Part 1 General

1.1 SUMMARY

.1 Provide one (1) submersible pump and related accessories.

.2 Provide pump discharge piping system as specified.

1.2 SUBMITTALS

.1 Shop drawings: submit in accordance with E10 of the Bid Opportunity Documents.

1. Pump: make, model, weight and horsepower.
2. Complete catalogue information, description 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

.1 Provide Flowserve 8MSX11A, maximum 1800 rpm, and operating design condition point of 114 L/s at 10.2 m T.D.H.

.2 The pump shall be submersible intended for water containing solids or fibered material, clean water or surface water.

.3 Provide integral wired-in rotor/shaft directional reversing action. The impeller shall be capable of operating in forward and reverse by means of an automatic or manual controller without removal from the pit.

.4 The pump body, motor casing shall be cast iron, free form 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.

.5 Use high chrome abrasion resistant impeller.

.6 Mechanical seals suitable for the pump liquid.

.7 Abrasion and corrosion resistant external finish.

.8 Furnish pump with 30hp electric motor rated at 600V, 60 cycle, 3 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 operating cable having a minimum length of 20 m (66 ft.) for connection to panel.

.9 Provide leakage sensor in stator housing.

.10 Provide thermal contacts for stator that activate alarm and stops the pump on over temperature. Provide leak detection sensor system.

.11 The pump coupling for the pump discharge shall be 200 mm discharge elbow connection for lift station, or approved equal in accordance with B7, complete with guide pipes, upper guide pipe holder, floor mounted discharge elbow and stainless steel concrete anchor bolts.

.12 The coupling shall have self-cleaning, non-clogging closing action.

.13 The coupling shall permit removal of pump and its return to service without entering the pump well to unbolt or unlock the connection between the pump and piping.

.14 The pump guide pipes for the pump couplings shall be Schedule 10-304 stainless steel pipe, sized to the pump manufacturer's requirements.

.15 Replaceable pump casing wear rings and impeller wear rings shall be corrosion and wear resistant.

.16 Provide exterior paint finish as per manufacturer's specifications.

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 Make good all defects in the operation of the pump. Provide 1 year warranty.

3.3 TESTING

.1 Test the pump after installation. Record and document electrical data on pump performance and confirm 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 Sump pump discharge piping:

1. Inside chamber to be schedule 80, steel pipe or Class 52 ductile iron.
2. Outside chamber to be AWWA C900 PVC.

2.2 FITTINGS AND JOINTS

.1 Sump pump discharge piping:

1. 200mm diameter “uni-flange” or approved equal in accordance with B7 removable flange.

.2 Use appropriate radius elbows where necessary to ensure proper fitment of pipework as shown on drawings

2.3 CHECK VALVE

.1 Ductile iron body with flanged ends and removable inspection cover manufactured and tested in accordance with AWWA C508.

.2 Flanges shall conform in dimension and drilling to ASME B16.1, Class 125.

.3 Valve Body, Cover: ductile iron ASTM A536 Gr. 65-45-12

.4 ASTM D2000-BG, Buna-N (NBR) sewage-resistant rubber flap and Type 302 stainless steel disc accelerator.

.5 Provide backflow actuator and mechanical indicator.

.6 Attach manufacturer's nameplate to the valve body with stainless steel fasteners.

.7 Verification: tested and inspected in accordance with AWWA C508, Section 5

.8 Acceptable product: Val-Matic Series 500 or approved equal in accordance with B7.

2.4 SOLID WEDGE GATE VALVE

.1 Solid wedge gate valves shall be metal-seated, single wedge NRS type comprised of ductile iron body with flanged ends designed and produced in accordance with AWWA C500.

.2 Valves to be designed for open/close service with minimal moving parts to prevent clogging or excessive build-up of foreign matter.

.3 Connections: flanged ends in accordance with ASME B16.1, Class 125

.4 Valve Body, Bonnet, Wedge: ductile iron ASTM A536 Gr. 65-45-12

.5 Scraper, Stem Nut, Wedge and Body Seat Rings: cast from ASTM B62 low-zinc bronze

.6 Stem: machined from ASTM A276 Type 304 or Type 316 stainless steel or materials offering equal and/or greater physical and material properties

.7 Provide stem with an integrally cast thrust collar.

