector Module

.1 Requirements:

.1 This module protects Profibus PA network against lightning strikes and surges.

.2 Max. Continues Operating DC Voltage: 33 V.

.3 Nominal Current: 1A.

.4 Operating Temperature: -40 to +80°C.

.5 CSA Approved.

.2 Manufacturer and Model:

.1 DEHN, BXT ML4 BD 24 Module, part number: 920 344.

.2 DEHN,BXT BAS Protection Module Base, part number: 920 300.

.3 Or approved equal.

2.13 Lightning Protection Module Test Device

.1 Requirements:

.1 Portable device for testing of BXT ML Lightning Protection Modules.

.2 Voltage Supply: Lithium Battery.

.3 RFID Transmission Frequency: 125 kHz.

.4 Operating Temperature: -20 to +60°C.

.2 Manufacturer and Model:

.1 DEHN, DRC LC M1+, part number: 910 655.

.2 Or approved equal.

2.14 Modbus Serial to TCP Gateway

.1 Requirements:

.1 1-port advanced Modbus gateway.

.2 Serial Port: 1 RS-232/422/485.

.3 Serial Port Isolation: 2 KV.

.4 Ethernet Interface: Modbus TCP.

.5 Supported Serial Protocols: Modbus RTU/ASCII Slave/Master.

.6 Operating Temperature: -40 to +80°C.

.7 Power Input: 12 to 48 VDC, 278 mA @ 24 V.

.8 Approvals: CSA or equivalent.

.2 Manufacturer and model:

.1 MOXA, MGate MB3170I.

.2 Or approved equal.

2.15 Copper Ethernet Modular Patch Panel

.1 Requirements:

.1 Mounting: 35 mm DIN Rail mount, TS-35 “U” Rail.

.2 2 X Single Copper Module.

.3 Shielded Keystone RJ45 Cat 6 Connectors.

.4 Ports: As noted.

.5 Rated for Shielded Cat 6 wiring.

.2 Manufacturer and model:

.1 Belden MIPP-BD-CSD4 (as required).

.2 Or approved equal.

2.16 Spare Parts

.1 Provide spare parts that are identical to and interchangeable with similar parts installed and in accordance with Schedule 18 Technical Requirements and the following:

.1 One (1) PROFIBUS repeater headstation.

.2 One (1) PROFIBUS power supply module.

.3 Two (2) PROFIBUS two channel repeater modules.

.4 Two (2) PROFIBUS DP/PA link modules.

.5 One (1) PROFIBUS Fiber Optic Module.

.6 One (1) PROFIBUS Remote Master.

.7 One (1) 6 channel PROFIBUS PA segment protector.

.8 One (1) 12 channel PROFIBUS PA segment protector.

.9 Ten (10) PROFIBUS DP protector modules.

.10 One (1) PROFIBUS PA protector module.

.11 One (1) Ethernet protector module.

.12 One (1) MODBUS serial to TCP gateway.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Network Configuration

.1 City of Winnipeg staff shall determine IP address allocation and provide to the Contractor upon request.

.2 The installed control network is arranged as a dual redundant ring. At each network panel, modify the fibre connections of each control network switch from parallel to series, provide fibre patch cables for each switch to switch link within the network patch panels to complete the trunked network topology.

.3 Configure the PCS network equipment to operate with the Turbo Ring V2.

.1 Network speed of 1Gb/s throughout the plant is required.

.2 For the control network only, use trunked communication mode on each switch to combine the bandwidth of the fibre into a single link.

.1 Rewire the patch cables on the control network of the existing network switches to achieve the trunked single ring as shown on the drawings.

.4 Provide hardwired fault monitoring wired back to the local area PCS PLC for all network switches.

.5 Refer to the City's Automation Design Guide for an overview of each network.

3.3 Profibus Network Installation and Commissioning

.1 See Section 17936 - Automation Wire and Cables for Profibus Cable installation guidelines.

.2 Install network terminations as indicated on the drawings.

.3 Verify operation of all network and devices on all Profibus network segments.

.4 Submit bus analysis and waveform capture of all Profibus network segments to Contract Administrator. Verify that there are no errors. The PROFIBUS installation shall not be considered complete if it has communication errors even if communication is occurring.

.5 See Commissioning Procedure documents for Profibus network commissioning details.

3.4 General Installation

.1 Configure process control network equipment to create a correctly communicating installation.

.2 Ethernet installations shall be certified to Category 6 standards.

.3 Equipment shall be installed in panels by a CSA certified panel shop.

