

Part 1 General

1.1 SUMMARY

- .1 Provide one (1) submersible pump and related accessories in the new manhole.
- .2 Provide pump discharge piping system as specified.

1.2 SUBMITTALS

- .1 **Shop Drawings:** Submit in accordance with E5 of the Bid Opportunity Documents.
 - .1 Pump: make, model, weight, and horsepower.
 - .2 Complete catalogue information, descriptive literature, specifications, dimensions, and identification of materials of construction.
 - .3 Performance data curves showing head, capacity, horsepower demand, and pump efficiency over entire operating range of pump, from shutoff to maximum capacity. Indicate separately design points, head, capacity, horsepower demand and overall efficiency at duty point.
 - .4 Motor operating data, including motor and insulation ratings, start-up and operating current ratings, operating voltage and amperage tolerances.
 - .5 Power and control wiring diagrams, including terminals and numbers.
 - .6 Complete motor nameplate data, as defined by NEMA, from motor manufacturer.
 - .7 Factory finish system.
 - .8 Installation instructions indicating assembly and mounting requirements, alignment and assembly tolerances
 - .9 Start-up instructions including lubricant requirements, electrical requirements, etc.
 - .10 List special tools, materials, and supplies furnished with equipment for use prior to and during start-up and for future maintenance, if any.
- .2 **Quality Control Submittals:**
 - .1 Factory test reports.
 - .2 Special shipping, storage and protection, and handling instructions.
 - .3 Suggested spare parts list to maintain equipment in service for period of one (1) year and five (5) years. Include list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

Part 2 Products

2.1 SUBMERSIBLE PUMP, P-1

- .1 Provide Flygt CP3127.090, Type HT, maximum 1800 rpm, and operating design condition point of 31.55 L/s at 4.0 m T.D.H.
 - .2 The pump shall be submersible intended for water containing solids or fibered material, clean water, or surface water.
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- .3 The pump body, motor casing and impeller shall be cast iron, free from blow holes, sand holes and other faults, accurately machined and fitted. All passages shall be designed and finished to reduce friction and the passageways shall be balanced with the impeller to reduce vibration. The impeller shall be statically and dynamically balanced.
- .4 Mechanical seals suitable for the pumped liquid.
- .5 Abrasion and corrosion resistant external finish.
- .6 Furnish pump with 5.59kW electric motor rated at 220V, 60 cycle, single phase. The motors shall be capable of driving the pumps continuously through the entire range of pump operation without increasing the temperature of the windings above the insulation rating. Pump units shall be supplied with sufficient length of operating cable for connection to panel.
- .7 Provide leakage sensor in stator housing.
- .8 Provide thermal contacts for stator that activate alarm and stops the pump at overtemperature.
- .9 The pump coupling for the pump discharge shall be Flygt 100 mm discharge elbow connection for lift station, or approved equal in accordance with B7 of the Bid Opportunity Documents, complete with guide pipes, upper guide pipe holder, floor mounted discharge elbow and stainless steel concrete anchor bolts.
- .10 The couplings shall have self-cleaning, non-clogging closing action.
- .11 The couplings shall permit removal of a pump and its return to service without entering the pump well to unbolt or unlock the connection between the pump and piping.
- .12 The pump guide pipes for the pump couplings shall be Schedule 10-304 stainless steel pipe, sized to the pump manufacturer's requirements.
- .13 Replaceable pump casing wear rings and impeller wear rings shall be corrosion and wear resistant.
- .14 Shop finish all units in accordance with the manufacturer's instructions.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product bulletins, handling, storage, installation instructions, and datasheet.

3.2 EQUIPMENT INSTALLATION

- .1 Dimensions shown on the Drawings for equipment bases and piping connections, etc., are approximate. Correct to suit the exact dimensions of the equipment provided.
 - .2 Supply and install all necessary shims, gaskets, any other items required to complete the installation.
 - .3 Provide all necessary lifting and loading equipment and all tools required to complete the installation.
 - .4 All defects in the operation of the pump shall be made good. Provide 1 year warranty.
 - .5 All equipment shall be standard finished and painted at the factory before shipment.
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3.3 TESTING

- .1 Pump shall be subjected to an operating test after installation. Electrical data on pump performance shall be documented and confirmed acceptable.

END OF SECTION

Part 1 General

1.1 QUALITY ASSURANCE

- .1 Welding materials, fabrication standards and labour qualifications must conform to ANSI/ASME B31.1, ANSI B16.25, ASME Section IX, and the Provincial Board of Labour Regulations latest current editions.
- .2 Use welders fully qualified and licensed by Provincial Authorities.
- .3 Non-specified pipe joining and pipe fitting methods such as T-drill and press fit are not permitted.

