PART 1 – GENERAL

1.1 Related Sections

.1 This section covers items common to sections of Division 26.

1.2 References

.1 Canadian Standards Association (CSA International)

.1 Current adopted edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V, latest edition

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.2 EEMAC Y1-1-1955, Equipment Green Colour for Outdoor Electrical Equipment.

.3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, latest edition.

1.3 Definitions

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 Design Requirements

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels for control items in English.

1.5 Submittals

.1 Submit for review single line electrical diagrams.

.2 Shop drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Provinces of Manitoba, Canada.

.2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

.3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.5 Submit copies of 600 x 600 mm minimum size drawings and product data to authority having jurisdiction.

.6 If changes are required, notify Contract Administrator of these changes before they are made.

.3 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to site.

.1 Submit test results of installed electrical systems and instrumentation.

.2 Permits and fees: in accordance with General Conditions of contract.

.3 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.

.4 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Contract Administrator.

.4 Manufacturer's Field Reports: submit to Contract Administrator manufacturer's written report, within three days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 Quality Assurance

.1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial apprentices' program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

1.7 Delivery, Storage and Handling

.1 Material Delivery Schedule: provide Contract Administrator with schedule within two weeks after award of Contract.

1.8 Waste Management and Disposal

.1 Separate waste materials for reuse and recycling.

.2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling.

.3 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Contract Administrator.

.4 Fold up metal banding, flatten and place in designated area for recycling.

.5 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.6 Place materials defined as hazardous or toxic waste in designated containers.

.7 Ensure emptied containers are sealed and stored safely for disposal away from children.

.8 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.9 Do not dispose of preservative treated wood through incineration.

.10 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.

.11 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by Contract Administrator.

1.9 Care, Operation and Startup

.1 Instruct Contract Administrator in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer 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 will aspects of its care and operation.

1.10 Operating and Maintenance Manuals

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 An electronic draft copy of the operation and maintenance manuals shall be submitted (word version, if available) two (2) weeks prior to Substantial Performance of the Work for review and comments. Submission of individual data will not be accepted unless directed by the City. Make changes and incorporate the Contract Administrator’s review comments as required and re- submit as directed by the Contract Administrator.

.3 After review and acceptance by the City, five (5) hard copies and one electronic (PDF) copy of the final operation and maintenance manuals shall be submitted. The final electronic copy shall be provided on a flash memory drive.

.4 Prepare operation and maintenance manuals using personnel experienced in maintenance and operation of described products.

.5 Operation and maintenance instructions and technical data to be sufficiently detailed with respect to design elements, construction features, component function, correct installation procedure, and maintenance requirements to permit effective start-up, operation, maintenance, repair, modification, extension, and expansion of any portion or feature of installation. Technical data to be in the form of approved Shop Drawings, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists.

.6 For the guidance of the City’s operation and maintenance personnel, the Contractor shall prepare operation and maintenance manuals for the Work, describing in detail the construction of each part of the Work and the recommended procedure for operation, servicing, and maintenance.

.7 All instructions in these operation and maintenance manuals shall be in simple language to guide the City in the proper operation and maintenance of this installation.

.8 Format

.1 Organize data as instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf, 8.5” by 11” with spine

and face pockets.

.3 When multiple binders are used, correlate data into related consistent groupings.

.1 Identify contents of each binder on spine and face.

.4 Cover: identify each binder with title sheet labelled "Operation and Maintenance Instructions", and containing project name and date, facilities covered in the manual, City's Contract number, the name and address of the Contractor, and the issue date.

.5 Arrange content by Division and Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: manufacturer's printed data or type written data.

.8 Drawings: provide with reinforced punched binder tab.

.1 Bind in with text; fold larger drawings to size of text pages.

.9 Content

.1 For each operation and maintenance manual volume, provide an overall title sheet that includes:

.1 The title "Operation and Maintenance Instructions";

.2 Project name and date;

.3 Facilities covered in the manual;

.4 City's Contract number;

.5 Addresses and telephone numbers of Consultant and Contractor with name of responsible parties; and

.6 Schedule of products and systems, indexed to content of volume;

.2 For each operation and maintenance manual volume, provide an overall list of contents which includes the contents for all the operation and maintenance manual volumes.

.3 In addition to operation and maintenance information required in the individual Specification sections, include:

.1 Brochures/catalogue excerpts of all components of the Work.

.2 Product data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.3 Documentation of all test results.

.4 Complete set of equipment and assembly drawings.

.5 Installation, start-up, individual equipment operation and maintenance manuals.

.6 Shop Drawings and cutsheets of all equipment and materials.

.1 Do not utilize the cutsheet and Shop Drawing submittals that were sent to the Contract Administrator for review as these may contain inaccurate information and markups. Only provide cutsheets and Shop Drawings representing the final materials and equipment supplied, without any markups from the Contract Administrator.

.2 For generic cutsheets and Shop Drawings that list multiple model numbers or configurations, place a rectangle around

the specific model that was supplied and cross out other models.

.7 Sections for the record Drawings and as-built Drawings of all installations. Drafted record Drawings and as-built Drawings of size 432x279 mm (11 x 17") will be inserted by the Contract Administrator, based on the as-built Drawings marked up by the Contractor.

.8 Names, addresses, and telephone numbers of all major Subcontractors and suppliers.

.9 Certificate of Inspection from the inspection authority.

.10 Testing and commissioning documentation.

.11 Warranty certificate, signed and dated.

.12 Written process narratives outlining the programming of the PLC systems for individual processes or systems.

.13 Final instrumentation set points including but not limited to:

.1 Units

.2 Scale

.3 Alarm points (low-low, low, high, high-high)

.4 4-20 mA settings

.4 General catalog data for the operations and maintenance manual is unacceptable. If manufacturer's specification sheets are generalized in any way, they shall be clearly marked to show exactly which item has been supplied, and the project designation for that item (e.g., LT-S951) is to be noted on manufacturer's specification sheet which includes all details for this unit, including complete model number, serial number, and construction and performance data.

.4 Equipment and Systems

.1 For each item of equipment and each system include description of unit or system, and component parts.

.1 Give function, normal operation characteristics, and limiting conditions.

.2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.

.1 Include regulation, control, stopping, shut-down, and emergency instructions.

.2 Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble- shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings,

and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Additional requirements: as specified in individual Specification sections.

.5 Materials and Finishes

.1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.

.1 Provide information for re-ordering custom manufactured products if applicable.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional requirements: as specified in individual Specifications sections.

.10 Operating instructions have to be laminated and placed within the station next to its equipment. Operating instructions to be reviewed by Contract Administrator prior to laminating.

.11 Post instructions where directed.

.12 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.13 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.11 As-Built / Record Drawings

.1 Accurately mark-up deviations from the Contract caused by the Site conditions and changes ordered by the Contract Administrator. Update daily.

.2 The Contractor shall keep one 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 the as-built and record Drawings. As the Work on-site proceeds, the Contractor shall clearly mark up the white prints in red pencil all the Work which deviated from the original Contract. Identify Drawings as "Project Record Copy". Maintain in good condition and make available for inspection on-site by the Contract Administrator at all times.

PART 2 – PRODUCTS

2.1 Materials And Equipment

.1 Provide material and equipment.

.2 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from Electrical Inspections Department before delivery to site.

.3 Factories assemble control panels and component assemblies.

2.2 Electric Motors, Equipment and Controls

.1 Provide all power and control wiring and connections including mechanical control wiring as specified on mechanical and electrical drawings.

.2 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.3 Control wiring and conduit: in accordance with Section 250501 – Controls: General Requirements except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.3 Warning Signs

.1 Warning Signs: in accordance with requirements of Electrical Inspection Department and Contract Administrator.

.2 Decal signs, minimum size 175 x 250 mm.

2.4 Wiring Terminations

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.5 Equipment Identification

.1 Identify electrical equipment with nameplates and labels as follows:

.1 Nameplates: lamacoid 3 mm thick plastic engraving sheet, matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES			
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	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

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

.4 Allow for minimum of twenty-five (25) letters per nameplate and label.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Identify equipment with Size 3 labels engraved with equipment tag.

.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.8 Terminal cabinets and pull boxes: indicate system and voltage.

.9 Transformers: indicate capacity, primary and secondary voltages.

2.6 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings, using Electrovert Type Z cable markers (or equal in accordance with B7), on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

.5 Use number coded wires in control cables, matched throughout system. Identify conductors with permanent indelible identifying markings, numbered on both ends.

.6 Use number coded pairs in instrument cables, matched throughout system. Pairs shall be also colour coded black and white for polarity indication. Identify conductor pairs with permanent identifying markings at both ends.

2.7 Finishes

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

.1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.

.2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

PART 3 – EXECUTION

3.1 Installation

.1 Complete installation in accordance with the current edition of the Canadian Electrical Code, CSA C22.1, except where specified otherwise.

.2 Overhead and underground systems to be installed in accordance with the current edition of CSA C22.3 No.1 except where specified otherwise.

.3 Perform all work in accordance with local codes and bylaws.

3.2 Nameplates and Labels

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 Conduit and Cable Installation

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: PVC, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 Location of Outlets

.1 Locate outlets in accordance with Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings, and as shown on the drawings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 Mounting Heights

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation. Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1400 mm.

.2 Wall receptacles:

.1 General: 300 mm.

.2 Above top of continuous baseboard heater: 200 mm.

.3 Above top of counters or counter splash backs: 175 mm.

.4 In mechanical rooms: 1400 mm.

.3 Panelboards: as required by Code or as indicated.

3.6 Co-ordination of Protective Devices

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 Field Quality Control

.1 Load Balance:

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct and pay for the following tests in accordance with Section E9 – "Shop Drawings" of this Bid Opportunity.

.1 Point to point wire continuity test for all conductors.

.2 Power generation and distribution system including phasing, voltage, grounding and load balancing.

.3 Circuits originating from branch distribution panels.

.4 Test resistance to ground of the completed grounding electrode.

.5 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.4 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 – SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 – QUALITY ASSURANCE.

.5 Submit test results for Contract Administrator's review.

3.8 Cleaning

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

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

END OF SECTION

PART 1 – GENERAL

1.1 Section Includes

.1 Materials and installation for wire and box connectors.