3.5 Time Synchronization

.1 Enable time synchronization using SNTP:

.1 Use 2048 as a default time interval unless a shorter time interval is required for switch specific functionality.

.2 Use the default gateway.

3.6 Testing

.1 Refer to Section 17908 for FAT and SIFT procedures.

.2 Demonstrate communication on all networks with live data from installed equipment.

.3 Perform ping tests at variable packet sizes to demonstrate that the network speed and bandwidth meet the Manufacturer's Specifications.

.4 Perform, monitor, and record live disconnections of network links to demonstrate the network recovery performance per the communication protocol and Manufacturer's Specifications.

.5 The installation shall not be considered complete if there are errors even if communication is occurring.

.6 Use latest IEEE 802 standards for testing.

.7 Test disconnecting switches and system recovery as per turbo ring v2 functionality.

END OF SECTION

INSTRUMENT INDEX

1. GENERAL

1.1 Summary

.1 Provide equipment to conform to the requirements of Section 17905 – Instrumentation General Requirements and the Final Design.

.2 Install all instruments in accordance with the instrument index details associated with each tagged instrument provided within the Final Design.

.3 Refer to Specification Section listed for each instrument or equipment for additional information.

.4 Refer to instrument loop diagram drawings for wiring and control device requirements.

.5 Refer to the Standard Details for installation and other instructions pertinent to a particular device.

1.2 Definitions

.1 The following definitions relate to the “Supply Code” listed on the Instrument Index:

.1 ACC. – Instrument accessory supplied as an integral part of another device with no ISS reference.

.2 CON. – Contractor supplied instrument.

.3 CITY – City supplied instrument.

.4 PKG. – Instrument supplied as part of packaged equipment.

.5 EXIST. – Existing instrument requiring no purchase.

.6 REL. – Existing instrument requiring relocation.

1.3 Submittals

.1 Provide submittals for all instruments in accordance with the requirements specified in Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17905 – Instrumentation General Requirements.

.2 Provide all required columns listed in the Automation Design Guide filled out with the associated instrument information.

2. PRODUCTS

2.1 Performance Criteria

.1 Provide all Instrument Specification Sheets (refer to Section 17994 – Instrument Specification Sheets).

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

END OF SECTION

INSTRUMENT SPECIFICATION SHEETS

1. GENERAL

1.1 Summary

.1 Provide the Instrument Specification Sheet (ISS) details relevant for the supply of devices.

1.2 Submittals

.1 Submit all ISS documents in accordance with the requirements specified in Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System.

.2 As-Built Documents:

.1 Update the ISS to reflect the latest data and Manufacturer information.

.2 Provide ISS which contain actual data provided as part of a packaged equipment submittal. Any additional instruments shall be included in the Instrument Index and be properly cross referenced.

2. PRODUCTS

2.1 Manufacturers and Products

.1 The ISS define Acceptable Manufacturers and Acceptable Products.

2.2 Performance Criteria

.1 Provide the ISS for all instrumentation devices and detail application requirements indicated in the Final Design.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

END OF SECTION

AUTOMATION – PROCESS MEASUREMENT DEVICES

1. GENERAL

1.1 Summary

.1 This Section specifies process and HVAC instrumentation.

1.2 Standards

.1 National Electrical Manufacturers Association (NEMA).

.2 Canadian Standards Association (CSA International).

.3 Canadian Electrical Code (CEC).

.4 Canadian Underwriters Laboratory, Inc. (cUL).

.5 National Pipe Thread (NPT).

.6 International Protection Code (IP).

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 – Submittals, Section 16010 – Electrical General Requirements, and Section 17800 – General Requirements for Automation System and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 General

.1 Control devices of each category to be of same type and Manufacturer.

.2 External trim materials to be corrosion resistant (NEMA 4X).

.3 Operating conditions: 0-35°C with 5-95% RH (non-condensing) unless otherwise specified for indoor components.

.4 All outdoor instrument and equipment to be rated for -40 to 40°C.

.5 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

2.2 Outdoor/Indoor Temperature Element and Transmitter (Wall mount)

.1 Requirements:

.1 Sensor:

.1 3- wire RTD, Pt100.

.2 Probe length 120 mm.

.3 Probe diameter 6.25 mm.

.4 Measurement range: -200 to 850°C.

.5 Protective sheath for external mounting.

.2 Transmitter:

.1 Output signal: 4-20 mA 2 wire with connection to HART.

.2 Accuracy: +/- 0.06°C.

.3 Enclosure:

.1 Transmitter is housed in a NEMA4X wall mount electrical enclosure with temperature element mounted externally.