Part 2 Products

2.1 PIPE

- .1 Pump discharge piping: Schedule 10s, 304 stainless steel

2.2 FITTINGS AND JOINTS

- .1 Pump discharge piping: Stainless steel grooved fittings.
- .2 Victaulic Brand or Grinnel Gruv-Lok only
- .3 Use appropriate radius elbows where necessary to ensure proper fitment of pipework as shown on drawings

Part 3 Execution

3.1 PREPARATION

- .1 Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.
- .2 Prepare piping ends for use of grooved fittings.
- .3 Protect all pipes when stored on site from external conditions.

3.2 INSTALLATION

- .1 Provide dielectric type connections wherever joining dissimilar metals in open systems.
- .2 Support piping with suitable hangers, supports, and properly anchor as shown on drawings

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section Includes:
 - .1 General requirements for Control Systems.
- .2 Related Sections:
 - .1 Section 25 05 54 - Controls: Identification.
 - .2 Section E5 – “Shop Drawings” of this Bid Opportunity.
 - .3 City of Winnipeg Electrical Design Guide – Appendix A.
 - .4 City of Winnipeg Identification Standard.

1.2 References

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
 - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
 - .1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.
- .4 Electrical and Electronic Manufacturers Association (EEMAC).
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).

1.3 System Description

- .1 The controls shall include but not be limited to:
 - .1 Level transmitters (LE-001 and LE-002)
 - .2 Float level switch (LS-001)
 - .3 RTU control panel
 - .4 Termination of control wiring to terminals within existing field termination section.

1.4 Scope of Control Work

- .1 Design and installation to be in accordance with the City of Winnipeg Electrical Design Guide and Identification Standard, refer to Appendix E and F respectively.
- .2 The Contractor shall engage a factory trained representative to supervise the installation, setup, calibrate and operationally verify and commission the following:

- .1 Ultrasonic level transmitters
- .2 Float level switches
- .3 RTU control panel
- .3 The Contactor shall provide a certified instrument technician in order to operate all field devices that are wired to the RTU control panel in order for City of Winnipeg staff to verify the loop is correctly wired.
- .4 The Contractor shall submit written reports identifying the commissioning work, together with any parameter settings and final adjustments.
- .5 The Contractor is responsible for the supply and installation of the RTU control panel, termination of field wiring for power, controls and instrumentation to the terminals within the RTU control panel. All programming of the RTU control panel is to be provided by the contractor. Coordinate all remote interface and alarm points with City of Winnipeg.

1.5 Submittals

- .1 Make submittals in accordance with Section E5 – “Shop Drawings” of this Bid Opportunity.
- .2 Submit for review equipment list and system manufacturers 10 days after award of contract.

PART 2 - PRODUCTS

- .1 Not Used

PART 3 - EXECUTION

3.1 Manufacturer's Recommendations

- .1 Installation: to manufacturer's recommendations.

3.2 Painting

- .1 Painting: as follows:
 - .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
 - .2 Clean and prime exposed hangers, racks, fastenings, and other support components.
 - .3 Paint unfinished equipment interiors to EEMAC 2Y-1.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section Includes.
 - .1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, the Control System Work and nameplates materials, colours and lettering sizes.
- .2 Related Sections.
 - .1 Section 25 05 01 - Controls: General Requirements.
 - .2 Section 26 05 01 - Common Work Results - Electrical.
 - .3 Section E5 – “Shop Drawings” of this Bid Opportunity.
 - .4 City of Winnipeg Electrical Design Guide – Appendix A.
 - .5 City of Winnipeg Identification Standard – Appendix B.

1.2 References

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.1-06, The Canadian Electrical Code, Part I (20th Edition), Safety Standard for Electrical Installations.

1.3 System Description

- .1 Language Operating Requirements: provide identification for control items in English.

1.4 Submittals

- .1 Submittals in accordance with Section E5 – “Shop Drawings” of this Bid Opportunity supplemented and modified by requirements of this Section.
- .2 Submit to Contract Administrator for approval samples of nameplates, identification tags and list of proposed wording.

PART 2 - PRODUCTS

2.1 Nameplates for Panels

- .3 Provide panel identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .4 Nameplate for each panel size 4 engraved as indicated.
- .5 Nameplate for each panel mounted device size 2 engraved as indicated.

2.2 Nameplates for Field Devices

- .1 Provide field device identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Nameplate for field device size 7 engraved as indicated.
- .3 Nameplate shall be attached by chain.

2.3 Wiring

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each control panel.

PART 3 - EXECUTION

3.1 Nameplates and Labels

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section Includes:
 - .1 Control processors integral to the Control System: SCADA system.
 - .2 Related Sections:
 - .1 Section 25 05 01 - Controls: General Requirements.
 - .2 Section 25 05 54 - Controls: Identification.
 - .3 Section 26 05 01 - Common Work Results - Electrical.
 - .4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings
 - .5 Section 26 27 26 - Wiring Devices.
 - .6 Section E5 – “Shop Drawings” of this Bid Opportunity.