1.2 References

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, latest edition

.2 CSA C22.2 No.65, Wire Connectors, latest edition

PART 2 – PRODUCTS

2.1 Materials

.1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Clamps or connectors for armoured cable and flexible conduit as required to: CAN/CSA-C22.2 No.18.

PART 3 – EXECUTION

3.1 Installation

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

PART 1 – GENERAL

1.1 Related Sections

.1 Section 26 05 00 – Common Work Results - Electrical.

.2 Section 260520 – Wire and Box Connectors - 0 - 1000 V.

.3 Section 260534 – Conduits, Conduit Fastenings and Conduit Fittings.

1.2 References

.1 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables, latest edition

.2 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable, latest edition

1.3 Product Data

.1 Submit product data in accordance with Section 26 05 00 – Common Work Results – Electrical.

PART 2 – PRODUCTS

2.1 Building Wires

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 1 kV TECK90 Power Cable

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated. (#12 AWG minimum where not indicated)

.3 Insulation:

.1 Type: ethylene propylene rubber.

.2 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material.

.7 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 300 mm centers.

.3 Threaded rods: 6 mm dia. to support suspended channels.

.8 Connectors:

.1 Watertight, explosion-proof approved for TECK cable.

2.3 600 V TECK90 Control Cable

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated. (#14 AWG minimum where not indicated)

.3 Insulation:

.1 Type: ethylene propylene rubber.

.2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material.

.7 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 300 mm centers.

.3 Threaded rods: 6 mm dia. to support suspended channels.

.8 Connectors:

.1 Watertight, explosion-proof approved for TECK cable.

2.4 300 V Instrument Cable – Armoured

.1 Conductors: #16 AWG, 7 strand concentric lay, Class B tinned copper, twisted pairs/triads.

.2 Insulation: PVC TW75, 75 °C Wet, 105 °C Dry (-40 °C), 300 Volt.

.3 Twisted pairs/triads cabled with staggered lays.

.4 Shielding: Individual twisted pair(s)/triads Aluminum/mylar shield with ST drain wire, 100 % shield. Overall aluminum/mylar shield with ST drain wire. Individual drain wires one size smaller than conductor AWG. Overall drain wire the same AWG as conductors.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material (90 °C, -40 °C).

.7 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 300 mm centers to prevent cable from drooping.

.8 Connectors:

.1 Watertight, explosion proof approved for armoured cable.

2.5 Type RW90 Conductor

.1 In accordance with CSA C22.2 No.38

.2 Circuit conductors shall be concentric stranded soft copper, size as indicated (#12 AWG minimum where not indicated).

.3 Insulation to be chemically cross-lined thermosetting polyethylene rated type RW90 XLP, 600V

.4 Suitable for installation in temperatures down to minus 40 °C.

.5 90 °C conductor operating temperature.

2.6 Type TEW Conductor

.1 Circuit conductors shall be stranded soft copper, as per ASTM B-3 and B-8.

.2 Insulation to be thermoplastic compound meeting the requirements of Canadian Standards Association Type TEW, per CSA 22.2 Part 1, No.127.

.3 Insulation rated to 600 Volts.

.4 Suitable for installation in temperatures down to minus 40 °C

.5 105 °C conductor operating temperature.

.6 Use #16 AWG for PLC cabinet internal wiring.

2.7 Wiring Identification

.1 Provide wiring identification in accordance with Section 26 05 01 – Common Work Results – For Electrical.

PART 3 – EXECUTION

3.1 Installation of Building Wires

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

3.2 Installation of TECK Cable 0 - 1000 V

.1 Install cables.

.1 Group cables wherever possible on channels.

.2 Provide standoff cable clamp when installed in Category 2 wet locations.

.2 Install cable in trenches in accordance with Section 26 05 43.01 – Installation of Cables in Trenches and in Ducts.

.3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000V.

3.3 Installation Of Armoured Cables

.1 Group cables wherever possible.

.2 Provide a **standoff cable clamp** when installing cables in chamber areas, in-pipe locations, and Category 2 wet locations

.3 Install cable in trenches in accordance with Section 26 05 43.01 – Installation of Cables in Trenches and in Ducts.

.4 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors - 0 - 1000V.

3.4 Installation of Control Cables

.1 Install control cables in conduit.

.2 Ground control cable shield at one end only.

3.5 Installation of OEM Control Cable

.1 Provide a **standoff cable clamp** when installing cables in chamber areas, in-pipe locations, and Category 2 wet locations.

3.6 Direct Burial Installation of Cables

.1 After sand bed is in place, lay cables maintaining 75mm clearance from each side of trench to nearest cable. Do not pull cable into trench.

.2 Provide offsets for thermal action and minor earth movements. Offset cables 150mm for each 60m run, maintaining minimum cable separation and bending radius requirements.

.3 Underground cable splices not acceptable.

.4 Minimum permitted radius at cable bends for rubber or plastic, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

.5 Spacing of feeder cables:

.1 As shown in drawings.

.6 After sand protective cover is in place, install continuous rows of pressure treated planks to cover length of run.

.7 Repair, replace or make good all trenching to asphalt, concrete, gravel or sod surfaces to satisfaction of City.

END OF SECTION

PART 1 – GENERAL

1.1 Related Sections

.1 Section 26 05 00 – Common Work Results - Electrical

1.2 References

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding, latest edition

.2 Canadian Standards Association (CSA International)

.1 Current adopted edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.3 City of Winnipeg

.1 Winnipeg Electrical By-law including Technical Interpretations, latest edition

1.3 Waste Management and Disposal

.1 Separate and recycle waste materials.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility as approved by Contract Administrator.

.5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 – PRODUCT

2.1 Equipment

.1 Clamps for grounding of conductor: size as required.

.2 Grounding conductors: stranded copper, tinned, soft annealed, size as indicated.

.3 Rod electrodes: copper clad steel 19 mm diameter by 3 m long.

.4 Insulated grounding conductors: green, type RW90.

.5 Ground bus: copper complete with insulated supports, fastenings, connectors.

.6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

PART 3 – EXECUTION

3.1 Installation General

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Use mechanical connectors for grounding connections to equipment provided with lugs.

.5 Soldered joints not permitted.

.6 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.7 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.8 Connect building structural steel and metal siding to ground by welding copper to steel.

.9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.10 Bond single conductor, metallic armoured cables to cabinet at supply end, and load end.

3.2 System And Circuit Grounding

.1 Install system and circuit grounding connections to neutral of 240 V system

3.3 Equipment Grounding

.1 Install grounding connections to typical equipment included in, but not necessarily limited to the following list: service equipment, duct systems, control panels, building steel work, distribution panels and outdoor lighting.

3.4 Grounding Bus

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0 AWG.

3.5 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Contract Administrator and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

PART 1 – GENERAL

1.1 References

.1 Canadian Standards Association (CSA)

.1 Current adopted edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware, latest edition

.3 CSA C22.2 No. 45, Rigid Metal Conduit, latest edition

.4 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit, latest edition

1.2 Product data

.1 Submit product data for non-metallic raceways in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2– PRODUCTS

2.1 Electrical Metallic Tubing (EMT)

.1 Conduit: electrical metallic tubing with wall thickness less than rigid conduit, hot dipped galvanized with corrosion resistant and friction reducing coating on inside, to CAN/CSA C22.2 No. 83.

.2 Connectors and fittings to be rain-tight type.

2.2 Rigid Metal Conduit

.1 Conduit: rigid galvanized steel, heavy wall, with threaded joints and connections to CAN/CSA C22.2 No. 45.

.2 Connectors: liquid and dust tight with insulated throat.

.3 Rigid conduit fittings: outlet boxes, junction boxes, LB's and other fittings cast metal with factory applied epoxy paint.

.4 Expansion joints: rigid conduit type with external bonding jumper.

.5 Ground bushing: threaded type with insulated throat.

2.3 Rigid PVC Conduit

.1 Conduit: rigid non-metallic conduit of unplasticized polyvinyl chloride to CAN/CSA C22.2 No. 211.1.

.2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied and recommended by conduit manufacturer.

.3 Fire rating: FT4.

.4 Expansion joints: as supplied and recommended by conduit manufacturer, complete with two O-rings.

2.4 High Density Polyethylene Conduit

.1 General Information

.1 Product Name: DL Smooth Out/Ribbed In Conduit

.2 Material: High Density Polyethylene (HDPE)
.3 Color: Orange
.4 Wall Type: SDR 11
.5 Size: 50mm diameter
.6 Installation Type: Directional Bore
.7 Manufacturer: Dura-Line or approved equivalent.

.2 Compliance: Meets or exceeds CSA C22.2 No. 327-18.

.3 Markings: Permanent marking along the conduit includes material, relevant standards, production info, and sequential feet or meter markings. Custom options are available.

2.5 Conduit Fastenings

.1 One hole steel straps to secure surface conduits 50 mm and smaller. Two-hole steel straps for conduits larger than 50 mm.

2.6 Conduit Fittings

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

2.7 Fish Cord

.1 Polypropylene.

PART 3 – EXECUTION

3.1 Installation

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Surface mount conduits.

.3 Use rigid metallic conduit, complete with watertight fittings, for all power wiring inside electrical cabinets.

.4 Use PVC coated rigid galvanized conduit, complete with for all control wiring in hazardous area.

.5 Install conduit sealing fittings in hazardous areas. Fill with compound.

.6 Minimum conduit size for lighting and power circuits: 19 mm.

.7 Bend conduit cold. Replace conduit if kinked or flattened more than $1/10^{th}$ of its original diameter.

.8 Mechanically bend steel conduit over 19 mm dia.

.9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.10 Install fish cord in empty conduits.

.11 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.12 Dry conduits out before installing wire.

.13 Connect conduit to equipment securely to maintain continuity for the purpose of bonding to ground.

.14 Seal conduits with duct seal where they run between heated and unheated areas. Use Dow Corning 3-6548 sealant to seal openings where conduits, cables, or cable trays pierce fire separations. Ensure all conduits entering or leaving hazardous classified areas are sealed with approved seals.