.4 Operating Ambient Conditions:

.1 -40 to 85°C, 98% relative humidity with condensation.

.5 Approvals: CSA or equivalent.

.2 Acceptable Products:

.1 Siemens SITRANS TH300.

.2 This product was standardized by the City via RFP 449-2014.

2.3 HVAC Temperature Element and Transmitter (Pipe mount)

.1 Requirements:

.1 Sensor:

.1 3- wire RTD, Pt100.

.2 Probe length 120 mm.

.3 Probe diameter 6.25 mm.

.4 Measurement range: -20 to 85°C.

.5 Insertion type element.

.2 Transmitter:

.1 Output signal: 4-20 mA 2 wire with connection to HART.

.2 Accuracy: +/- 0.06°C.

.3 Enclosure:

.1 Transmitter is housed in a NEMA4X electrical enclosure with temperature element mounted.

.4 Operating Ambient Conditions:

.1 -40 to 85°C, 98% relative humidity with condensation.

.5 Thermowell:

.1 Process Connection: 19 mm NPT(M) unless otherwise noted.

.2 Material: 316 stainless steel.

.3 Insertion Length: 89 mm minimum immersion.

.6 Approvals: CSA or equivalent.

.2 Acceptable Products:

.1 Siemens SITRANS TH300 or Magnetrol Autrol Series,

.2 This product was standardized by the City via RFP 449-2014.

2.4 Room Temperature Element and Transmitter

.1 Requirements:

.1 Sensor:

.1 Device box cover type 2- wire RTD, Pt100.

.2 Measurement range: 0 to 50°C.

.3 Stainless steel or Powder coated white steel.

.2 Transmitter:

.1 Output signal: 4-20mA 2 wire with connection to HART.

.2 Accuracy: +/- 0.06°C.

.3 Enclosure:

.1 Transmitter is housed in a NEMA4X electrical enclosure with temperature element mounted.

.4 Operating Ambient Conditions:

.1 -40 to 85°C, 98% relative humidity with condensation.

.5 Thermowell:

.1 Process Connection: 19 mm NPT(M) unless otherwise noted.

.2 Material: 316 stainless steel.

.3 Insertion Length: 89 mm minimum immersion.

.6 Approvals: CSA or equivalent.

.2 Acceptable Products:

.1 Siemens SITRANS TH300.

.2 Or approved equal.

2.5 HVAC Temperature Switches

.1 Requirements:

.1 Functionality: Field adjustable with reference dials for each pole.

.2 Output: Qty 2, individually adjustable, DPDT dry contacts.

.3 Operating Temperature: -20 to 40°C minimum.

.4 Sensor: Local.

.5 Mounting: Duct.

.6 Enclosure Rating: NEMA Type 4X.

.7 Approvals: CSA or equivalent.

.8 Electrical Connections: Conduit: 19 mm NPT(F) unless otherwise noted.

.9 Material: 316 stainless steel.

.2 Acceptable Products:

.1 Ashcroft B-Series.

.2 United Electric B402-120.

.3 Or approved equal.

2.6 Thermostat for HVAC applications

.1 General:

.1 Approvals: CSA or cUL.

.2 Industrial Grade.

.3 Type: Wall mount Thermostat.

.2 Enclosure:

.1 Hazardous locations, Class I Zone 2, Groups C, D.

.2 Explosion proof.

.3 Specifications:

.1 Temperature Rating: 2°C to 28°C

.2 Contact Type : SPDT, Snap Action.

.3 Electrical Rating: 120 VAC.

.4 Conduit connection: ¾" – 14 NPT.

.5 Manufacturer and Model:

.1 Ruffneck XT-312.

.2 Or approved equal.

2.7 Temperature Gauge, Thermometer

.1 General:

.1 Function: Indicate process temperature.

.2 Type: Bi-metallic, circular dial.

.3 Parts: Temperature gauge and thermowell.

.2 Performance:

.1 Scale Range: As noted.

.2 Accuracy: 1% of full scale.

.3 Thermometer Features:

.1 Stem Length: 100 mm, unless otherwise noted.

.2 Stem Type: Every angle, unless otherwise noted. Adjustable 90 degrees vertical, 360 degrees horizontal.

.3 Dial:

.1 Heavy-duty glass, unless otherwise noted.

.2 125 mm circular, unless otherwise noted.

.3 Hermetically sealed.

.4 Construction: All-welded, stainless steel.

.4 Thermowell:

.1 Type: 13 mm NPT connection, Type 316 stainless steel.

.2 Extension Neck: When noted, with length as noted.

.5 Manufacturers:

.1 Ashcroft.

.2 WIKA.