1.2 References

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

1.3 Submittals

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section E5 of this Bid Opportunity. Shop drawings shall indicate the control panel layout indicating all components and dimensions and all wiring diagrams.
- .2 Pre-Installation Tests.
 - .1 Test all I/O points, components and wiring within the RTU control panel prior to shipment from control panel manufacturer. Replace devices not meeting specified performance.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

PART 2 - PRODUCTS

2.1 General

- .4 Control devices of each category to be of same type and manufacturer.
- .5 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.

- .6 Operating conditions: 0 to 32 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified. Provide control panel environmental controls as required (heating and cooling) to maintain internal control panel temperature between 10⁰C and 30⁰C.
- .7 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .8 Control panel equipment to be unaffected by external transmitters including walkie talkies.

2.2 Process Controller

- .1 Process Controller Requirements:
 - .1 32 bit controller
 - .2 32 MHz clock & integrated watchdog timer
 - .3 16MB flash ROM, 4MB CMOS RAM, 4kB EEPROM
 - .4 Analog inputs - none
 - .5 Analog output – none
 - .6 Discrete inputs/outputs – 8 user selectable as dry contact inputs or open drain outputs, with removable terminal blocks
 - .7 Communication ports:
 - .1 Three (3) RS-232/485 serial ports,
 - .2 One (1) RJ-45 10/100Base-T Ethernet port
 - .3 Two (2) USB 2.0 compliant ports
 - .8 Power supply – 11 – 30 VDC, 12W at 24VDC maximum
 - .9 Three (3) year warranty
- .2 Additional I/O Board:
 - .1 Analog inputs - eight (8) selectable as 0-10VDC or 0-20mA with removable terminal blocks
 - .2 Analog output – none
 - .3 Discrete inputs – sixteen (16) at 12/24VDC, with removable terminal blocks
 - .4 Discrete outputs – ten (10) dry contact relay outputs, with removable terminal blocks

Approved Manufacture; Schneider Electric model P334-1A00-AB00. No alternates will be accepted.

- .3 Landline modem shall be a Phoenix Contact PSI-DATA/FAX-MODEM/RS232 (Part No. 2708203).
- .4 Programming to be provided by contractor according to the control narrative. Contractor to coordinate all SCADA communication I/O points with City of Winnipeg between Lee Blvd control panel and the McPhillips Street control station.

2.3 UPS and Power Supply

- .1 Combined power supply unit with UPS power backup
- .2 120VAC input
- .3 24VDC output, capable of delivering 2 amps for a duration of one hour with utility power failure
- .4 Din-Rail mounted
- .5 Acceptable material – Phoenix Contact model TRIO-PS/1AC/24DC/5 with battery unit model UPS-BAT/VRLA/24DC/3.4AH

2.4 Panels

- .1 Free-standing or wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Contract Administrator without adding additional cabinets.
- .3 Panels to be lockable with same key.

PART 3 - EXECUTION

3.1 Installation

- .1 Control panel to be manufactured within a CSA approved facility.
- .2 Provide terminal blocks and wireways within control panel as required.
- .3 Install panel in location as indicated on drawings.
- .4 Connect all field wiring to control panel and terminate.
- .5 Power to be applied to control panel after installation of panel is complete and all field wiring has been terminated and verified.
- .6 Provide all programming for all components as required. Any and all custom objects or applications that have been used in the development of the programs for all devices shall have full source code turned over to the City. There shall be no custom objects that are locked preventing the City from modifying the object and/or application. No intellectual property rights on the programs, objects or applications are permitted. The City shall have full access to all aspects of programs, objects and applications. Provide a hard copy of all files to be included within the O&M manuals.
- .7 Programming language shall be ladder logic format complete with full descriptions of all program elements and rungs.

3.3 Control Narrative

- .1 Pump Controls (P-1):
 - .1 The RTU will monitor the following for the pump:
 - .1 Selector switch in Auto control mode
 - .2 Selector switch in Hand control mode
 - .3 Pump run status
 - .4 Pump fault status – Temperature or Level alarm
 - .5 Control power statusThe RTU will also provide an output signal to the pump for pump disable. This command is for non-flood season use.
 - .2 The Level Transmitter will have start/stop control of the pump when the following conditions are met:
 - .1 Pump ready status is confirmed
 - .2 No Pump fault status is detected
 - .3 Selector switch is in Auto control mode
 - .3 The Level Transmitter will start/stop the pumps based on water level within the manhole.
 - .1 The pump shall start at 229.35m above sea level

- .2 The pump shall stop at 228.75m above sea level
- .3 A two (2) minute interval shall be required between pump stop and start.
- .4 The following alarms shall be generated for the pump:
 - .1 Pump fault status
 - .2 Control power status
 - .3 Motor ready status

- .2 Manhole Level Controls:
 - .1 The level in the manhole and in the gate chamber will be monitored by ultrasonic level transmitters.
 - .2 The following alarms shall be generated based on the following level conditions:
 - .1 High level in manhole
 - .2 High-high level in manhole
 - .3 An alarm will be generated if the pump is operating continuously for more than 12 hours and the manhole level and gate chamber level remain within a maximum difference of 50mm.