.15 EYS seal conduits after explosion-proof boxes leading to unclassified areas. Apply Chico compound to prevent the migration of hazardous gases only after all tests and commissioning are successfully completed.

.16 Provide for expansion and contraction of the conduit system.

.17 Install ground wire in all conduits. Size ground wire as per CEC Table 17.

3.2 Surface Conduits

.1 Run parallel or perpendicular to building lines.

.2 Run conduits in flanged portion of structural steel.

.3 Group conduits wherever possible on suspended or surface channels.

.4 Do not pass conduits through structural members except as indicated.

.5 Provide **standoff conduit bracket** when installed in Category 2 wet locations.

3.3 Concealed Conduits

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.4 Conduits In Cast-In-Place Concrete

.1 Locate to suit reinforcing steel. Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete.

.3 Install sleeves where conduits pass through slab or wall.

.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Do not place conduits is slabs in which slab thickness is less than 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

3.5 Conduits Underground

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.6 Horizontal Directional Drilling of High Density Polyethylene.

.1 Site Preparation:

.1 Locate Existing Underground Utilities.

.2 Identify and mark the location of existing underground utilities to avoid damage.

.3 Coordinate with utility companies as required.

.2 Conduct a Site Survey:

.1 Assess the site conditions, including soil type and potential obstacles.

.3 Provide Digging Holes:

.1 Provide digging holes at the entry point, turning point and exit point of the bore. Digging holes shall be done by soft dig.

.4 Restore the Site:

.1 Restore the site after the pipe installation. The site should be returned to its original condition, minimizing surface disruption.

END OF SECTION

PART 1 – GENERAL

1.1 References

.1 CSA International

.1 CAN/CSA-Z809, Sustainable Forest Management, latest edition.

.2 Insulated Cable Engineers Association, Inc. (ICEA)

1.2 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect cables from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 – EXECUTION

2.1 Direct Burial of Cables

.1 After sand bed is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable.

.1 Do not pull cable into trench.

.2 Include offsets for thermal action and minor earth movements.

.1 Offset cables 150 mm minimum for each 60 m run, maintaining minimum cable separation and bending radius requirements.

.3 Make termination only as indicated leaving 0.6 m minimum of surplus cable in each direction.

.4 Underground cable splices not acceptable.

.5 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable or in accordance with manufacturer's written recommendations; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

.6 Cable separation:

.1 Maintain 75 mm minimum separation between cables of different circuits.

.2 Maintain 300 mm minimum horizontal separation between low and high voltage cables.

.3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.

.4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.

2.2 Cable Installation in Ducts

.1 Install cables as indicated in ducts.

.2 Do not pull spliced cables inside ducts.

.3 Install multiple cables in duct simultaneously.

.4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.7 After installation of cables, seal duct ends with duct sealing compound.

2.3 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform tests using qualified personnel.

.1 Include necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds.

.1 Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Acceptance Tests:

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.3 High Potential (hipot) Testing.

.4 Conduct hipot testing at 1000VDC for all 600V rated cables and 500VDC for all 300V rated cables for a duration of one (1) minute.

.6 Provide the Contract Administrator with list of test results showing location at which each test was made, circuit tested and result of each test.

.7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

2.4 Cleaning

.1 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

2.5 Protection

.1 Repair damage to adjacent materials caused by cables installation.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 26 05 00 – Common Work Results - Electrical

1.2 Reference Standards

.1 Canadian Standards Association (CSA International)

.1 Latest adopted edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 CSA C22.2 No.29, Panelboards and Enclosed Panelboards, latest edition

.2 City of Winnipeg

.1 Winnipeg Electrical By-law including Technical Interpretations, latest edition

1.3 Action And Informational Submittals

.1 Submit in accordance with Section 26 05 00 – Common Work Results – Electrical.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Include on drawings:

.1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 Closeout Submittals

.1 Submit in accordance with Section 26 05 00 – Common Work Results – Electrical.

.2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store and protect panelboards from nicks, scratches, and blemishes.

.2 Replace defective or damaged materials with new.

PART 2 GENERAL

2.1 Panelboards

.1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 208 V panelboards: bus and breakers rated as indicated on drawings.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Minimum of 2 flush locks for each panel board.

.6 Two keys for each panelboard and key panelboards alike.

.7 Copper bus with neutral of equal ampere rating of mains.

.8 Mains: suitable for bolt-on breakers.

.9 Trim with concealed front bolts and hinges.

.10 Trim and door finish: baked enamel.

.11 Isolated ground bus.

.12 Include grounding busbar with minimum 3 terminals for bonding conductor equal to breaker capacity of the panel board.

2.2 Breakers

.1 Breakers: to Section 26 28 16.02, Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

2.3 Surge Protection Device

.1 SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449, latest edition).

.2 Voltage: Refer to drawings.

.3 Maximum Continuous Operating Voltage (MCOV): The MCOV shall not be less than 115% of the nominal system operating voltage.

.4 The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

.5 Protection Modes – The TVSS must protect all modes of the electrical system being utilized. The required protection modes are:

.1 1Ø, 3W Wye System: L-L, L-N, L-G, and N-G

.6 Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 80kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 80kA shall be rejected.

.7 ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

.1 L-N, L-G, N-G:

.1 120/240 V: 700V

.2 L-L:

.1 120/240 V: 1200V

.8 SPD Design

.1 Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPD containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPD requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPD requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

.2 Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable TVSS modules shall not be accepted.

.3 Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method.

.4 Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall utilize low impedance conductors.

.5 Monitoring Diagnostics – Each TVSS shall provide the following integral monitoring options:

.1 Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of each protection mode on each phase.

.6 The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

.7 Overcurrent Protection

.1 The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur, that would cause them to enter a thermal runaway condition.

.9 Approved Manufacturer: Total Protection Solution Service Track ST080 or approved equal.

2.4 Ground Fault Relay (TT-G681)

.1 Measurement:

.1 RMS measurements

.2 Digital display with real-time readings

.2 Adjustable Pickup Value: 10 mA to 10 A

.3 Time Delays:

.1 Pickup delay

.2 Startup delay

.3 Delay on reset

.4 Outputs:

.1 Two Form-C (SPDT) relay outputs, configurable for pre-warning or main alarm

.5 Current Transformer:

.1 Connects to a single external current transformer

.6 Power Supply:

.1 RCM420-D-1: 70-300 VDC

.7 Display:

.1 Digital display for real-time measurement values

.8 Current Transformer:

.1 CTAC35

.9 . Configuration:

.1 On-board test and reset buttons

.2 Configurable via display and push buttons

.10 Operation:

.1 Latching or non-latching

.2 Normally energized (failsafe) or de-energized (non-failsafe) operation

.11 Acceptable Products:

.1 Bender LINETRAXX RCM420.

2.5 Power Fail Relay

.1 Basis of Design: LITTLEFUSE HLVA6I23 complete with socket and DIN rail adapter

.2 Location and mounting:

.1 Electrical Enclosure: Equipment to be installed in a hinged box with a ¼ turn latch, box to be mounted on enclosure backboard.

.3 Features:

.1 1-phase over and under voltage, phase sequence, phase loss and asymmetry monitoring.

.2 Detects when all phases are present and have the correct sequence (phase angle).

.3 Detects if all the phase-phase or phase-neutral voltages are within the set limits.

.4 Detects if asymmetry is below set value.

.5 Separately adjustable set points.

.6 Separately adjustable delay functions (0.1 to 30 sec).

.7 Output: 30 Amp relay SPDT.

.8 LED indication for relays, fault, and time delay status.

2.6 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00, Common Work Results - Electrical.

.2 Nameplate for each panelboard size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

PART 3 EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed Departmental Representative.

3.2 Installation

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 00, Common Work Results for Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

.6 Surge Protection Device

.1 The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and subfeed breaker options.

.2 The SPD shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.

.3 The panelboard shall be capable of re-energizing upon removal of the SPD.

.4 Utilize a breaker, appropriately rated as directed by the SPD manufacturer, to connect the SPD to the panelboard. The SPD shall be located directly adjacent to the circuit breaker.

.5 Install SPD as shown on the drawings.

.1 Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor

length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

.7 Ground Fault Relay

.1 Install ground fault relay in PLC control panel as indicated on drawing.

.2 Install ground fault relay on DIN rail.

.3 Refer to manufacturer installation instructions.

.8 Power Fail Relay

.1 Locate power fail relay as indicated on drawing.

.2 Install power fail relay in a Type 2 enclosure, complete with a DIN rail and a LittleFuse DIN rail adapter (Model No. P1023-20). Size the enclosure as required.

3.3 Cleaning

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.4 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by panelboard installation.

END OF SECTION

PART 1– GENERAL

1.1 Related Sections

.1 Section 26 05 00 – Common Work Results

1.2 References

.1 Canadian Standards Association (CSA International)

.1 Latest adopted edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 City of Winnipeg

.1 Winnipeg Electrical By-law including Technical Interpretations, latest edition

1.3 Shop Drawings and Product Data

.1 Indicate detail construction, dimension, capacities, weights and electrical performance characteristics of equipment or material.

PART 2– PRODUCT

2.1 Materials - General

.1 NEMA 4X rated enclosure for all locations except within electrical rooms and control rooms.

.2 NEMA 12 rated enclosures for devices within electrical rooms or control rooms unless otherwise specified.

.3 Door: hinged, minimum 3 point latching, with padlocking means.

.4 Door interlocks

.5 Customized as indicated.

PART 3– EXECUTION

3.1 INSTALLATION

.1 Assemble enclosures in accordance with manufacturer's instructions and mount on concrete housekeeping pad.

.2 Install surface or flush mounted cabinets at locations and heights indicated on drawings.

.3 Mount equipment in enclosure.

END OF SECTION

PART 1 – GENERAL

1.1 Section Includes

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 Related Sections

.1 Section 26 05 00 – Common Work Results – Electrical.

1.3 References

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices, latest edition

.2 CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D), latest edition

.3 CSA-C22.2 No.55, Special Use Switches, latest edition

.4 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with latest edition of UL 20), latest edition.

1.4 Shop Drawings And Product Data

.1 Submit shop drawings and product data in accordance with Section 26 05 00 – Common Work Results – Electrical.