.3 Or approved equal.

2.8 Flow Element and Transmitter, Electromagnetic

.1 No alternates or substitutes will be accepted.

.2 All requests for purchase or quotation shall reference RFP 449-2014 to receive standardized pricing that the City has negotiated with the vendor.

.3 Manufacturer and Model:

.1 Siemens MAG6000 transmitter.

.2 MAG3100 flow tube, unless shown otherwise.

.3 This product was standardized by the City via RFP 449-2014.

2.9 Flow Element and Transmitter, Thermal Mass Flow

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Directly measure, indicate, and transmit the mass flow of the gas in the duct or pipeline.

.3 Type: Insertion type, thermal dispersion detection probe using platinum resistance temperature detectors (RTD).

.4 Parts: Element and transmitter.

.2 Performance:

.1 Flow Turndown: As noted, to 100:1.

.2 Accuracy: Plus or minus 1% of reading or 0.5% full scale.

.3 Temperature, Operating:

.1 Flow Element: -40 to +30°C, unless otherwise noted.

.2 Transmitter Housing: -40 to +30°C.

.4 Pressure, Operating, Flow Element: Up to 10 000 kPa, unless otherwise noted.

.5 Integral temperature compensation for process temperature variation.

.3 Flow Element:

.1 Features:

.1 Insertion Length: As noted or as required by Manufacturer's recommendation.

.2 Wetted Surfaces Materials: Type 316 stainless steel, unless otherwise noted.

.2 Process Connections:

.1 Connection Type: Threaded 25 mm (1”) NPT full bore ball valve.

.2 Connection Material: Type 316 stainless steel, unless otherwise noted.

.3 Sensor Termination Enclosure: Aluminum, NEMA 4X, rated for Hazardous locations, Class 1 Zone 2, Group IIA, unless otherwise noted.

.4 Process Orientation: Horizontal, unless otherwise noted.

.4 Transmitter:

.1 Features: Minimum 2-line by 16-character LCD, keypad programmable.

.2 Signal Interface:

.1 Outputs: 4 to 20 mA with HART for maximum 600 ohm load, unless otherwise noted.

.2 Communication Protocols: Capable of both PROFIBUS DP and PROFIBUS PA.

.3 Provide communication protocol as shown on design documents.

.3 Power:

.1 Selectable: 115VAC, 230VAC, 24 VDC.

.2 Electrical Connection: 2 x 3/4-inch NPT.

.4 Transmitter Enclosure: Type: Aluminum NEMA 4X, unless otherwise noted.

.5 Mounting: Remote or integral to sensor.

.6 Cables: Supply cable as required between sensor and transmitter.

.7 Manufacturer and model:

.1 Endress and Hauser 65I.

.2 Or approved equal.

2.10 Level Element and Transmitter, Ultrasonic

.1 No alternates or substitutes will be accepted.

.2 All requests for purchase or quotation shall reference RFP 449-2014 to receive standardized pricing that the City has negotiated with the vendor.

.3 Manufacturer and Models:

.1 Siemens Milltronics Multiranger 100 with XPS 15 sensor.

.2 Siemens Sitrans Probe LU.

.3 These products were standardized by the City via RFP 449-2014.

2.11 Level Transmitter, Submersible Hydrostatic

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Directly measure, indicate, and transmit level of process fluid.

.3 Type: Hydrostatic level measurement.

.2 Service: Wastewater, unless otherwise noted.

.3 Performance:

.1 Range: As noted.

.2 Temperature: –10 to +70°C.

.4 Features:

.1 Ambient Temperature Range (sensor): -10 to +70°C(for 42 mm diameter).

.2 Transmitter Material and Size: stainless steel housing, external diameter of 42 mm.

.5 Accessories: Terminal box IP66/IP67 with GORE-TEX filter.

.6 Signal Interface:

.1 Output: Analog 4 to 20 mA.

.2 Communication: HART 6.0 Protocol.

.7 Manufacturer and model:

.1 Endress and Hauser, Waterpilot FMX21.

.2 Or approved equal.

2.12 Level Switch, Float

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Actuate contact at preset liquid level.

.3 Type: Direct-acting float with an enclosed switch and integral cable.

.2 Service: Wastewater, unless otherwise noted.

.3 Performance:

.1 Set Point: As noted.

.2 Temperature: 0 to 50°C.

.4 Features:

.1 Entire Assembly: Watertight and impact resistant.

.2 Float Material and Size: Polyethylene/foam filled; 114 mm diameter max.

.5 Signal Interface: Switch Contacts: Form C Dry Contact rated 4.5 A continuous at 120 VAC.