.8 Packing and gaskets: non-asbestos materials

.9 Coatings: consistent with AWWA C500, Section 4

.10 Verification: tested and inspected in accordance with AWWA C500, Section 5

.11 Markings: cast on each valve in accordance with AWWA C500, Section 6

.12 Acceptable product: American R/D AWWA Solid Wedge Gate Valve, 100 Series for NRS style or approved equal in accordance with B7

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 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 anchors as shown on drawings.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 This Section covers items common to Sections of Division 26. This section supplements requirements of Division 1.

1.2 CODES AND STANDARDS

.1 Do complete installation in accordance with CSA C22.1-15 except where specified otherwise.

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

1.3 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 B4.

1.4 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.

1.5 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.

1.6 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Contract Document.

.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 12 unless otherwise specified.

1.7 ELECTRICAL EQUIPMENT MODIFICATION

.1 Where electrical equipment is field modified, arrange for special inspection and pay all associated fees.

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 switchgear and 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:

.2 Nameplates:

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

.2 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

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

.4 Allow for average of twenty-five (25) letters per nameplate.

.5 Identification to be English.

1.10 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings on both ends of phase conductors of feeders and branch circuit wiring.

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

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

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

1.11 MANUFACTURERS AND CSA LABELS

.1 Visible and legible, after equipment is installed.

1.12 WARNING SIGNS

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

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

1.13 WALL MOUNTED DRAWINGS

.1 Provide drawings in plexiglass holder adjacent to the main electrical distribution.

.1 Plexiglass holder to be designed for the purpose and allow for easy replacement of the drawing.

.2 Size: 432 x 279 mm minimum size.

.2 Drawings:

.1 Single Line Diagram

.2 Process P&ID

1.14 LOCATION OF OUTLETS

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

1.15 MOUNTING HEIGHTS

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

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights.

.1 Panelboards: 1800 to top

.2 Light switches: 1420 to top

.3 Wall receptacles: 900 to top

.4 Control panels: 1800 to top

.5 Emergency lights: 2400 (minimum)

.6 Emergency stop switches: 900 to top

.7 Motor disconnect switches: 1800 to top

1.16 CONDUIT AND CABLE INSTALLATION

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

.2 For wall, partitions, and ceilings the sleeve ends shall be flush with the finish on both sides but for floors they shall extend 100 mm above finished floor level.

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

1.17 FIELD QUALITY CONTROL

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

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

1.18 TESTING

.1 All test instruments utilized are to have been calibrated within one year of the date utilized.

1.19 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

.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.

1.20 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.

.2 Provide as-built drawings in AutoCAD current format. Retain and pay WSP for this service.

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 REFERENCES

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

.2 CAN/CSA-C22.2 No. 38, Thermoset-Insulated Wires and Cables.

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

.4 CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Contract Document.

Part 2 Products

2.1 BUILDING WIRES

.1 Wire: to CAN/CSA-C22.2 No. 38

.2 Conductors:

.1 Size as indicated. Minimum size: 12 AWG.

.2 Stranded for 10 AWG and larger.

.3 Copper conductors.

.3 Voltage rating:

.1 Circuits 480 V and less: 600 V

.2 Circuits > 480 V: 1000 V

.3 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

.4 Colour coding to Section 26 05 01, wires sized 2 AWG and smaller to be factory-coded, taping will not be accepted.

2.2 TECK CABLE

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

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90, 1000V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: polyvinyl chloride material.

.7 Fastenings:

.1 One-hole malleable iron / 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.

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

.8 Connectors:

.1 Watertight, approved for TECK cable.

2.3 VFD CABLE

.1 Cable to:

.1 CAN/CSA-C22.2 No. 38.

.2 CAN/CSA-C22.2 No. 174.

.3 CAN/CSA-C22.2 No. 230.

.2 Conductors:

.1 Grounding conductors: Three copper, symmetrically located in continuous contact with the copper tape shield or continuous aluminum armour.

.2 Circuit conductors: copper, size as indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90, 1000V.

.4 Shield: Continuous copper tape shield with 50% overlap or continuous (non-interlocked) aluminum armour.

.5 Armour: aluminum, interlocking or continuous.

.6 Overall covering: polyvinyl chloride material.

.7 Approved for six-pulse VFD use.