PART 2 – PRODUCTS

2.1 Switches

.1 15 A, 120 V, single pole, double pole, three-way, four-way industrial grade switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111 as required.

.2 Manually-operated general purpose ac switches with following features:

.1 Terminal holes approved for No. 10 AWG wire.

.2 Silver cadmium oxide contacts.

.3 Fully enclosed with urea or melamine moulding for parts subject to carbon tracking.

.4 Suitable for back and side wiring.

.5 Brown toggle.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

.5 Acceptable materials: Hubbell 1200 Series or equivalent.

2.2 Receptacles

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:

.1 Brown urea moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Break-off links for use as split receptacles.

.4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and rivetted grounding contacts.

.2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:

.1 Brown urea moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Four back wired entrances, 2 side wiring screws.

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

.5 Acceptable materials: Hubbell 5252 or equivalent.

2.3 Cover Plates

.1 Stainless steel or pvc cover plates for wiring devices.

.2 Cover plates from one manufacturer throughout project.

.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.4 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

.5 Weatherproof double lift spring-loaded stainless steel or pvc cover plates, complete with gaskets for duplex receptacles as indicated on the drawings.

.6 Weatherproof spring-loaded stainless steel or pvc cover plates complete with gaskets for single receptacles or switches as indicated on the drawings.

PART 3 – EXECUTION

3.1 Installation

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height in accordance with Section 26 05 00 – Common Work Results – Electrical.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height in accordance with Section 26 05 00 – Common Work Results – Electrical.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.4 Mount lighting fixture receptacles local to fixtures.

.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

PART 1 – GENERAL

1.1 Related Sections

.1 Section 26 05 01 – Common Work Results – Electrical.

1.2 References

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with the latest editions of UL 489 and NMX-J-266-ANCE).

1.3 Submittals

.1 Submit product data in accordance with Section 26 05 01 – Common Work Results – Electrical.

PART 2– PRODUCTS

2.1 Breakers General

.1 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters, Fused circuit breakers, and Accessory high-fault protectors: to CSA C22.2 No. 5

.2 Bolt-on and Plug-in moulded case circuit breaker: quick-make, quick-break over center switching mechanism that is mechanically trip-free, for manual and automatic operation with temperature compensation for 40 degrees C ambient. Automatic tripping of the breaker shall be clearly indicated by the handler position. Contacts shall be non-welding silver alloy, and arc extinguishing shall be accomplished by means of DE-ION arc chutes.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.5 Circuit breakers with interchangeable trips as indicated.

.6 Auxiliary switch for status monitoring as indicated on drawing.

.7 Circuit breakers to have minimum symmetrical rms interrupting capacity rating as indicated on the drawings.

2.2 240V Main Breaker (MCB-G70)

.1 Requirements:

.1 Frame Size: 125A.
.2 Trip Rating: as shown on drawings.
.3 Interrupting Rating: 14kAIC
.4 Long Time Delay: not application
.5 Short Time Delay: Inst – not applicable
.6 Service entrance rated.
.7 Enclosure: NEMA 3R lockable in “On” position

.2 Trip unit: Thermal magnetic

.3 Catalog Number: Eaton or approved equal in accordance with B7.

2.3 240V Main Breaker (MCB-G71)

.1 Requirements:

.1 Frame Size: 125A.
.2 Trip Rating: as shown on drawings.
.3 Interrupting Rating: 14kAIC
.4 Long Time Delay: not application
.5 Short Time Delay: Inst – not applicable
.6 Enclosure: NEMA 3R lockable in “Off” position
.7 Trip unit: Thermal magnetic

.2 Catalog Number: Eaton or approved equal in accordance with B7.

PART 3– EXECUTION

3.1 Factory Testing

.1 Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of CSA standard.

3.2 Installation

.1 Install circuit breakers as indicated on drawings per the manufacturer’s recommendations.

3.3 Field Settings

.1 The contractor shall perform field adjustments of the circuit breakers as required to place the equipment in final operating condition. The settings shall be in accordance with the drawings.

END OF SECTION

PART 1 – GENERAL

1.1 Section Includes

.1 Materials and installation for industrial control devices including pushbutton stations, control and relay panels.

1.2 Related Sections

.1 Section 26 05 01 – Common Work Results – Electrical.

1.3 References

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.14, Industrial Control Equipment, latest edition

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1, Industrial Control and Systems: General Requirements, latest edition

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 26 05 01 – Common Work Results – Electrical.

.2 Include schematic, wiring, interconnection diagrams.

1.5 Quality Assurance

.1 Submit to Contract Administrator one copy of test results.

1.6 Waste Management and Disposal

.1 Separate and recycle waste materials.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Contract Administrator.

PART 2 – PRODUCTS

2.1 AC Control Relays

.1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.

.2 Convertible contact type: contacts field convertible from NO to NC, electrically held, with poles to suit. Coil rating: 120 VAC. Contact rating: 120 VAC, 10 A minimum or 24 VDC, 2 A minimum as required.

.3 Fixed contact plug-in type: general purpose with poles to suit. Coil rating: 120 V. Contact rating: 120 VAC, 10 A minimum or 24 VDC, 2 A minimum as required.

.4 Relay to have visual status indication.

2.2 DC Control Relays

.1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.

.2 Convertible contact type: contacts field convertible from NO to NC, electrically held, with poles to suit. Coil rating: 24 VDC. Contact rating: 120 VAC, 10 A minimum or 24 VDC, 2 A minimum as required.

.3 Fixed contact plug-in type: general purpose with poles to suit. Coil rating: 24 VDC. Contact rating: 120 VAC, 10 A minimum or 24 VDC, 2 A minimum as required.

.4 Relay to have visual status indication.

2.3 Relay Accessories

.1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

2.4 Solid State Timing Relays

.1 Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants.

.2 Operation: on-delay or off-delay, or as indicated on drawings.

.3 Supply voltage: 120 VAC, 60 Hz.

.4 Temperature range: minus 20 degrees C to 60 degrees C.

.5 Output contact rating: maximum voltage 300 V AC or DC. Current: NEMA ICS 1.

.6 Timing ranges: minimum 1.0 s, maximum 12 minutes.

.7 Relay to have visual status indication.

2.5 Pushbuttons

.1 Heavy duty Oil tight. Operator extend type. Black, with 1-NO and 1-NC contacts rated at 2 A minimum, AC, labels as indicated. Stop pushbuttons coloured red, labelled as indicated.

2.6 Control and Relay Panels

.1 CSA Type 12 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.7 Control Circuit Transformers

.1 Single phase, dry type.

.2 Primary: 600 VAC, 60 Hz

.3 Secondary: 120 VAC.

.4 VA Rating: as required by loads plus 20%.

.5 Secondary fuse rating: as required by loads

.6 Close voltage regulation as required by magnet coils and solenoid valves.

PART 3 – EXECUTION

3.1 Installation

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

3.2 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

END OF SECTION

PART 1 – GENERAL

1.1 Related Sections

.1 Section 26 05 00 – Common Work Results - Electrical

1.2 References

.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE C62.41, Surge Voltages in Low-Voltage AC Power Circuits, latest edition

.2 American Society for Testing and Materials (ASTM)

.1 ASTM F1137, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners, latest edition

.3 United States of America, Federal Communications Commission (FCC)

.1 FCC (CFR47) EM and RF Interference Suppression.

.4 Canadian Standards Association (CSA International).

.1 Current adopted addition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.5 City of Winnipeg

.1 Winnipeg Electrical By-law including Technical Interpretations, latest edition

.2 City of Winnipeg Electrical Design Guide (510276-0000-47ER-0001), Revision 05

1.3 Shop Drawings and Product Data

.1 Submit shop drawings in accordance with Section 26 05 00 – Common Work Results - Electrical

.2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Engineer.

.3 Photometric data to include: VCP Table and spacing criterion.

PART 2 – GENERAL

2.1 Lamps

.1 Lamps shall be as indicated on luminaire schedule on drawings.

2.2 Led Driver

.1 LED Driver: CSA certified, energy efficient type, IC electronic.

.1 Rating: 120 V, 60 Hz.
.2 Totally encased and designed for 40 degrees Celsius ambient temperature.
.3 Start-up ambient temperature of -20°C for indoor luminaires, and -40°C for outdoor luminaires.
.4 Power factor: minimum 95% with 95% of rated lamp lumens.
.5 Harmonics: 10 % maximum THD.

.6 Estimated lifespan equal or greater than LED lamps of respective luminaire.
.7 Sound rated: Class A.
.8 Mounting: integral with luminaire.

2.3 Finishes

.1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.4 Luminaires

.1 As indicated in luminaire schedule.

PART 3 – GENERAL

3.1 Installation

.1 Locate and install luminaires as indicated.

3.2 Wiring

.1 Connect luminaires to lighting circuits:

.2 TECK90 cable for luminaires.

3.3 Luminaire Supports

.1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors (Nylon shields not acceptable) or as recommended by Anchor Construction Industrial Building Products Ltd for the specific surface & equipment being installed.

.2 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.3 All channel support for wall and surface mounted luminaires to be PVC coated strut, aluminum or stainless-steel type.

3.4 Luminaire Alignment

.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 This section covers items common to sections of Division 40.

1.2 Related Sections

.1 Section 26 05 00 – Common Works Result - Electrical

1.3 Codes And Standards

.1 Do complete installation in accordance with the latest adopted version of CSA C22.1 except where specified otherwise.

.2 Comply with all laws, ordinances, rules, regulations, codes, and orders of all authorities having jurisdiction relating to this Work.

.3 City of Winnipeg Electrical Design Guide (510276-0000-47ER-0001), Revision 05,

.4 City of Winnipeg Automation Design Guide (612620-0013-40ER-0001), Revision 03,

1.4 Drawings and Specifications

.1 The intent of the Drawings and Specifications is to include all labour, products, and services necessary for complete Work, tested and ready for operation.

.2 These Specifications and the Drawings and Specifications of all other divisions shall be considered as an integral part of the accompanying Drawings. Any item or subject omitted from either the Specifications or the Drawings, but which is mentioned or reasonably specified in and by the others, shall be considered as properly and sufficiently specified and shall be provided.