.6 Manufacturer and model:

.1 Flygt ENM-10.

.2 Or approved equal.

2.13 Level Controller – Sump Pit

.1 General:

.1 Approvals: CSA or cUL.

.2 Ratings: NEMA 4.

.3 Function: Mechanical Alternator – Contacts alternate closing when operating within first switch set points, when higher set point is reached, both contacts close.

.4 Temperature: -30 to 121°C.

.2 Service: Liquid; water, wastewater, unless otherwise noted.

.3 Switch Contacts:

.1 Isolated, rated 10A continuous at 120 VAC.

.2 Close on liquid rise.

.4 Float:

.1 Center Hole.

.2 Material: Stainless Steel.

.5 Manufacturer and Model:

.1 Square D 9038AW1.

.2 Or approved equal.

2.14 Limit Switch – Clarifier Rake Sensor

.1 General:

.1 Approvals: CSA or cUL.

.2 Ratings: Explosion Proof.

.3 Function: Normally open and normally closed contacts that switch when the lever arm is actuated by the rotating clarifier scum trough rake.

.4 Temperature: -40 to 40°C.

.2 Service:

.1 Rated for wastewater application.

.3 Wiring:

.1 Wiring cable, fittings, and installation to be rated for explosion proof area.

.4 Manufacturer and Model:

.1 Rockwell Automation 802XR with 802MC-W3C lever arm.

.2 Or approved equal.

2.15 Pressure Differential Switch

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Monitor differential pressure and provide contact closure(s) when differential pressure is at the noted set point.

.3 Type: Diaphragm actuated.

.2 Performance:

.1 Set Point: Adjustable over the full range.

.2 Range: The noted set point shall fall between 20 and 80% of the range.

.3 Set Point Repeatability: Plus or minus 1.0% of range span.

.4 Maximum Pressure: Minimum 400% over range.

.3 Features:

.1 Actuator Seal: Buna-N, unless otherwise noted.

.2 Pressure Connection: Nickel-plated brass, unless otherwise noted.

.4 Process Connection: 6.35 mm NPT female connection, unless otherwise noted.

.5 Enclosure: NEMA 4X, unless otherwise noted.

.6 Signal Interface:

.1 Contact Type: SPDT, rated for 10 amps at 120 VAC.

.2 Hermetically sealed switch, if noted.

.7 Manufacturers:

.1 Ashcroft.

.2 United Electric.

.3 Or approved equal.

2.16 Pressure Gauge

.1 General:

.1 Function: Pressure indication.

.2 Type: Bourdon tube.

.2 Performance:

.1 Scale Range: As noted.

.2 Accuracy: Plus or minus 0.50% of full scale.

.3 Features:

.1 Vibration Dampening: Required – Liquid filled or otherwise.

.2 Dial: 114 mm diameter, unless otherwise noted.

.3 Case Material: Black phenolic plastic, unless otherwise noted.

.4 Element Material: Phosphor-bronze, unless otherwise noted.

.5 Throttling Devices.

.1 Pulsation Dampener required, unless otherwise noted.

.2 Brass, unless otherwise noted.

.6 Pointer: Micrometer-adjustable.

.7 Movement: Stainless steel, teflon coated bearings, rotary geared.

.8 Window: Glass, unless otherwise noted.

.9 Socket Materials: brass, unless otherwise noted.

.10 Threaded reinforced polypropylene front ring for easy zero adjustment.

.11 Case Type: Solid front with solid wall between window and element. Rear of case, gasketed pressure relief.

.4 Process Connection:

.1 Mounting: Lower stem, unless otherwise noted.

.2 Size: 13 mm, unless otherwise noted.

.3 Connection Type: Threaded (NPT).

.5 Manufacturers and Products:

.1 Ashcroft.

.2 Or approved equal.

2.17 Pressure Switch

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Monitor pressure and provide contact closure(s) when pressure is at the noted set point.

.3 Type: Diaphragm sealed piston actuator.

.2 Performance:

.1 Set Point: Adjustable over the full range.

.2 Range: The noted set point shall fall between 30% and 70% of the range.

.3 Set Point Repeatability: Plus or minus 1% of range.

.3 Features:

.1 Diaphragm Material: Buna-N, unless otherwise noted.

.2 Pressure Connection: Stainless steel, unless otherwise noted.

.3 Reset: Automatic, unless otherwise noted.

.4 Enclosure: NEMA 4X, unless otherwise noted.

.5 Signal Interface: SPDT, snap action switch, rated for 15 amps at 120 VAC.