All level alarm setpoints shall be configurable through the remote SCADA system.
- .3 Miscellaneous Controls:
 - .1 The RTU shall monitor the following instruments:
 - .1 PNL-L7 power supply status
 - .2 RTU panel UPS fault status
 - .3 RTU panel UPS battery mode status
 - .4 RTU panel UPS charging mode status
 - .5 RTU panel supply power status
 - .6 RTU panel temperature
 - .7 Surge protection device status
 - .2 The following alarms shall be generated:
 - .1 PNL-L71 power failure
 - .2 RTU panel UPS fault
 - .3 RTU panel supply power failure
 - .4 RTU panel low temperature alarm

3.2 Testing and Commissioning

- .1 Calibrate and test control panel devices for accuracy and performance.
- .2 Verify control system operates as specified in control narrative.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section Includes:
 - .1 Instrumentation devices integral to the Control System: transmitters, sensors, controls, meters, switches, dampers, damper operators, valves, valve actuators, and low voltage current transformers.
 - .2 Related Sections:
 - .1 Section 25 05 01 - Controls: General Requirements.
 - .2 Section 25 05 54 - Controls: Identification.
 - .3 Section 26 05 01 - Common Work Results - Electrical.
 - .4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings
 - .5 Section 26 27 26 - Wiring Devices.
 - .6 Section E5 – “Shop Drawings” of this Bid Opportunity.

1.2 References

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1-06, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.

1.3 Definitions

- .1 Acronyms and Definitions: refer to Section 25 05 01 - Controls: General Requirements.

1.4 Submittals

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.
- .2 Pre-Installation Tests.
 - .1 Submit samples at random from equipment shipped, as requested by Contract Administrator, for testing before installation. Replace devices not meeting specified performance and accuracy.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

PART 2 - PRODUCTS

2.1 General

- .4 Control devices of each category to be of same type and manufacturer.

- .5 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.
- .6 Operating conditions: -40 - 40 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified.
- .7 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .8 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .9 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .10 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

2.2 Level Transmitter

- .1 Ultrasonic Level Transmitter Requirements (LT-L100-2):
 - .1 Dual point level monitoring,
 - .2 Pump on/off control,
 - .3 Modbus communication,
 - .4 Wall mount,
 - .5 Resolution: 0.1% of range,
 - .6 Power requirement: 24VDC
 - .7 Safety Approvals: FM/CSA Class 1, Div.2 Approval.

Approved Manufacture; Siemens MultiRanger 100 Dual Point

- .2 Remote Ultrasonic Transducer Requirements (LE-001, LE-002):
 - .1 Remote Ultrasonic Level Meter,
 - .2 Measuring Range: 0.3 to 8 m,
 - .3 Beam angle: 10⁰,
 - .4 Weight: 1.2kg,
 - .5 Frequency: 44Hz,
 - .6 Safety Approvals: FM/CSA Class 1 Div. 2,

Approved Manufacture; Siemens Echomax ERS-5

2.3 Electromechanical Relays

- .3 Requirements:
 - .1 Double voltage, DPDT, plug-in type with termination base.
 - .2 Coils: rated for 120 Vac or 24 Vdc. Other voltage: provide transformer.
 - .3 Contacts: rated at 5 amps at 120 Vac.
 - .4 Relay to have visual status indication

2.6 Panels

- .1 Free-standing or wall mounted enamelled steel cabinets with hinged and key-locked front door as indicated on drawings.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Contract Administrator without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.7 Wiring

- .1 In accordance with Section 26 27 26 - Wiring Devices.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #14 AWG Teck 90 Cu or RW90 Cu in conduit in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 Analog input and output: shielded #18 minimum stranded twisted pair ACIC Cu.