.8 Fastenings:

.1 One-hole malleable iron / 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.

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

.9 Connectors:

.1 Watertight, approved for the cable.

2.4 ACIC/CIC CONTROL CABLE

.1 Cable: to CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.

.2 Conductors, copper, size as indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90, 600V. City of Winnipeg Section 26 05 21

.4 Shielding as indicated on the drawings.

.5 A higher level of shielded cable may be substituted for unshielded, or overall shielded cable, unless otherwise specified, provided that all appropriate shield grounding, as required by the Contract Administrator, is performed. All subsequent related changes, such as required conduit size, fittings, etc. are the responsibility of the Contractor.

Part 3 Execution

3.1 GENERAL

.1 Do not splice cables. A continuous length is required for all feeds.

.2 Install in accordance with manufacturer's recommendations, observing requirements for minimum bending radius and pulling tensions.

3.2 INSTALLATION OF BUILDING WIRES

.1 Install in conduit as per Section 26 05 34.

3.3 INSTALLATION OF TECK CABLE 0 -1000 V

.1 Where surface mounted, provide clamps spaced a maximum of 1 m apart.

.2 Perform an insulation-resistance test on each conductor, prior to termination, utilizing a megohmmeter with a voltage output of 1000 volts DC. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute.

.3 Investigate resistances less than 50 megaohms, or deviations between parallel conductors. Conductors with insulation resistance values, at one minute, less than 25 megaohms, or that deviate from other similar conductors by more than 50% will be rejected.

3.4 INSTALLATION OF CONTROL CABLES

.1 Ground shields at one end only. Where possible, ground shields at the end where power is supplied to the cable. Utilize shield grounding bar in panels, where present, to ground overall shields. Individual pair shields to be grounded on appropriate terminals.

.2 Shield drain wires, at the ungrounded end, are to be taped back to the cable. Fully insulate the shield. Do not cut the shield drain wire off.

.3 ACIC cable may be installed in cable tray, provided that:

.1 The cable tray does not contain power cables, unless specifically authorized by the Contract Administrator in writing.

.2 The ACIC cable voltage rating is equal or greater than the highest voltage contained in the cable tray.

3.5 TERMINATIONS AND SPLICES

.1 Wire nuts are permitted only in the following circuits:

.1 Lighting circuits.

.2 Receptacle circuits.

.2 Exercise care in stripping insulation from wire. Do not nick conductors.

.3 Strictly follow manufacturer's instructions with regards to tool size and application methods of terminations and compounds.

.4 Where screw-type terminals are provided on equipment and instrumentation, terminate field wiring with insulated fork tongue terminals.

.1 Manufacturer: Thomas and Betts, Sta-Kon, or approved equal in accordance with B7.

3.6 INSTALLATION IN CONDUIT

.1 Utilize cable grips, appropriately selected to accommodate the type and geometry of the cable.

.2 Utilize cable pulling lubricant, compatible with the cable and conduit.

3.7 CABLE INDENTIFICATION

.1 Install cable tags.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

.1 Provide submittals in accordance with Contract Document.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

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.

.2 Canadian Standards Association, (CSA International)

Part 2 Execution

3.1 EQUIPMENT GROUNDING AND BONDING

.1 Install grounding connections to transformers.

.2 Install bonding connections to all electrical equipment.

.3 Include a separate green bonding wire in all power conduits including branch circuit wiring sized according to the largest power conductor in the conduit:

.1 8 AWG green ground wire for up to 4 AWG power conductors.

.2 6 AWG green ground wire for up to 2 AWG power conductors.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Perform tests before energizing electrical system.

END OF SECTION

Part 1 General

1.1 NONE

.1 None.

Part 2 Products

2.1 FRAMING AND SUPPORT SYSTEM

.1 Materials:

.1 Conduit support structures shall employ an aluminum strut framing system together with the manufacturer's connecting components and fasteners for a complete system.

.2 Finishes:

.1 Wet locations: Aluminum.

.2 Indoors/ inside panels, dry locations: Aluminum.

.3 Nuts, bolts, machine screws: Stainless steel.

2.2 CONCRETE AND MASONRY ANCHORS

.1 Materials: hardened steel inserts, zinc plated for corrosion resistance.

.2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four.