.6 Manufacturer and Model:

.1 Ashcroft B-Series,

.2 Or approved equal.

2.18 Pressure Transmitter

.1 No alternates or substitutes will be accepted.

.2 All requests for purchase or quotation shall reference RFP 449-2014 to receive standardized pricing that the City has negotiated with the vendor.

.3 Provide factory installed block and bleed manifold, unless otherwise shown.

.4 Manufacturer and Model:

.1 Siemens Sitrans P 320.

.2 This product was standardized by the City via RFP 449-2014.

2.19 Pressure Transmitter – HVAC

.1 General:

.1 The measurement of room to atmospheric pressure.

.2 Local indication.

.2 Material:

.1 316 Stainless Steel

.3 Signal Interface:

.1 4-20 mA signal.

.4 Accuracy

.1 0.2% of span.

.5 Manufacturer and Model:

.1 Honeywell STD 700 Basic.

.2 Or approved equal.

2.20 Density Meter

.1 General:

.1 Solids analyzers shall measure the concentration of the solids pumped through the process pipeline.

.2 316 stainless steel flangeless wafer-style flow-through in-line transmitter.

.2 Performance:

.1 Measuring range: 0-50% total solids.

.2 Repeatability: +/- 0.01% TS.

.3 Sensitivity: of +/-0.001%TS over the entire range.

.3 Features:

.1 Touch screen display 7 Inch.

.2 Interconnection cable: 10 M.

.3 Measuring range: 0-50% total solids.

.4 Repeatability: +/- 0.01% TS.

.5 Sensitivity: of +/-0.001%TS over the entire range.

.4 Enclosure:

.1 Sensor housing: NEMA 4X.

.5 Power supply: 120VAC.

.6 Signal Interface:

.1 Input: 4 digital programable relay.

.2 Output: 2 4-20 mA.

.3 Communication: Profibus-PA.

.7 Manufacturer and Model:

.1 Valmet TS 4G CSA.

.2 Or approved equal.

2.21 Horn

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Audible alarm.

.2 Performance:

.1 Temperature, Operating: -40 to+65°C.

.2 Sound Output Level: 100 dB nominal at 3 m.

.3 Features:

.1 Dimensions: 111 mm in height and width, and 63.5 mm in depth, for horn and enclosure.

.2 Diaphragm: Stainless steel.

.3 Projector: None, unless otherwise noted.

.4 Enclosure: Type: Corrosion resistant NEMA 4X.

.5 Voltage: 120 VAC, 60 Hz, unless otherwise noted.

.6 Current: less than 0.2 A.

.7 Manufacturers:

.1 Federal Signal 350WB.

.2 Or approved equal.

2.22 Warning Light, Strobe

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Visual alarm.

.3 Type: Rotating reflector or flashing bulb.

.4 Provide means to synchronize flashes within corridors or rooms in the same field of view.

.2 Performance:

.1 Temperature, Operating: -37 to 87°C.

.2 Flash Rate: Minimum 80 per minute.

.3 Light Intensity: 800,000 candela or greater.

.3 Features:

.1 Dome Colour: Red, unless noted otherwise.

.2 Lamp Life: 60,000 hours minimum.

.3 Lamp: LED.

.4 Enclosure:

.1 Type: Corrosion resistant NEMA 4X.

.2 Mounting: Wall bracket, unless otherwise noted.

.3 Indoor/outdoor use.

.5 Voltage: 120 VAC, 60 Hz, unless otherwise noted.

.6 Current: less than 0.2 A.

.7 Manufacturer and model:

.1 Federal Signal SLM100.

.2 Or approved equal.

2.23 Door Switch

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Monitor intrusion of standard door.

.3 Type: Magnetic, indoor use.

.4 Parts: Magnet on door, switch on door frame.

.2 Features:

.1 Type: Aluminum housing with 914 mm (36”) armored cable, unless otherwise noted.

.2 Gap Distance/Type: 76 mm (3”) Make.

.3 Signal Interface.

.1 Voltage: 24 VDC.

.2 Contact Type: SPDT.

.3 Contact Rating: 0.25 A @ 24 VDC.

.4 Connection: 914 mm (36”) lead wires.

.4 Manufacturer and model:

.1 GE Security 2507A.

.2 Or approved equal.

2.24 Motion Detector

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Monitor occupancy.

.3 Type: Dual Technology Ultrasonic and Passive Infrared.

.2 Features:

.1 Type: plastic Casing.

.2 Coverage: 150 square meter (1600 square feet).

.3 Mounting: Mounting base provided.

.4 Operating temperature: 0° to 40°C

.5 Relative humidity: 0% to 95%.