PART 3 - EXECUTION

3.1 Installation

- .1 Instrument components are not specifically located on drawings, but located on drawings in the general vicinity. The instrument components shall be field located as defined by mechanical piping and in accordance with the following:
 - .1 Instrument components shall not be attached to vibrating equipment, but shall be remotely mounted to a solid structure or on approved instrument mounting stands.
 - .2 Location of instruments, when shown on the drawings, is only approximate. The Contractor is responsible for actual location of field devices and must avoid interferences between conduit, pipes, equipment and instruments while providing maximum accessibility.
 - .3 Locate instruments components at eye level and in an easily accessible location.
 - .4 Instrument components that must be removed for servicing shall be installed with re-usable connectors, unions and flexible conduit.
 - .5 Electrical connections and terminations for field instruments and other field devices shall be in strict compliance with the manufacturer's instructions and loop drawings. This will include wire, wire termination, labelling, rigid and flexible conduit, fittings, and seals where required.
- .2 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on wall or pipe stands with approved mounting brackets or stands at a nominal height of 1.4 meters off floor.

- .5 For instruments with pre-terminated cable lengths provide a junction box as close as practical to connect with armoured cable or cable in conduit.
- .6 Allow for a variation of 3 meters from locations of devices as shown on drawings without extra cost provided pertinent information is provided prior to installation. Exact location will be determined by the installation of piping and mechanical equipment.
- .7 Threaded fastenings for mounting instrument components shall have either lock nuts or double nuts.
- .8 Cover locally mounted instrument components, after installation, with plastic bags to protect them from dust, dirt, paint spray, insulation materials, etc. Protect from mechanical damage.
- .9 Set output pressure of local air sets to pressure recommended for instrument to which it is to be connected.
- .10 Independently support solenoids, regulators or similar control devices on solid, vibration free structures and not on control valves. Minimize load on pneumatic tubing.
- .11 Field instruments located outdoors shall be winterized to prevent process or measurement fluids from freezing. The use of steam or electrical tracing, fill fluids, or enclosures will be shown on the Installation Detail drawings.
- .12 All instrument signal wiring and 120 Vac wiring shall be run by the Contractor from the field instrument to the field device as shown on the loop drawings. This includes wiring, rigid and flexible conduit, fittings and seals where shown. Conduit penetrations are not permitted into the top of any field junction box.
- .13 Electrical:
 - .1 Provide and route all instruments, power and control signal cabling.
 - .2 Complete installation in accordance with Section 26 05 01 - Common Work Results - Electrical.
 - .3 Refer to electrical control schematics included as part of control design schematics on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Contract Administrator before beginning Work.
 - .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
 - .5 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
 - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .3 Maximum conduit fill not to exceed 40%.
 - .4 Design drawings do not show conduit layout.
 - .6 Install conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

3.2 Instrument Supports

- .1 Clean and paint fabricated galvanized carbon steel mounting stands and brackets.
- .2 Before a mounting stand is attached to a concrete floor the surface of the concrete to be in contact with grout shall be roughed and cleaned of all dirt, oil, grease and loose material.

3.3 Temperature and Humidity Sensors

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

3.4 Panels

- .1 Arrange for conduit and tubing entry from bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.5 Calibration Tagging

- .1 When satisfactorily inspected and calibrated, the item shall have a tag affixed to it in an immediately visible location, which shall indicate that the device has been calibrated, by whom and the date of the calibration. Calibration procedures and records shall be available to the Contract Administrator throughout the course of the project and shall be delivered to the Contract Administrator upon the completion of work.

3.6 Identification

- .1 All field-mounted instrument items shall have an approved identification tag permanently attached by the Contractor upon completion of the initial inspection and calibration. This tag shall reflect the device's identification as shown on the appropriate drawing.
- .2 The tag will be permanently attached to the instrument with screws, rivets, or stainless steel or Monel wire, as appropriate. If an instrument is inside a protective enclosure or mounted behind a panel, instrument identity tags shall be mounted twice, once on the instrument and again on the enclosure. All instruments mounted on a control panel shall have an identity tag mounted on the instrument body and again on the face of the panel below the instrument face.
- .3 Identify field devices in accordance with Section 25 05 54 - Controls: Identification.

3.7 Testing and Commissioning

- .1 Calibrate and test field devices for accuracy and performance.

~End~

PART 1 - GENERAL

1.1 Related Sections

- .1 This section covers items common to sections of Division 26.
- .2 Section E5 – “Shop Drawings” of this Bid Opportunity.

1.2 References

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-06, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.
 - .2 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .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 SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th 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 Submittals: in accordance with Section E5 – “Shop Drawings” of this Bid Opportunity.
- .2 Submit for review single line electrical diagrams and locate under plexiglass as indicated.
 - .1 Electrical distribution system pad mounted enclosure.
- .3 Shop drawings in accordance with Section E5 – “Shop Drawings” of this Bid Opportunity.
 - .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 of 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.
- .4 Quality Control in accordance with Section E5 – “Shop Drawings” of this Bid Opportunity.
- .5 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.
- .6 Manufacturer's Field Reports: submit to Contract Administrator manufacturer's written report, within 3 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 Quality Assurance in accordance with Section E5 – “Shop Drawings” of this Bid Opportunity.
- .2 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 2 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 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Service instructions: Including a list of spare parts and replacement parts and the names and addresses of all suppliers.
 - .3 Maintenance instructions: Including start up, proper adjustment, lubrication and shutdown procedures.
 - .4 Installation instructions.
 - .5 Operating instructions.
 - .6 Safety precautions.
 - .7 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 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.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

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 and submit such approval as described in PART 1 - SUBMITTALS.
- .3 Factory 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: lamicoid 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.