.3 Manufacturer: Hilti (Canada) Limited or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to solid masonry, tile and plaster surfaces with galvanized anchors.

.2 Secure equipment to poured concrete with expandable inserts.

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

.4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.5 Maximum spacing between conduit supports:

.1 16mm conduit: 1.0 m

.2 21mm conduit: 1.5 m

.3 27mm conduit: 1.5 m

.4 35mm conduit: 2.0 m

.5 41mm conduit and larger: 2.5 m

.6 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole aluminum straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole aluminum straps for conduits and cables larger than 50 mm.

.7 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm dia. threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm dia. threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels, with maximum centre spacing as indicated above.

.9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Contract Administrator.

.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and components for splitters, junction, pull boxes, and cabinets.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.76, Splitters

Part 2 Products

2.1 JUNCTION AND PULL BOXES AND CABINETS

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.

.3 Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

.4 All enclosures shall suit the environment where they are installed as follows:

.1 CSA/ NEMA 1 metal enclosures when installed inside panel

.2 CSA/ NEMA 4 (WP) stainless steel enclosures when installed outdoors

.3 CSA/ NEMA 7 (XP) metal enclosures when installed in hazardous classified areas.

3.2 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Install size 3 identification labels indicating system voltage and phase.

.3 Install a permanent label or lamacoid on the cover of all junction boxes indicating the circuit(s) contained within.

.1 Example: L10-2 (Panel L10, circuit 2)

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-18, Canadian Electrical Code, Part 1, 24th Edition.

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.

.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 SURFACE MOUNTED OUTLET BOXES FOR METAL CONDUIT

.1 General Requirements:

.1 Acceptable materials:

.1 Cast Aluminum

.2 Cast ferrous alloy with corrosion resistant epoxy coating.

.2 Suitable for threaded rigid conduit

.3 Mounting lugs as required.

.2 Specific Requirements:

.1 In Panel Outlets:

.1 Crouse Hinds VXF/VFT series

.2 Device Boxes:

.1 Crouse Hinds FS/FD series

.2 Wet location covers for all locations below grade

.3 Device Boxes in classified areas:

.1 Crouse Hinds ‘explosion-proof’ rated.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 CONDUIT BOXES

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices in Panels.

2.6 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.7 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 35 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

.1 All boxes for outlets and devices shall suit the environment where they are installed as follows:

.1 CSA/ NEMA 1 metal enclosures when installed inside panel

.2 CSA/ NEMA 4 (WP) stainless steel enclosures when installed outdoors

.3 CSA/ NEMA 7 (XP) metal enclosures when installed in hazardous classified areas.Support boxes independently of connecting conduits.

.2 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

.3 Vacuum clean interior of outlet boxes before installation of wiring devices.

.4 Provide permanent label or lamacoid for all device boxes indicating the circuit(s) contained within.

.1 Example: L10-2 (Panel L10, circuit 2)

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

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

.2 CAN/CSA C22.2 No. 45.1, Electrical Rigid Metal Conduit – Steel.

.3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

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

.5 CAN/CSA C22.2 No. 227.3, Nonmetallic Mechanical Protection Tubing (NMPT) and Fittings (Binational Standard, with UL 1696).

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45.1, galvanized steel threaded,

.2 Electrical Metallic Tubing CAN/CSA C22.2 No. 83, aluminum threaded.

.3 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

.4 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.

2.3 CONDUIT FITTINGS

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

.2 Utilize insulated grounding bushings at all enclosure entries.

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 Use rigid aluminum threaded conduit and flexible metal conduit inside P&C Panel.

.3 Use rigid galvanized steel threaded conduit outside P&C Panel and in Chambers.

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

.5 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits. City of Winnipeg Section 26 05 34

.6 Do not include more than the equivalent of four (4) quarter bends. Provide pull boxes as required.

.7 Ensure electrical continuity in all conduit systems.

.8 All conduit shown exposed in finished areas is to be free of unnecessary labels and trade marks.

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

.10 EYS seal conduits after explosion-proof boxes towards unclassified areas. Add Chico compound to stop migration of hazardous gases only after all tests and commission is successfully done.

.11 Where conduits pass through walls, group and install through openings. After all conduits shown on the Drawings are installed, close wall openings with material compatible with the wall construction.

.12 Install fish cord in empty conduits.