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

.4 If discrepancies or omissions in the Drawings or Specifications are found, or if the intent or meaning is not clear, advise the Contract Administrator for clarification before submitting Bid, in accordance with B5.

1.5 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 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.

1.6 Permits, Fees and Inspection

.1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay associated fees.

.3 Notify 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.

1.7 Materials and Equipment

.1 Provide materials and equipment in accordance with the manufacturer’s written instructions.

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

.3 Minimum enclosure type to be used is NEMA 4X unless otherwise specified.

1.8 Finishes

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

.1 Paint indoor distribution 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.

1.9 Equipment Identification

.1 Identify electrical equipment with nameplates as follows:

.1 Nameplates:

.1 Lamacoid 3 mm thick plastic lamacoid nameplates, white face, black lettering, mechanically attached with self tapping screws.

NAMEPLATE SIZES			
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	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
Size 8	35 x 100 mm	3 lines	5 mm high letters

.2 Lamacoid Requirements as per the City of Winnipeg Electrical Design Guide, Revision 05, Section 2.3 – Identification.

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

.4 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.2 Allow for minimum of twenty-five (25) letters per nameplate and label.

.3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.4 Identify equipment with Size 3 labels engraved as directed by Contract Administrator. Eg. “CP-G81”

.5 Lamacoid equipment identification structure shall be as per the City of Winnipeg Electrical Design Guide, Revision 05, Section 2.3 – Identification, Table 2-1: Lamacoid requirements.

1.10 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings on both ends of conductors.

.1 Wire tags to be heat shrink type with black letters on white background.

1.11 Submittals

.1 Prior to delivery of any Products to job Site and sufficiently in advance of requirements to allow ample time for checking, submit Shop Drawings for review as specified in Division 1.

.2 Submit Shop Drawings (including Product Data) for all equipment as required in each Section of this Specification.

.3 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.

.4 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.

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

1.12 Record Drawings

.1 The Contractor shall keep one (1) complete set of white prints at the Site during work, including all addenda, change orders, Site instructions, clarifications, and revisions for the purpose of Record 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. Record Drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.

1.13 O&M Manual

.1 Operations and Maintenance Manuals

.1 Refer to Section 26 05 00 for general O&M Manual requirements.

.2 In addition to the general requirements, provide the following information:

.1 Table of Contents – Arrange contents sequentially by systems under Section numbers. Label tabs of dividers between each to match section numbers in the Table of Contents.

.2 Systems Descriptions – A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.

.3 Manuals containing all pertinent information, drawings and documents of the Contractor's supply and/or documentation included with the instruments supplied by others, such as:

.1 Mechanical drawings of the equipment.

.2 Installation drawings and procedures.

.3 Instrument model numbers.

.4 Equipment specifications.

.5 Detailed utility requirements.

.6 Replacement parts list with model numbers.

.7 Recommended preventative maintenance frequency.

.8 Troubleshooting procedures.

.9 Procedures for dismantling.

.10 Procedure to operate the equipment/instruments.

.11 Recommended cleaning procedure.

.12 Recommended list of supplies to be used in conjunction with the operation and maintenance of the equipment.

.13 Recommended spare parts list

.4 A copy of all wiring diagrams complete with wire coding.

.5 Include type and accuracy of instruments used.

.6 Set of final reviewed Shop Drawings clearly indicating make, model, and any selected options or accessories that were included in the final construction.

.7 Testing documentation including:

.1 Loop Check Report

Part 2 Products

2.1 Not Used

.1 Not Used.

Part 3 Execution

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 40 05 01 – Common Work Results - Automation

1.2 Definitions

.1 FAT: Factory Acceptance Test

1.3 Design Requirements

.1 Develop a demonstration and test procedure, along with test forms, for the FAT.

1.4 Submittals

.1 Submit the following for review at least 15 Working Days prior to FAT.

.1 Detailed test procedure and test forms for review.

.1 Incorporate all changes to the procedure and test forms requested by the Contract Administrator.

.2 Submit the following, to be received on the date of the FAT:

.1 Detailed listings of all control logic and software utilized to implement the control sequences, for the scenarios demonstrated as part of the FAT. Listings are to be neatly organized and commented as required. All supporting documents, including variable listings are to be included.

1.5 Closeout Submittals

.1 Include all FAT documentation and test forms in the O&M manuals.

1.6 Demonstration and Testing

.1 The purpose of testing is to ensure all status signals, alarm signals, and interlocks defined in the Doncaster Outfall Chamber Upgrade (“Control Narrative”) within the PLC are conveyed to the City’s SCADA HMI system via the cellular communication link. This shall be performed in conjunction with the Contract Administrator and/or City of Winnipeg personnel. The Contract Administrator is responsible for PLC programming, the Contractor is responsible for constructing the PLC panels and assisting in simulating signals and testing.

.2 The location of the FAT will be in a Contractor-supplied facility, within Winnipeg, Manitoba, Canada.

.3 Correct deficiencies at no additional cost and re-test until satisfactory performance is obtained.

.4 Acceptance of tests during the FAT will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

1.7 Completion Of Fat

.1 The FAT is considered to be complete only when full approval of the Contract Administrator has been received by the Contractor. The FAT results shall be sealed by a professional engineer licensed to practice in Manitoba.

.2 Schedule additional re-tests at no additional cost until approval is obtained.

PART 2 - PRODUCTS

2.1 None Used.

.1 None Used.

PART 3 - EXECUTION

3.1 Demonstration System

.1 Setup the complete automation system in the Contractor's facility, in a manner to allow for the complete and expeditious testing of the system and associated programming.

3.2 Procedures

.1 All tests shall be documented.

.2 Produce test forms to allow for recording the results of the simulations and tests.

.3 All points to the SCADA system will be tested with the assistance of City personnel.

.4 Advise Contract Administrator of the date of testing. Contract Administrator may, at their discretion, observe factory acceptance testing based on the completeness of the submittal or other factors.

.1 Demonstration tests to include:

.1 Testing of all discrete physical inputs with the use of wire jumpers.

.1 Confirm that the City's SCADA system is able to see the state transition.

.2 Confirm that the light on the front of the control panel illuminates (where a light is provided).

.2 Testing of all analog inputs by using a 4-20mA process simulator (multi-meter with signal generating functions).

.1 Test the input at 0%, 50%, and 100% of full scale.

.2 Test the under range (0.0 - 3.9 mA) and overrange (20.1 – 24.0 mA) operation.

.3 Confirm that the City's SCADA system as able to see each of the 0%, 50%, and 100% of full scale values as they are tested.

.3 Testing of physical pushbuttons, selector switches, and pilot lights on the control panel(s).

.4 Testing of DNP3 parameters.

.2 Demonstration tests need not include:

.1 Connection of instruments to the control panel.

.2 Configuration of instruments.

.5 The Contract Administrator may request additional tests and simulations at the FAT. No additional payment shall be made for additional minor tests.

.6 The Contract Administrator will review the system, simulations, and test results. Incorporate comments and feedback from the Contract Administrator into the system design.

3.3 Evaluation

.1 All evaluations will be pass/fail.

.2 The Contractor is expected to ensure that all required demonstrations are fully operable and meet required specifications, prior to the FAT. Upon failure of a required demonstration in the FAT, the Contractor shall provide subsequent re-tests to the satisfaction of the Contract Administrator.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 40 05 01 – Common Work Results - Automation

1.2 Submittals

.1 Submit commissioning plans and procedures, in writing, at least 20 Working days prior to commissioning.

1.3 Closeout Submittals

.1 Final Report:

.1 Include measurements, final settings and certified test results.

.2 Include completed commissioning forms

.3 Bear signature of commissioning technician and supervisor

.4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications as set during commissioning and submit to the Contract Administrator.

.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.4 Commissioning Forms

.1 The Contract Administrator will provide a base set of standard commissioning forms. Additional forms will be required and must be prepared by the Contractor.

.2 Supplement the provided forms as required to make a complete commissioning report package. Utilize the specifications, drawings, and Functional Requirements Specification as the basis for preparation of the additional commissioning forms.

1.5 Commissioning

.1 Carry out commissioning under direction of the Commissioning Agent and in the presence of representatives of the Contract Administrator and the City.

.2 Inform, and obtain approval from the Contract Administrator in writing at least 14 days prior to commissioning or each test. Indicate:

.1 Location and part of system to be tested or commissioned.

.2 Testing/commissioning procedures, anticipated results.

.3 Names of testing/commissioning personnel.

.3 Correct deficiencies and re-test until satisfactory performance is obtained.

.4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.5 Perform tests as required.

1.6 Completion Of Commissioning

.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by the Contract Administrator.

PART 2 Products

2.1 Not Used

PART 3 Execution

3.1 Status Prior To Commissioning

.1 Prior to commissioning, ensure that the following is completed:

.1 Installation of all panels and completion of all wiring connections.

.2 Testing wiring for continuity from the field device to the control panel.

.3 Automation panels are cleaned (interior and exterior)

3.2 Procedures

.1 Provide a minimum of one qualified electrician to assist in testing and commissioning of the control system.

.2 Contractor shall assist in testing each I/O point from the instrument to the City's SCADA HMI.

.1 Test both states of discrete points.

.2 Test, at minimum, two values for analog points.

.3 Test each piece of equipment individually for complete functionality.

.4 All deficiencies unrelated to PLC programming must be corrected by the Contractor.

.5 Commission each system using procedures prescribed by the Contract Administrator.

.6 The Contractor is reminded that this facility is critical to operation of the City's wastewater pumping station.

3.3 Checklists, Forms, And Reports

.1 Complete checklists, forms, and reports for each instrument, loop, and control device.

.1 Instrument Loop Checklist.

.2 Discrete Device Checklist.

3.4 Demonstration

.1 Demonstrate to the Contract Administrator operation of systems including sequence of operations under all potential conditions, start-up, shut-down interlocks and lock-outs.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Process instrumentation.

1.2 RELATED SECTIONS

.1 Section 40 05 01 – Common Work Results - Automation

1.3 REFERENCES

.1 National Electrical Manufacturer's Association (NEMA)

.1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum), latest edition.

.2 Canadian Standards Association (CSA International).

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations, latest edition adopted by the City of Winnipeg.