2.8 Electrical Single Line Diagrams

- .1 Provide electrical single line diagrams under plexiglass as follows:
 - .1 Electrical distribution system: locate in main electrical room
- .2 Drawings: 280 x 432 mm minimum size.

PART 3- EXECUTION

3.1 Installation

- .1 Do complete installation in accordance with the current edition of the Canadian Electrical Code, CSA C22.1, except where specified otherwise.
- .2 Do overhead and underground systems 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.

- .4 Telephone and interphone outlets: 300 mm.
- .5 Wall mounted telephone and interphone outlets: 1500 mm.
- .6 Fire alarm stations: 1500 mm.
- .7 Fire alarm bells: 2100 mm.
- .8 Wall mounted speakers: 2100 mm.

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 E5 – “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 Lighting and its control.
 - .5 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .6 Systems: fire alarm system and communications.
 - .7 Test resistance to ground of the completed grounding electrode.
 - .8 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.18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2 No.65-93(R1999), Wire Connectors.

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 260520 - Wire and Box Connectors - 0 - 1000 V.
- .2 Section 260534 – Conduits, Conduit Fastenings and Conduit Fittings.
- .3 Section E5 – “Shop Drawings” of this Bid Opportunity.

1.2 References

- .1 CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131-M89(R1994), Type TECK 90 Cable.

1.3 Product Data

- .1 Submit product data in accordance with Section E5 – “Shop Drawings” of this Bid Opportunity.

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 260534 – 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 Install cable in trenches in accordance with Section 260543.01 – Installation of Cables in Trenches and in Ducts.
- .3 Terminate cables in accordance with Section 260520- Wire and Box Connectors - 0 - 1000 V.

3.3 Installation Of Armoured Cables

- .1 Group cables wherever possible.
- .2 Install cable in trenches in accordance with Section 260544 – Installation of Cables in Trenches and in Ducts.
- .3 Terminate cables in accordance with Section 260520 - Wire and Box Connectors - 0 - 1000 V.

3.4 Installation of Control Cables

- .1 Install control cables in conduit.

.2 Ground control cable shield.

END OF SECTION

PART 1 - GENERAL

1.1 References

- .1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

PART 2 - PRODUCTS

2.1 Outlet and Conduit Boxes General

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 Conduit Boxes

- .1 Cast FS or FD copper free aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle for rigid conduit or Teck Cable.
- .2 PVC boxes for PVC conduit.

2.3 Fittings - General

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 - EXECUTION

3.1 Installation

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

PART 1 - GENERAL

1.1 References

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - .2 CAN/CSA C22.2 No. 18-98, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
 - .3 CSA C22.2 No. 45-M1981(R1992), Rigid Metal Conduit.
 - .4 CSA C22.2 No. 211.2-M1984(R1999), Rigid PVC (Unplasticized) Conduit.

1.2 Preferences

- .1 In general power and control wiring shall be by TECK or armoured cable. Where suitable, PVC conduit may be used in wet areas and RGS may be used in dry areas.

PART 2 - PRODUCTS

2.1 Conduits

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Rigid pvc conduit: to CSA C22.2 No. 211.2.

2.2 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 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at spacing as per Rule 12-1010 of the current edition of the Canadian Electrical Code for rigid metal conduit.
- .4 Channel type supports for two or more conduits at spacing as per Rule 12-1114 of the current edition of the Canadian Electrical Code for pvc conduit.
- .5 Threaded rods, 6 mm dia., to support suspended channels.

2.3 Conduit Fittings

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

2.4 Expansion Fittings for Rigid Conduit

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 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 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .4 Minimum conduit size for lighting and power circuits: 19 mm.
- .5 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .6 Mechanically bend steel conduit over 19 mm dia.
- .7 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .8 Install fish cord in empty conduits.
- .9 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .10 Dry conduits out before installing wire.
- .11 Connect conduit to equipment securely to maintain continuity for the purpose of bonding to ground.
- .12 Provide for expansion and contraction of the conduit system.

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.

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 in 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.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-Z809-[08], Sustainable Forest Management.
- .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 01 - 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 Summary

- .1 Section Includes:
 - .1 Materials and installation for service entrance board.

1.2 Related Sections

- .1 The Bid Opportunity Documents
- .2 Section 260501 – Common Work Results – Electrical.