.6 Power Requirements: Voltage: 24 VDC.

.3 Signal Interface.

.1 Voltage: 24 VDC.

.2 Contact Type: SPDT.

.3 Contact Rating: 500 mA @ 24 VDC.

.4 Manufacturer and model:

.1 Hubbell LODTRP.

.2 Or approved equal.

2.25 Grinder Pump Level Control Switch

.1 General:

.1 Provide an integral alternating pump control switch rated for wastewater applications.

.2 The pump controller will activate the output contacts based on the float position.

.3 Configure the start and stop height of the pump controller based on the sump pit high and low/empty levels.

.2 Manufacturer and Model:

.1 Pedastal Mounted mechanical alternator Square D Pumptrol 9038AG1C complete with float kit Schneider Electric 9049A6.

.2 Or approved equivalent.

2.26 Gas Detection System

.1 General:

.1 Provide and install a gas detection system for the Work.

.2 Standard CSA C22.2 No. 152 – Combustible gas detection instruments.

.2 Performance Criteria:

.1 All devices supplied under this Section shall be the product of a single Manufacturer.

.2 Provide a multi-point wired systems for combustible and toxic gas monitoring and control.

.3 The gas detection system shall consist of sensor transmitter, Monitor Panel, connection to BMS and PCS, and all necessary hardware/software to make the system operational.

.1 For life safety measurements the gas detection system connection to the BMS shall be direct to reduce points of failure.

.3 Configuration, Components and Features:

.1 Field Sensors and Transmitters:

.1 Provide all gas detection equipment and accessories required and provide the Instrument Specification Sheet (refer to Section 17994 – Instrument Specification Sheets).

.2 Solid State Infrared Combustible Gas transmitter/sensor, type 316 stainless steel, tamper-resistant, mounted as detailed in Manufacturer's installation instructions, and Site tests.

.1 Sensor Range will be 0 to 100% LEL for Methane.

.2 Sensor Range will be 0 to 50 ppm Hydrogen Sulphide.

.3 Sensor Range will be xxx to xxx for NO.

.4 Sensor Range will be xxx to xxx for CO.

.5 Sensor Range will be xxx to xxx for O2.

.6 Refer to Manitoba regulations, the Warning and Alarm values for gas concentrations shall be based on the threshold limit values (TLV) for each gas as recommended by the American Conference of Governmental Industrial Hygienists © for time weighted average (TWA), STEL (short term exposure limit), and exposure ceiling for each gas type.

.3 Display with gas type and levels (minimum 90 mm LCD). Integral diagnostics with plain text messaging.

.4 Gas level data logging, sensor condition reporting, and three alarm levels.

.5 Bluetooth connectivity for configuration, interrogation, and troubleshooting.

.6 Self-check every six (6) hours.

.7 The sensor and housing shall be rated for Zone 2 Hazardous Environment applications per the Canadian Electrical Code (CEC).

.8 Multipoint panel to monitor sensors:

.1 Panel shall incorporate individual controllers for each sensor shown and shall be within a housing rated for Zone 2 Hazardous Environment applications per the Canadian Electrical Code.

.2 If any toxic or combustible gas level exceeds the preset limits, the discrete alarm status lights shall activate with the associated relay contacts and interface with the PCS/BMS automation system to control equipment as per design (example: start the emergency ventilation).

.3 Front panel shall incorporate LED lights to indicate power on, high alarm, low alarm, and sensor failure.

.9 Panel shall also have audible alarm and silence/reset pushbuttons on doors. Visual indicators for sensor failure.

.10 Provide monitoring points of the gas detection system to the PCS/BMS automation system. Monitoring points shall include; gas concentration, warning, threshold, alarm threshold, and instrument fault.

.2 Provide spare contacts for remote monitoring of various gas level alarms by the BMS/PCS (separate alarm outputs for each monitored gas) and Alarm Beacons and Horns:

.1 Alarm beacons and horns shall operate on 120 VAC, 60 Hz controlled by the gas detection system.

.2 Provide rotating alarm beacon in hazardous locations.

.3 Alarm beacons and horns located in outdoor locations shall be of corrosion resistant type NEMA 4X construction.

.4 Provide audible alarm and flashing red light at each interior and exterior entrance to the building complete with red lamacoid 200 mm x 150 mm (8-inch x 6 inch) label identifying the alarm.

.5 Provide a Zone 2 rated audible alarm and flashing red light at interior of monitored space complete with red lamacoid 200 mm x 150 mm (8-inch x 6 inch) label identifying the alarm.