.3 City of Winnipeg

.1 Winnipeg Electrical By-law including Technical Interpretations, latest edition

.2 City of Winnipeg Electrical Design Guide (510276-0000-47ER-0001), Revision 05

.3 City of Winnipeg Automation Design Guide (612620-0013-40ER-0001), Revision 03

1.4 SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in Section 40 05 01 – Common Work Results for Automation.

.2 Manufacturers' Instructions:

.1 Include the manufacturer's installation instructions for specified equipment and devices in O&M Manuals.

PART 2 - PRODUCT

2.1 General

.1 Control devices of each category to be of the same type and manufacturer.

.2 External trim materials to be corrosion resistant.

.3 Operating conditions: 0 +5°C with 5 - 95% RH (non-condensing) unless otherwise specified.

.4 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

2.2 Hydrostatic Level Transmitters (LT-S751)

.1 Requirements:

.1 Measurement Principle: Hydrostatic pressure
.2 Accuracy: ±0.2% of full scale
.3 Protection: IP68 , suitable for submersion
.4 Housing Material: Stainless steel, PPE, or ETFE
.5 Temperature Range: -10°C to +80°C
.6 Power Supply: 10 - 30 V DC loop powered
.7 Approval: CSA, Zone 1, Category 2
.8 Stainless Steek protective cap
.9 Cable Length: 20 meters
.10 Accessories:
.1 Suspension clamp
.2 IP65, IP66, IP67 Terminal box

.2 Products:

.1 Endress Hauser Waterpilot FMX21
.2 Or approved equal in accordance with B7.

2.3 Inclinometer (ZT-S851)

.1 Requirements:

.1 Tilt transmitter
.2 15° full clockwise rotation
.3 60° counterclockwise rotation
.4 20-4 mA output signal
.5 Enclosure : 303 Stainless steel, NEMA 4X, IP68
.6 Mounting: surface mount
.7 Safety Approvals: CSA Class 1 Div. 2

.2 Product:

.1 Durham Instruments, Celesco Inclinometer Model IT9420
.2 Part Number: IT9420-015-060-2670 (No alternative)
.3 Email Order: sales@disensors.com
.4 Reference: Quote:62968.JJ

2.4 Ultrasonic Level Transmitter (LT-S951)

.1 Service:

.1 Fluid: Wastewater
.2 Ambient Temperature: -40°C to 85°C
.3 Calibration range: 0 - 12 meters of Water Column

.2 Sensor/Transmitter:

.1 Enclosure Material: ETFE or PVDF transducers for chemical compatibility
.2 Power Supply: 10.5 – 45 Vdc (loop powered),
.3 Output Signal: 2 wire, 4-20 mA with HART,

.4 Accuracy: ≤ 0.15%
.5 Resolution: ≤ 3 mm
.6 Update time: ≤ 4 s
.7 Enclosure : Type 4X, IP68
.8 Explosion protection: Zone 1, Category 2
.9 Accessories:
.1 Stainless steel FMS200 universal box bracket mounting kit 7ML1830-1BK
.10 Acceptable Products:
.1 Simens Probe LU 240 Model 7ML5110-1GD07-4CK3-Z E34 (Standardized product. No Alternative)

2.5 Temperature Transmitter (TT-G681)

.1 Input Type:
.1 Thermocouples
.2 Linear resistance, potentiometer, and DC voltage sources
.2 Output:
.1 Resistance Thermometer
.2 4-20 mA current loop
.3 HART communication interface (optional)
.3 Mounting:
.1 DIN rail mounting
.4 RTD Sensor:
.1 Platinum Resistance Thermometer (PRT).
.2 Nominal Resistance: 100 ohms at 0°C
.3 Temperature Range: -200°C to +850°C
.4 Configuration:
.1 2-wire, 3-wire, or 4-wire
.5 Material:
.1 Platinum element
.2 Stainless steel sheath (for probes)
.6 Insulation Resistance:
.1 Minimum 100 MΩ at 100 V DC
.5 Power Supply:
.1 12-35 VDC
.6 Accuracy:
.1 ±0.1% of span
.7 Operating Temperature:
.1 -40°C to +85°C
.8 Enclosure:
.1 IP20 for standard models

.9 Certifications:

.1 ATEX, FM, CSA for hazardous areas

.10 Acceptable Products:

.1 Simens Probe TR320 Part Number 7NG0320-0JA10-0AA0

2.6 Radar Level Transmitter (LT-S651)

.1 General Information:

.1 Product Name: VEGAPULS C 23 **(No alternative)**
.2 Type: Two-wire 4 … 20 mA/HART Radar Sensor
.3 Application: Continuous level measurement for liquids and bulk solids in various industrial applications, including water treatment, pumping stations, rain overflow basins, rivers, lakes, and silos.

.2 Technical Specifications

.1 Measuring Range: Up to 30 meters (98.43 feet)
.2 Accuracy: Deviation ≤ 2 mm
.3 Beam Angle: 4°
.4 Measuring Frequency: W-band (80 GHz technology)
.5 Output Signal: 4 … 20 mA/HART

.3 Environmental Conditions

.1 Process Pressure: -1 … +3 bar (-100 … +300 kPa / 14.5 … +43.51 psig)
.2 Process Temperature: -40 … +80 °C (-40 … +176 °F)
.3 Ambient Temperature: -40 … +80 °C (-40 … +176 °F)
.4 Protection Rating: IP66/IP68 (3 bar, 24 h) according to IEC 60529, Type 4X/6P according to UL 50

.4 Materials

.1 Wetted Parts: PVDF (Polyvinylidene Fluoride)
.2 Connection Cable: PUR (Polyurethane) insulated

.5 Electronics Versions

.1 Standard: Two-wire electronics with 4 … 20 mA/HART

.6 Electrical Connection

.1 Wire Assignment:
.1 Brown (+) to voltage supply or processing system
.2 Blue (-) to voltage supply or processing system
.3 Shielding

.7 Mounting Accessories

.1 PN AC-222 2Y2

.8 Certifications:

.1 ATEX, FM, CSA for hazardous areas

.9 Vendor:

.1 EECOL Reference Order #: RA-222 B6M

PART 3 - EXECUTION

3.1 Installation

.1 Install equipment and components so that the manufacturer 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 Install in a manner to allow easy removal of the transducer and cable assembly for maintenance purposes.

.4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.5 Electrical:

.1 Complete installation in accordance with Section 26 05 01 - Common Work Results – Electrical.

.2 Provide complete conduit/cable system to link instrumentation and the control panel(s).

.3 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.4 Maximum conduit fill not to exceed 40%.

.5 Design drawings do not show conduit layout.

3.2 Inspection and Instruction

.1 Provide a factory-trained representative who shall give instructions regarding the installation of the equipment.

.2 The factory-trained representative shall visit the site as required to ensure that the installation work is being performed in a proper and workmanlike manner. Allow for a minimum of one (1) full working day.

.3 The factory-trained representative shall be present to supervise the commissioning, initial operation, and functional testing of the equipment.

3.3 Identification

.1 Identify field devices with lamacoids. Install lamacoids in a conspicuous location.

3.4 Testing and Commissioning

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 40 80 11 - Automation Commissioning.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 40 05 01 – Common Work Results - Automation

1.2 References

.1 Canadian Standards Association (CSA International).

.1 C22.2 No.205, Signal Equipment, latest edition

.2 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations, latest edition adopted by the City of Winnipeg.

.2 City of Winnipeg

.1 Winnipeg Electrical By-law including Technical Interpretations, latest edition

.2 City of Winnipeg Electrical Design Guide (510276-0000-47ER-0001), Revision 05

.3 City of Winnipeg Automation Design Guide (612620-0013-40ER-0001), Revision 03

.3 International Electrotechnical Commission (IEC)

.1 IEC 61131, Programmable Controllers

1.3 Definitions

.1 PLC: Programmable Logic Controller

1.4 PLC System Description

.1 The PLC consists of a controller and an I/O expansion module, mounted in control panel.

.2 One PLC panels is to be constructed, CP-G81 as indicated on the drawings.

.3 The City utilizes a remote SCADA system that interfaces with the outfall chamber control system PLC via cellular links using DNP3 protocol.

.4 The Contractor’s responsibility on the SCADA system is limited to:

.1 Provision of an interface in the PLC for the SCADA system.

.2 Testing of all status, alarm signals, and analog points between the PLC and the City’s SCADA system via the cellular network during the Factory Acceptance Test. This work will be performed in conjunction with the Contract Administrator and/or the City of Winnipeg.

.3 Testing of all status, alarms, and DNP3 points in the mapping list between the PLC and the City's SCADA system via the cellular network during commissioning. Functional check for control/interlock functions and individual points to the city's SCADA during commissioning. Ensure that DNP3 Communications are according to city’s SCADA requirement. This work will be performed in conjunction with the Contract Administrator and/or the City of Winnipeg.

1.5 System Architecture – CP-G81

.1 Single PLC

.1 Local I/O modules.

.2 No remote I/O.

.3 A minimum of 20% spare shall be provided within the chassis for the future addition of modules. Alternatively, space can be provided within the control panel for the addition of another PLC chassis in the future.

.4 Connected to the following:

.1 MDM01 – Cellular modem (supplied by the City).

1.6 Design Requirements

.1 Design and implement a complete operating PLC system.

.2 The consequences of system failure could be significant, and thus a high level of care, attention to detail, and testing is expected.

.3 The Contract Administrator will review the overall design. Make changes as requested by the Contract Administrator at no additional cost.

1.7 Submittals

.1 All submittals to be in accordance with Section 40 05 01 – Common Work Results - Automation

.2 Submit product datasheets.

1.8 O&M Manuals

.1 Include the following in the O&M Manuals:

.1 Product datasheets.

.2 Hardware and software user manuals.

PART 2 - PRODUCTS

2.1 Programmable Logic Controller

.1 These products were standardized by the City via RFP 756-2013. No alternates or substitutes will be accepted.

.2 Part or Model numbers shall be as shown on the Control Panel drawings. Suitable product shall be a Schneider Electric M580 PLC system.

.3 Provide all required hardware for a complete installation.