1.3 References

- .1 CAN/CSA-C22.2 No.31-M89 (R2000), Switchgear Assemblies.

1.4 Shop Drawings and Product Data

- .1 Submit shop drawings and product data in accordance with the Bid Opportunity Document.
- .2 Indicate on shop drawings.
 - .1 Floor anchoring method and foundation template.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned position and size of bus.
 - .4 Overall length, height and depth.
 - .5 Dimensioned layout of internal and front panel mounted components.
- .3 Include time-current characteristic curves for circuit breakers and fuses.

1.5 Closeout Submittals

- .1 Provide maintenance data for service entrance board for incorporation into manual as specified in the Bid Opportunity Documents.
- .2 Submit copies of maintenance data for complete assembly including components.

1.6 Extra Materials

- .1 Provide maintenance materials in accordance with the Bid Opportunity Documents.

PART 2 - PRODUCTS

2.1 Service Entrance Board

- .1 Service Entrance Board: to CAN/CSA-C22.2 No.31.
- .2 Confirm access requirements, provide narrow depth board if required.
- .3 Rating: as indicated on drawings.
- .4 Pad mounted Type 4 enclosure, complete with power distribution equipment, controls, motor starter, and lighting.

- .5 Provision of metering socket in separate enclosure mounted to exterior of main distribution enclosure.
- .6 Distribution section.
- .7 Access panels with captive screws.
- .8 Bus bars and main connections: 99.3% copper.
- .9 Cable from meter to lugs of main breaker.
- .10 Identify phases with colour coding.
- .11 Stainless steel continuous hinged doors, internal 3-point latch and Type 316L stainless steel padlocking capabilities in 2 locations on doors.

2.2 Moulded Case Circuit Breakers

Refer to 262821.

2.3 Fusible Disconnects and Fuses

- .1 N/A.

2.4 Grounding

- .1 Copper ground bus extending full width of cubicles and located at bottom.
- .2 Lugs at each end for size 2/0 grounding cable.

2.5 Finishes

- .1 Apply finishes in accordance with Section 260501 – Common Work Results – Electrical.
 - .1 Service entrance board exterior: grey.

2.6 Equipment Identification

- .1 Provide equipment identification in accordance with Section 260501 – Common Work Results – Electrical.
- .2 Nameplates:
 - .1 White plate, black letters, size 7.
 - .2 Complete board labelled: “240/120V”.
 - .3 Main disconnect labelled: “Main Breaker”.
 - .4 Branch disconnects labelled: as indicated.

2.7 Surge Protection Device

- .3 Maximum rated surge current – 80kA per phase
- .4 Rated applications – ANSI-IEEE C62.41 Location C, B & A
- .5 Fail safe design with dual component-level fusing
- .6 ET recognized component under UL 1449 3rd Edition as a type 1 and type 2 SPD
- .7 Input frequency 40 to 440 Hz

- .8 Maximum continuous operating current – 60 amps
- .9 Modes of protection – L-N, L-L, L-G, N-G
- .10 Status indicating lights
- .11 Short circuit rating – 200kAIC short circuit current rating with a 60 amp Class T fuse
- .12 Multi-point mounting feet
- .13 Acceptable material – Total Protection Solutions model ServiceTrack ST-080

PART 3 - EXECUTION

3.1 Installation

- .1 Locate service entrance board and fasten to fibreglass pad.
- .2 Connect main secondary service to line terminals of main breaker.
- .3 Connect load terminals of distribution breaker's to feeders.
- .4 Check factory made connections for mechanical security and electrical continuity.
- .5 Run grounding conductor 2/0 AWG bare copper from ground bus to ground rods indicated on drawings.

END OF SECTION

PART 1 - GENERAL

1.1 Section Includes

- .1 Materials and installation for standard and custom breaker type panelboards.

1.2 Related Sections

- .1 Section 26 05 01 - Common Work Results - Electrical.
- .2 Section 26 28 21 - Moulded Case Circuit Breakers.
- .3 Section E5 – “Shop Drawings” of this Bid Opportunity.

1.3 References

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.29-M1989(R2000), Panelboards and enclosed Panelboards.

1.4 Shop Drawings

- .1 Submit shop drawings in accordance with Section E5 – “Shop Drawings” of this Bid Opportunity.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

PART 2 - PRODUCTS

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.
- .2 250 V panelboards: Bus and breakers rated as indicated on drawings. 10 kA (symmetrical) interrupting capacity minimum.
- .3 600 V panelboards: Bus and breakers rated as indicated on drawings. 22 kA (symmetrical) interrupting capacity minimum.
- .4 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.
- .5 Panelboards: tin plated copper mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Tin plated copper bus with neutral of same ampere rating as mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked grey enamel.