13 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 Group conduits wherever possible on suspended or surface channels.

.3 Provide a minimum space of 12 mm between conduits.

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

.5 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

.6 Provide a separate ground wire within rigid conduit, bonded to motor frames and system ground.

3.3 LIQUID-TIGHT AND EXPLOSION-PROOF FLEXIBLE CONDUIT

.1 Use as LT raceways at all motors, pipe-mounted control devices, and other devices subject to movement or water when located in non-classified areas.

2 Use as XP raceways at all motors, pipe-mounted control devices, and other devices subject to movement when located in classified areas.

.3 At all motors provide a short length before connecting to the motor terminal box. Minimum length shall be 450 mm plus four times the conduit diameter.

.3 Provide a separate ground wire within flexible conduit, bonded to motor frames and system ground.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association, (CSA International)

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

Part 2 Products

2.1 CABLE PROTECTION

.1 38 x 190 mm planks pressure treated, water repellent preservative.

Part 3 Execution

3.1 DIRECT BURIAL OF DUCTS IN TRENCHES

.1 After sand base in trenches is in place, lay ducts maintaining 75 mm clearance from each side of trench to nearest cable. Maintain a burial depth of 1M throughout its length. Do not pull ducts into trench.

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

.3 Minimum permitted radius 6 times diameter of ducts or in accordance with manufacturer's instructions.

.4 Duct separation:

.1 As shown on drawings.

.5 After sand protective cover specified in Section 31 23 10 - Excavating, Trenching and Backfilling, is in place, install continuous row of 38 x 190 mm pressure treated planks as indicated to cover length of run.

3.2 CONCRETE ENCASED DUCTS IN TRENCHES UNDER VEHICULAR AREAS

.1 Follow steps 1 thru 5 as stated in item 3.1 above.

.2 Concrete encase with top and bottom reinforcements all ducts when running under or crossing vehicular traffic/ paved roadway areas

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 NETA ATS-2017, Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems, 2017 Edition

1.2 TESTING REPORT

.1 Prepare an overall inspection and test report that details all investigations and tests.

.2 The Contractor shall furnish five paper copies and two electronic copies on CD of each final report.

.1 The electronic copies of the report, including the test forms, shall be provided in PDF format.

.2 The Microsoft Word version of the all completed test forms provided to the Contractor shall also be included on the CDs.

.3 The report shall be neat and organized. Any omissions, inconsistencies, or incomplete work identified by the Contract Administrator shall be corrected and incorporated into the report in the appropriate section, and completely resubmitted.

.4 A draft of each report shall be completed and sent to the Contract Administrator for review a maximum of one month after the completion of the inspections at the Site.

.5 The final report shall be submitted a maximum of two weeks after the Contractor receives the mark-up of the draft report from the Contract Administrator.

.6 The report shall include the following:

.1 Summary of project.

.2 Testing Equipment.

.3 Detail the type, manufacturer, model, and last calibration date of all testing equipment.

.4 Description of equipment tested.

.5 Description of all tests.

.6 Typed inspection forms including:

.1 Identification of the testing organization.

.2 Equipment identification.

.3 Humidity, temperature, and other conditions that may affect the results of the tests/calibrations.

.4 Date of inspections, tests, maintenance, and/or calibrations.

.5 Identification of the testing technician.

.6 Indication of inspections, tests, maintenance, and/or calibrations performed and recorded, along with charts, and graphs as applicable. All measurements and readings taken shall be noted for inclusion in the report. Where repairs are made, measurements and readings before and after the repair shall be included.

.7 Indication of expected results, when calibrations are to be performed.

.8 Indication of "as-found" and "as-left" results, as applicable.

.7 Itemized list of all repaired deficiencies which shall include:

.1 Detailed description of the deficiency.

.2 The cost associated with the deficiency repair.

.8 Itemized list of all un-repaired deficiencies encountered which shall include:

.1 Detailed description of the deficiency.

Part 2 Products

2.1 NOT USED

.1 Not Used

Part 3 Execution

3.1 SCOPE OF TESTING

.1 PNL-L1, including:

.1 Surge Protector

.2 Power Meter

.3 CTs

.4 PTs (if present)
.3 Power Panel AA

.4 Power Panel A

.5 XFMR A

.6 Motor Starter – Pump

.7 Motor Starter – Actuator

.8 Motor, pump

.9 Motor, actuator

.10 Perform a harmonics measurement, at the following locations:

.1 Power Panel AA incoming feed.