.4 Modularity

.1 The construction of the PLC is to be an integrated processor, power supply, and I/O unit, utilizing additional separated I/O expansion modules that are located adjacent to the main unit on DIN rail as required.

.5 Self-Tests, Diagnostics and Failure Modes

.1 Integrity of controller hardware and software to be constantly monitored by an intrinsic series of continuously running self-tests and diagnostics.

.2 Immediately report abnormal results as system alarms.

.3 Have predictable failure mode upon an error. At a minimum, faults are to generate a system alarm.

.4 Equipment may have the ability to diagnose degradations to performance that may not yet adversely affect operator functions or be a permanent failure. When such conditions are automatically noted, the system is to journal the event in the Historian and have the capability to report such information selectively, as either a system alarm or a message on the programming workstation.

.6 Processor:

.1 Schneider Electric BMEP583020 CPU

.7 Memory

.1 Expandable Flash: 4 GB
.2 System Memory RAM: 10 kB
.3 Program RAM: 12 MB
.4 Data RAM: 1024 kB

.8 Integrated USB Ports:

.1 Qty 1, USB Port
  .1 Connector: Type Mini-B
  .2 Standard: USB 2.0
  .3 Speed: 480 Mbps (full speed).

.9 Visual Indicators:

.1 Run LED (RUN),
.2 Error LED (ERR),
.3 Input Output (I/O) LED,
.4 Download LED (DL),
.5 Backup LED (BKP),
.6 Sec LED, (SEC)
.7 Ethernet Mod Status LED (ETH MS)
.8 Ethernet Net Status LED

.10 Power Supply

.1 Requirements:
  .1 Supply Voltage: 10 to 30 VDC
  .2 Supply Protecting: Integral fuse or breaker.
  .3 Output Voltage: As required.
  .4 Output Current: As required.
  .5 Integrated protection against overloads, short circuits, and overvoltages.

.11 On-board Inputs:

.1 Discrete Inputs (DI):
  .1 Channels: 16
  .2 Voltage: 12/24 VDC.
  .3 Current sinking.
  .4 Meet IEEE C37.90.1 surge withstand capability.
  .5 Indicating LEDs: Channel status (on/off) for each channel.
.2 Analog Inputs (AI)
  .1 Channels: 8
  .2 Type: Single ended

.3 4 – 20mA inputs and one 0 - 32.768V input for battery voltage monitoring.

.4 Input impedance:

.1 20 kΩ for 0 – 10V inputs,

.2 60 kΩ for 0 - 32.768V inputs,

.3 250 Ω for 0 - 20mA inputs,

.5 Resolution:

.1 15 bits over the 0 – 10V measurement range

.2 14 bits over the 0 - 5V measurement and 0-20mA measurement range.

.6 Accuracy:

.1 +/- 0.1% at 25 °C.

.2 +/- 0.2% over temperature range.

.7 Response time: 100ms typical for 10% to 90% signal change.

.12 Required Accessories:

.1 Include all accessories including cables, terminators, backplanes, memory, batteries, and other components required to make the system operable.

.13 Acceptable Products:

.1 Controller: Schneider Electric Modicon M580.

.2 No alternates or substitutes will be accepted.

PART 3 - EXECUTION

3.1 Hardware Installation

.1 Install the PLC and associated components in Control Panel CP-G81 as per manufacturer instructions and recommendations.

3.2 Plc Programming Services

.1 PLC Programming is in the scope of the Contact Administrator

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 40 05 01 – Common Work Results - Automation

1.2 References

.1 Canadian Standards Association (CSA International).

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations, latest edition adopted by the City of Winnipeg.

.2 CSA C22.2 NO. 286, Industrial Control Panels and Assemblies, latest edition

.2 City of Winnipeg

.1 Winnipeg Electrical By-law including Technical Interpretations, latest edition

.2 City of Winnipeg Electrical Design Guide (510276-0000-47ER-0001), Revision 05

.3 City of Winnipeg Automation Design Guide (612620-0013-40ER-0001), Revision 03

1.3 General Requirements

.1 All Control Panels shall be built by a CSA/cUL-approved manufacturer and shall bear the CSA/cUL seal with the manufacturer's file number.

.2 All Control Panels shall be factory assembled and pre-wired. The Control Panel wiring shall be verified at the manufacturer's factory and completely tested before being shipped to the site.

.3 Supply, install, wire and test all components inside the Control Panels according to the specifications herein and the drawings.

1.4 Submittals

.1 Prior to construction:

.1 Submit product datasheets, and wait for approval, prior to construction of the Control Panels.

.1 AutoCAD drawings of the control panel can be provided to the Contractor if they are required to prepare their own drawing set due to CSA requirements.

.2 Submit stamped red-line mark-ups of the proposed modifications to the control panels. If significant modifications are proposed/required, AutoCAD drawings will be supplied to the Contractor for revision.

.2 Prior to shipment:

.1 Submit electronic pictures of enclosure exterior and interior, including door interior.

.1 Pictures to be of sufficient resolution to read component labels.

.2 As-built drawings:

.1 Submit as-built drawings. Minor changes may be made via red-line mark-ups.

.2 Draft significant changes on AutoCAD drawings.

.3 Do not ship control panel until approval from Contract Administrator is received.

1.5 Inspection

.1 A factory inspection of the control panels will be performed at the discretion of the Contract Administrator based upon the pre-shipment submittals.

.2 If requested, demonstrate and test the control panel in presence of the Contract Administrator designated representative.

PART 2 - PRODUCTS

2.1 General

.1 Construction of the control panels is required, in accordance with the supplied drawings.

.2 Control devices of each category shall be of same type and manufacturer.

2.2 Enclosures

.1 Install lamacoids as per the control panel layout drawings.

.2 All indoor control panels shall be NEMA 12 or as shown on drawings.

.3 All enclosure angles and cut-outs shall be free of dents, gouges or weld marks, and shall present a clean, smooth appearance.

.4 No screws, fittings or other fastenings shall be used on external panel faces, which must be free of any marks, scratches or defaults.

.5 The door is to be a minimum fourteen (14) gauge steel plate, full height and flush with adjacent surfaces.

.6 The exterior of the control panel shall be painted ANSI 61 grey.

.7 The interior of the control panel shall be painted gloss white.

.8 All control panel doors shall be 900 mm (36 inches) wide maximum.

.9 All control panel doors shall open through 180 degrees without restriction.

.10 All control panels of a depth greater than or equal to twelve (12) inches shall be equipped with a LED lighting device located in the cabinet's upper portion with a door switch. Whenever the door is opened, the lighting system shall automatically be activated.

.11 Enclosure brand shall be Hoffman or an approved equal in accordance with B7.

2.3 Power Source

.1 Each power source must be protected by a CSA approved circuit breaker or fuse.

.2 The location of each power source must be clearly shown.

.3 Panels powered by more than 1 electrical source shall display on their door; "Caution: This panel is electrically powered by more than one source".

2.4 Components

.1 Unless written approval for use of unapproved components is received from the City, all electrical materials (e.g., conduit, fittings, wireways, etc.) shall be CSA or cUL approved.

.2 Rails (DIN Rails)

.1 Rails used must be DIN Rail style TS 35mm, slotted.

.2 When used to mount terminals, rails shall be mounted on straight raisers (Rail support / Mounting feet) so as to raise them to the same height as the highest adjacent wiring duct.

.3 Raisers (Rail support / Mounting feet) shall not be used when rail hosts heavy components.

.3 Terminals

.1 Requirements:

.1 TS-35 DIN Rail mounting.

.2 Voltage rating:

.1 600V for general control circuits.

.2 600V for power circuits.

.3 Manufacturer: Phoenix Contact or approved equal in accordance with B7.

.2 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.

.3 Each terminal shall bear an identification number on both sides.

.4 Drawings and templates supplied may not detail all hardware components such as labels, stoppers, rail lifters, end plates, separators, etc. The supplier must supply and install such components when required.

.4 Ground Bus Bar

.1 Supply a ground bus bar in each control panel as indicated on the drawings.

.2 Requirements:

.1 Tapped holes with screws.

.2 Bar to have sufficient connection points for all cables entering the control panel, plus 25% spare.

.3 Maximum one wire termination per screw.

.5 Pushbutton, Switch and Indicator Light

.1 When required, all control panel pushbuttons, switches and indicator lights shall be at least NEMA 12 (or better)-type devices.

.2 Manufacturer to be Schneider Electric or approved equal in accordance with B7.

.6 Programmable Logic Controllers

.1 As per section 40 94 43.

.7 General Purpose Relays

.1	Coil Voltage:	DPDT or as shown on drawings
.2	Indication:	LED
.3	Diode:	Provided
.4	Contact arrangement:	As per drawings
.1	Contact Rating:	5A (120 VAC), 5A (24 VDC)

.2 Approvals: CSA

.3 Manufacturer: Omron or approved equal in accordance with B7.

.8 24 VDC Power Supply

.1 Input Voltage: 100 - 240 VAC (Single-phase).

.2 Output Voltage: 24V DC ±1%.

.3 Output Current: 10A.

.4 Power: 240W.

.5 Efficiency: ≥ 93%.

.6 Operating Temperature: -25°C to +70°C.

.7 Enclosure Rating: IP20 (suitable for panel mounting).

.8 Mounting Type: DIN rail

.9 Certifications: UL, CE, CSA, and RoHS compliant.

.10 Manufacturer: Phoenix Contact QUINT-UPS/24DC/10 (2866763) or approved equal in accordance with B7.

.9 24 VDC Uninterruptible Power Supply

.1 Input: 100 - 240 VAC

.2 Output: 24 VDC, 10 A (adjustable 22.5-29.5 VDC)

.3 Battery: 12 Ah

.4 Monitoring outputs: 24 VDC, Alarm, Battery Mode, Battery Charge

.5 Manufacturer: Phoenix Contact QUINT-UPS/24DC/10 (2320225) with UPS-BAT/PB/24DC/7AH (1274118) or approved equal in accordance with B7.

.10 Cellular Modem:

.1 Supplied by City and installed by Contractor.

.11 Grounding

.1 All control panel components shall be adequately grounded in accordance with the component manufacturer, especially control system components.