2.2 Breakers

- .1 Breakers: to Section 26 28 21 - 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.
- .4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to City of Winnipeg.

2.3 Equipment Identification

- .1 Provide equipment identification in accordance with Section 26 05 01 - 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.

PART 3 - EXECUTION

3.1 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 01 - Common Work Results - Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

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 01 - Common Work Results - Electrical.
- .2 Section E5 – “Shop Drawings” of this Bid Opportunity.

1.3 References

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No.42-99(R2002), General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CSA-C22.2 No.42.1-00, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA-C22.2 No.55-M1986(July 2001), Special Use Switches.
 - .4 CSA-C22.2 No.111-00, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

1.4 Shop Drawings And Product Data

- .1 Submit shop drawings and product data in accordance with Section E5 – “Shop Drawings” of this Bid Opportunity.

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 in accordance with B7.

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 in accordance with B7.

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 01 - 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 01 - 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 Section Includes

- .1 Materials for moulded-case circuit breakers, circuit breakers, and ground-fault circuit-interrupters, fused circuit breakers, and accessory high-fault protectors.

1.2 Related Sections

- .1 Section E5 – “Shop Drawings” of this Bid Opportunity.

1.3 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 UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.4 Submittals

- .1 Submit product data in accordance with Section E5 – “Shop Drawings” of this Bid Opportunity.
- .2 Include time-current characteristic curves for breakers with ampacity of 600 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

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 Circuit breakers to have minimum symmetrical rms interrupting capacity rating as indicated on the drawings.
- .7 Circuit breakers identified as MCP will operate on the magnetic principle with a current sensing element in each pole.
- .8 Circuit breakers 600 A through 2500 A frame shall be Cutler-Hammer type Westinghouse Series C with microprocessor-based RMS sensing trip units or approved equal in accordance with B7.
 - .1 Each moulded case circuit breaker microprocessor-based tripping system shall consist of three current transformers, and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analysing the secondary current

signals received from the circuit breaker current transformers and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached.

- .2 Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be fixed. Rating plugs shall be interlocked such that a breaker cannot be closed and latched with the rating plug removed.
- .3 The microprocessor-based trip unit shall have thermal memory capabilities to prevent the breaker from being reset following an overload condition until after a preset time delay.
- .4 When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override. Internal ground fault protection adjustable pick-up ratings shall not exceed 1200 amperes.
- .5 Breakers shall have built-in test points for testing the long time delay, instantaneous, and ground fault functions of the breaker by means of a 120 Volt operated test set. Provide one test set capable of testing all breakers 600 ampere frame and above.
- .6 System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:
 - .1 Adjustable long time pick-up and delay.
 - .2 Adjustable short time pick-up and delay.
 - .3 Adjustable instantaneous pick-up.
- .7 Circuit Breakers shall be Cutler-Hammer type Westinghouse Series C circuit breakers, microprocessor-based RMS sensing trip units type Digitrip RMS 310 LSI or LSIG trip units or approved equal in accordance with B7.
- .8 Accessories:
 - .1 Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.
- .9 Enclosure:
 - .1 All enclosed circuit breakers shall have EEMAC 1 general purpose enclosures.
 - .2 All enclosed circuit breakers shall have metal nameplates, front cover mounted, that contain a permanent record of catalog number and maximum rating. Provide handle mechanisms that are padlockable in the "OFF" position.

2.2 Thermal Magnetic Breakers

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
- .2 Acceptable Product: Cutler-Hammer type Westinghouse Series C or approved equal in accordance with B7.

2.3 Magnetic Breakers

- .1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

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.
- .2 Section E5 – “Shop Drawings” of this Bid Opportunity.

1.3 References

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.14-95(R2001), Industrial Control Equipment.
 - .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1-2001, Industrial Control and Systems: General Requirements.

1.4 Shop Drawings

- .1 Submit shop drawings in accordance with Section E5 – “Shop Drawings” of this Bid Opportunity.
- .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 V, AC, 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 Operator Control Stations

- .1 Enclosure:
 - .1 In general CSA Type 4X, surface mounting.

2.6 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.

2.7 Selector Switches

- .1 Maintained, 2 or 3 position as required, labelled as indicated on drawings, heavy duty oil tight operators standard, contact arrangement as indicated, rated 120 V, 2 A minimum, or 24 Vdc, 2 A minimum as required.

2.8 Indicating Lights

- .1 Heavy duty Oil tight, full voltage, LED type, lens colour as indicated, supply voltage: 120 V, lamp voltage: 120 V, labels as indicated.

2.9 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.

2.10 Control Circuit Transformers

- .1 Single phase, dry type.
- .2 Primary: 600 V, 60 Hz ac.
- .3 Secondary: 120 V, AC.
- .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 01 - 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