.3 Calibration Equipment:

.1 Each gas monitoring sensor shall be fitted with a calibration cap/fitting to facilitate calibration and bump testing using bottled zero reference and span gas.

.2 Where gas monitoring sensors are not readily accessible and/or are mounted at greater than 2m above finished floor, the sensor shall be fitted with calibration gas tubing from the sensor location to a calibration station located at 1.5m above finished floor and as close as practicable to the sensor.

.3 For each type of gas being monitored, provide a one-year supply (from substantial completion) of zero reference and span gas based on average gas consumption required for monthly calibration of each gas monitoring sensor.

.4 Manufacturers and products:

.1 Acceptable Manufacturers:

.1 Field Sensors and Transmitters:

.1 MSA, this product was standardized by the City via RFP 449-2014.

.2 Alarm Beacons and Horns:

.1 Edward, LED type Model AdaptaBeacon.

.2 Crouse-Hinds, LED type.

.3 Or approved equivalent.

2.27 Process Fluid Analyzer

.1 General

.1 Provide and install process fluid analyzers for the work.

.2 Configuration, Components and Features:

.1 Equipment Components:

.1 All devices supplied under this Section shall be the product of a single Manufacturer.

.2 Analyzers Primary Elements:

.1 Provide all analyzers primary elements required and provide the Instrument Specification Sheets (ISS; refer to Section 17994 – Instrument Specification Sheets).

.2 Instrument Manufacturer to confirm the selection of materials of primary elements that are in contact with specified process fluid are inert to the effects of the process fluid.

.3 Analyzers:

.1 Provide all microprocessor-based analyzers required and provide the ISS (refer to Section 17994 – Instrument Specification Sheets).

.2 Analyzers with Profibus communications shall be provided if available for the specified process measurement.

.3 Where a required analyzer is not available with Profibus communications, provide analyzers with integral 4 to 20 mA output "two-wire type" with operating power derived from the signal loop. Transmitter shall support an external load of up to 600 Ω or greater with a loop power supply of 24 VDC. Analyzers shall have adequate power output to drive all devices associated with signal loop. Provide signal boosters as required to achieve adequate signal strength.

.4 Analyzer’s 4 to 20 mA output shall be galvanically isolated from the process and the analyzer case.

.5 Analyzer and/or primary element enclosures or housings shall be, as a minimum, rated NEMA Type 4; where located outdoors or in areas specified as corrosive, enclosures shall meet NEMA Type 4X requirements.

.6 Provide transmitters with local indication scaled in engineering units and include a lamacoid label indicating the engineering units. Mount the transmitter such that the output indication is correctly oriented and visible from the normal operating floor position.

.3 Manufacturers and Products:

.1 Dissolved Oxygen:

.1 Oxyguard.

.2 Royce Technologies.

.3 Or approved equivalent.

.2 For Total suspended solids (TSS):

.1 Royce Technologies.

.2 BTG.

.3 Or approved equivalent.

.3 For PH levels:

.1 HACH.

.2 Or approved equivalent.

2.28 Spare Parts

.1 Provide spare parts that are identical to and interchangeable with similar parts installed and in accordance with Schedule 18 Technical Requirements and the following:

.1 One (1) calibration kit for each type of gas sensor, including a one (1) year supply of gases to calibrate sensor.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Installation

.1 Install equipment and components so that Manufacturers and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with Manufacturer's recommended methods, procedures, and instructions.

.3 Support field-mounted panels, transmitters, and sensors on pipe stands or channel brackets.

.4 Electrical:

.1 Install communication wiring in conduit or utilizing ACIC cabling if shown on the Drawings.

.1 Provide complete conduit/cable system to link instrumentation and the control panel(s).

.2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.3 Maximum conduits fill not to exceed 40%.

.4 Design Drawings do not show conduit layout.

3.3 Temperature Sensors

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Duct installations:

.1 Do not mount in dead air space.

.2 Locate within sensor vibration and velocity limits.

.3 Securely mount extended surface sensor used to sense average temperature.

.4 Thermally isolate elements from brackets and supports to respond to air temperature only.

.5 Support sensor element separately from coils or filter racks.

.4 Averaging duct type temperature sensors.

.1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from the one above it. Continue until complete cross-sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.

3.4 Pressure Switches and Transmitters

.1 Install in a manner to allow easy removal of the transducer and cable assembly for maintenance purposes.

.2 Survey and document the exact elevation of the pressure transmitter installation.

3.5 Differential Pressure Transmitter

.1 Install a valve and tee on each line coming into transmitter to allow tubing to be blown out.

END OF SECTION