.2 Firmly bond all panel mounted devices on or within the panels to ground. Provide supplementary bonding conductors for back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

.3 Where ground bars are installed on to the rear or side wall of the enclosure, seal screw penetrations to maintain enclosure rating.

.4 Refer to the City of Winnipeg Automation and Electrical Design Guides for additional grounding and bonding requirements.

.12 Internal lighting shall be LED type.

.13 Wiring

.1 Panel wiring shall be installed in a near and orderly manner.

.2 All conductors shall be securely fastened to terminals at both ends; no splices are allowed inside the panel.

.3 No more than two (2) conductors may be terminated under each terminal screw. All internal panel conductors shall be connected to the same side of a terminal

block, and external conductors to the other side. The only exception is for fused terminals which require connection to the field side for internal wiring.

.4 All wires and cables inside the control panels shall be identified on both ends with non-erasable markers.

.5 Identification shall follow the supplied documents, such as wiring diagrams.

.1 Label both ends of each wire.

.2 Utilize machine printed non-slip labels. Wrap-around or self-adhesive markers shall not be permitted.

.3 Wherever possible wire labels shall be positioned to be read from the panel opening without removal of wire duct covers or other wiring.

.6 Individual conductors or wires exiting a cable shall be identified using nonerasable markers.

.7 The routing of all analog, digital, and power cable wiring inside control panels shall be segregated as much as possible, in distinct wiring ducts, by the type of signal they are carrying.

.8 All wires shall be physically protected by wiring ducts with covers. The wiring ducts shall be of sufficient size to be filled to a maximum of 50% when all wires are inside.

.9 All analog signal wiring shall be 18 AWG shielded twisted pairs such as Belden No. 8760, or an approved equivalent. Shield wires exiting the jacket must be covered with a black heat shrink, and the overall cable at the jacket end must also be covered with a heat shrink.

.10 All 24 VDC or 120 VAC discrete signal panel wiring shall be 14 AWG TEW stranded conductor.

.1 Increase the size of power wiring, 12 AWG minimum.

.11 All 120 VAC power wiring shall be 14 AWG TEW stranded conductor, minimum.

.12 All 24 VDC and 24 VAC power wiring shall be 12 AWG TEW stranded conductor, minimum.

.13 The sizes and colours of wires shall be in accordance with the CSA and the Canadian Electrical Code.

.14 The panel builder shall group and form wiring into a loop when going from a fixed part of the panel to a door such that there is sufficient slack to minimize strand fatigue and breaking. Each end of the loop shall be properly supported.

.15 Ethernet Patch Cords

.1 Requirements:

.1 Cat-6A.

.2 Jacket colour: Blue.

.16 Wiring Duct

.1 All wires shall be run in narrow slot wiring duct such as such as Panduit or an approved equivalent in accordance with B7.

.2 Wiring Duct shall be installed on both sides of the panel and between the DIN rails.

.3 Wire or cable, connected to internal device or arriving from external device, shall be uncovered by Wiring Duct for a maximum of 10 cm.

.4 120 VAC wires cannot share wiring duct with 10 VDC, 24 VDC or 4-20 mA wires, but can cross their path.

.5 All DC, AC, and thermocouple wiring shall be routed in separate wireways to prevent signal interference.

.17 Wire ties shall be non-metallic.

.18 Wiring shall be arranged to be readily accessible for inspection and maintenance.

.19 The wiring arrangement shall not interfere with access to panel-mounted devices or spaces for future equipment.

.14 Overcurrent Protection

.1 Panel-mounted devices and all control circuits shall be protected by appropriately sized fuses or circuit breakers.

.15 Cooling Systems

.1 Thermoelectric Cooling System Unit:

.1 Cooling Capacity: 200 W (680 BTU/hr).

.2 Input Voltage: 24V DC.

.3 Power Consumption: 190W.

.4 Operating Temperature Range: -20°C to +55°C.

.5 Ingress Protection: IP66.

.6 Material: Powder-coated aluminum housing, corrosion-resistant.

.7 Mounting Type: Surface mount.

.8 Certifications: UL, CE, and RoHS compliant.

.9 Manufacturer: Hoffman Model No. TE121024020 or approved equal in accordance with B7.

.2 Thermoelectric Cooling Controller Unit:

.1 Input Voltage: 24V DC.

.2 4 cooling temperature set points range from 22.5 C to 35 C (35 C Factory Setting)

.3 Automatically switches between cooling and heating

.4 On-board LEDS indicate low temp, high temp alarm, and overall system status

.5 Dry contact relay output provides for external alarm indication

.6 Manufacturer: Hoffman Model No. TEC24VCNTLRN or approved equal in accordance with B7.

PART 3 - EXECUTION

3.1 Component Installation

.1 Components on the front of the panel shall be identified with an individual permanent nameplate installed in an organized manner. The nameplate must identify the component's function.

.2 Each component inside the control panel shall be identified with a nameplate corresponding to the drawings.

.3 All non-DIN rail mountable devices in the control panel shall be mechanically affixed to the back panel with either tapped or self-tapping screws.

.4 All control devices shall be mounted so that any component can be replaced without removing the sub-panel or other components.

.5 Components and/or auxiliary instruments mounted at the rear of the panel shall be readily accessible and their installation shall not be affected by, or interfere with the removal of any panel instrument.

.6 Nameplates shall be made of lamacoid material with a white background and engraved black letters for internal and external components. Nameplates must resist harsh industrial conditions.

.7 Supply and install all required fuses.

.8 Control devices must be spaced adequately to allow for cooling, replacement, servicing, and wiring access.

.9 Control devices shall be grouped according to voltage and function to reduce electrical noise.

.10 Cutouts for instruments shall be within the tolerances specified by the instrument manufacturer.

.11 If cutouts are specified for future instruments, the cutouts shall be covered by removable steel plates 3 mm (1/8 inch) thick. The cover plates shall be finished and painted with the same paint as applied to the front panel.

.12 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.

.13 Panel areas designated for future equipment shall be kept clear of stiffening members, rear-mounted equipment, wiring, and all other interferences.

.14 Ample space shall be provided for the entrance of external cables into the panel and for routing the cables to terminating points within the panel.

3.2 Identification

.1 Perform terminal identification using a computerized device. Handwriting is not acceptable.

.2 Label wires and terminals as shown on drawings.

.3 Install label above each terminal block with terminal block name.

3.3 Testing

.1 Testing of the control panels shall be completed to the greatest extent possible prior to the FAT, and shall include at minimum:

.1 Provide a signed and dated inspection sheet with all tests performed listed on it.

.2 The list of the various test procedures described hereunder is not restrictive, and does not relieve the control panel manufacturer of his responsibility to perform any other work that is not mentioned but requested to verify the good operation of the control panels.

.3 Isolate all instruments and components of the control panels as required to protect them from any damage during tests.

.4 Provide the services of qualified personnel as well as tools and equipment required to perform all tests and inspection of the control panels.

.5 Tests to include:

.1 Power supply functionality

.2 PLC component functionality

.3 Point to point tests of all inputs and outputs

.4 Power terminal voltage verification

.5 Relays and switches functionality

.6 Receptacle and lighting functionality

.7 Modem and Ethernet switch functionality.

.6 If the panel is modified after tests have been performed, tests shall be repeated at no additional cost.

3.4 Shipment

.1 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.

.2 Shipment of any panel having shortages of equipment shall be approved in writing by the City.

3.5 Spare Components

.1 Supply two spares of each fuse type and rating. Place in a clear plastic bag and attach to the panel door interior.

END OF SECTION

PART 1- GENERAL

1.1 Related Sections

.1 Section 40 05 01 – Common Work Results - Automation

1.2 Submittals

.1 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to the Contract Administrator, 30 working days prior to anticipated date of beginning of training.

.1 List name of trainers, and type of visual and audio aids to be used.

1.3 Quality Assurance

.1 Provide competent instructor(s) thoroughly familiar with all aspects of the instrumentation system installed in the facility.

.2 Contract Administrator reserves right to approve instructors.

1.4 Instruction

.1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of the system installed.

1.5 Training Materials

.1 Provide equipment, visual and audio aids, and materials necessary for training.

.2 Supply manual for each trainee, describing in detail data included in the training program.

.1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.6 Training Program

.1 Operations Training

.1 Location: Doncaster Outfall Chamber.
.2 Duration: Four hours.
.3 Number of trainees: Coordinate with Contract Administrator prior to training.
.4 Audience: Operations and maintenance personnel.
.1 Content:
.1 General system overview.
.2 Description of system components.
.3 Presentation of the control panels and system operation.

1.7 Monitoring Of Training

.1 Contract Administrator to monitor training program and may modify schedule and content.

.2 In the event that the Contract Administrator or City are unsatisfied with the training, make changes to the training program as required and repeat the training.

PART 2 - PRODUCTS

2.1 General

.1 Not Applicable.

PART 3 - EXECUTION

3.1 Training

.1 Provide on-site training to City personnel, as indicated above.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 40 05 01 – Common Work Results - Automation

1.2 Maintenance Services

.1 Not required.

1.3 Support Services

.1 Duration:

.1 The duration of support services is to extend during the Warranty period (one 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 to utilize service personnel knowledgeable in the products and have the required troubleshooting skills.

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

.4 Emergency Service Calls:

.1 Respond to service calls from the City when the system is not functioning correctly.

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

.1 A critical failure is the inability to operate of any critical system supplied by the Vendor.

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

.1 Communication networks,

.2 PLC system, and

.3 Instrumentation.

.3 Perform work continuously until 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 on approved form 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 to be due to poor workmanship or defect of the Contractor, no payment will be made to the Contractor.

.2 If the issue is determined to be due to failure of a physical component supplied, and covered under manufacturer's warranty, the Contractor will be paid for the service call.

.3 If the issue is determined to be due to an issue outside of the Contractor's responsibility, the Contractor will be paid for the service call.

.4 Payment will be based upon the rates specified in Form B.

.5 If the service call is subsequent to Total Performance, submit an invoice, based upon the established rates to the City.

PART 2 PRODUCTS

2.1 Not Applicable.

.1 Not applicable.

PART 3 EXECUTION

3.1 Not Applicable.

.1 Not applicable.

END OF SECTION