3.2 INSPECTION, TESTING AND MAINTENANCE PROCEDURES

.1 General

.1 All tests are based on NETA (InterNational Electrical Testing Association) standard ATS-2003. Where manufacturer's specifications, tolerances, and/or published data are not available, refer to the appropriate tables in ATS-2003.

.2 Torque all accessible bolted electrical connections. Additional requirements apply as specified.

.3 Utilize all drawings for reference while performing the specified electrical inspection work. Where the existing installation deviates from that shown on the drawings, mark-up the drawings with red pen as required to reflect the installation. Include the marked-up drawings in the report.

.4 The scope of required drawing checks is limited to the equipment and components that are part of the electrical inspection work.

.5 Any repairs made that affect the accuracy of the drawings shall be marked up on the drawings.

.6 Drafting of drawings is not required.

.7 All inspection values, readings, corrections, and assessments shall be clearly recorded for inclusion within the report.

.8 Where corrections or repairs are made, record both as found/as left test readings on the inspection sheet. If space is not provided on the inspection form, record the readings in the Note fields or on a separate sheet.

.2 Inspection Forms

.1 The inspection forms to be completed by the Contractor are provided for reference in PDF format.

.2 Microsoft Word form templates will be provided prior to the work being initiated.

.3 Make appropriate print-outs of the inspection forms and utilize for entry of data

and test results on site.

.4 Utilizing the Microsoft Word form templates, enter the data recorded manually into the forms electronically.

.5 Complete the inspection forms in the entirety and include them in the report.

.6 Submit electronic PDF copies of the inspection forms.

.7 The scope of work required in the specifications is in no way limited by the inspection forms, or spaces provided. Provide additional pages, documents, and forms as required to provide a complete report.

.8 The inspection forms may be updated during the Work by the City or Contract Administrator. Utilize the latest forms provided.

.9 Perform insulation resistance temperature correction calculations.

3.3 CABLES, < 1000 V (ALSO FEEDERS IN CONDUIT)

.1 Inspection and testing shall be comprised of the following:

.1 For cables/wires 4/0 AWG or larger, inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate and correct values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Torque all accessible bolted electrical connections.

.3 Inspect compression applied connectors for correct cable match and indentation.

.4 Inspect grounding and cable/conduit support.

.5 Verify that visible cable bends meet or exceed the minimum allowable bending radius.

.6 Measure length of cable/conduit and record in meters.

.7 If cables/wires are terminated through window-type current transformers, inspect to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.

.8 Perform an insulation-resistance test on each conductor. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 1000 megaohms. The voltage applied shall be 500 Vdc for 300 V rated cables, and 1000 Vdc for 600 V or 1000 V rated cables.

3.4 SURGE ARRESTORS, LOW VOLTAGE

.1 Inspection and testing shall be comprised of the following:

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, grounding, and required clearances.

.3 Clean the unit.

.4 Verify that arrestors are electrically connected in their specified configuration.

.5 Perform resistance measurements through bolted connections with a low resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.6 Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

.7 Verify that stroke counter, if present, is correctly mounted and electrically connected.

.8 Perform insulation-resistance tests for one minute from each phase terminal to the case.

.9 Equipment rated >= 600V, utilize a test voltage of 1000 VDC.

.10 Equipment rated < 600V, utilize a test voltage of 500 VDC.

.11 Test the grounding connection. Resistance between the arrester ground terminal and the ground system should be less than 0.5 ohm.

3.5 METERING DEVICES, DIGITAL

.1 Inspection and testing shall be comprised of the following:

.1 Inspect physical and mechanical condition.
.2 Torque all bolted connections.

.3 Record the equipment nameplate data for inclusion in the report.

.4 Verify accuracy of voltage and current at a minimum of two points each.

.5 If required, calibrate meters in accordance with manufacturer’s published data.

3.6 MOTORS, INDUCTION, AC, 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Inspect air baffles, filter media, cooling fans, slip rings, brushes, and brush rigging. Air baffles and filter media should be clean. Cooling fans should operate. Slip ring wear and brushes should be within manufacturer's tolerances for continued use. Brush rigging should be intact.

.5 Clean the unit.

.6 Inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.7 Verify the application of appropriate lubrication and lubrication systems.

.8 Verify the absence of unusual mechanical or electrical noise or signs of overheating.

.9 Perform a rotation test to insure correct shaft direction.

.10 Perform insulation-resistance tests in accordance with ANSI/IEEE Standard 43. Test voltage shall be in accordance with manufacturer's published data or 500 Vdc.

.1 Where possible, test each winding separately. Ground all windings not under test.

.2 Ensure all cables and accessories are disconnected during the test.

.3 For motors <= 150kW (200 HP), the test duration is to be one (1) minute. Calculate the dielectric absorption ratio.

.4 Correct test results to 40 °C.

.5 Investigate readings below 100 megaohms. Investigate dielectric absorption ratios less than 1.4 and polarization index ratios less than 2.0 for Class B insulation and Class F insulation.

.11 Where it is not possible to perform an insulation resistance test separately on each winding, perform a winding resistance test on each winding using a low-resistance ohmmeter.

.12 Measure running voltage and current and evaluate relative to load conditions and nameplate full-load amperes. Utilize a true RMS meter.

.1 Where powered by a VFD with bypass, perform test with the motor powered by the VFD and by the bypass starter.

.13 Perform insulation-resistance test on insulated bearings in accordance with manufacturer's published data, if applicable.

.14 Perform resistance tests on resistance temperature detector (RTD) circuits. RTD circuits should conform to design intent and/or machine protection device manufacturer's specifications.

3.7 MOTOR STARTERS, 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Record all adjustable settings, size of overload, etc.

.3 Inspect physical and mechanical condition.

.4 Inspect anchorage, alignment, and grounding.

.5 Verify the unit is clean.

.6 Torque all accessible bolted power connections.

.7 Inspect contactors for evidence of overheating or stress.

.8 Visually inspect and exercise circuit breaker.

.9 If power fuses are present, record fuse size and type. Measure the resistance of each fuse. Investigate inconsistent resistance values.

3.8 CIRCUIT BREAKERS, INSULATED CASE/MOLDED CASE, 600 V

.1 Inspection and testing shall include the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Record all adjustable settings.

.3 Inspect physical and mechanical condition.

.4 Inspect anchorage and alignment.

.5 Clean the unit.

.6 Torque all accessible bolted power connections.

.7 Operate the circuit breaker to insure smooth operation.

.8 Test all breakers utilizing the "Push-To-Trip" button, if equipped.

.9 Move operating handle to the off and on position.

.10 Restore breaker position to original position.

.2 For cables 4/0 AWG and larger, inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.3 For breakers with a frame size greater or equal to 250A, or as specified elsewhere in the specification:

.1 Perform an insulation resistance test.

.2 Breakers rated < 600V, test voltage is to be 500 VDC.

.3 Breakers rated >= 600V, test voltage is to be 1000 VDC.

.4 Perform a contact/pole-resistance test.

3.9 TRANSFORMERS, LOW VOLTAGE, DRY-TYPE

.1 Inspection and testing shall be comprised of the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Clean the unit.

.5 Torque all accessible bolted power connections.

.6 Record the tap setting.

.7 Perform insulation-resistance tests winding-to-winding and each winding-to ground. Duration of the test is to be one minute. Calculate the dielectric absorption ratio.

.1 600 V windings shall be tested at 1000 Vdc.

.2 120/208 V windings shall be tested at 500 Vdc.

3.10 PANELBOARDS, LOW VOLTAGE

.1 Inspection and testing shall be comprised of the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Clean the unit.

.5 Inspect breakers and verify mechanical operation by exercising all circuit breakers.

.1 Record breaker data on the inspection form.

.2 Test all breakers utilizing the “Push-To-Trip” button, if equipped.

.3 Move operating handle to the off and on position.

.4 Restore breaker position to original position.

.6 Test main and feeder/load breakers with a frame size >= 250A, or with long, short, or ground fault settings and complete a separate inspection form for each.

.7 Torque all accessible bolted power connections including incoming, load neutral and ground connections.

.8 Perform insulation-resistance tests on each bus phase with all other phases grounded.

.9 The main breaker, if present, is to be open for the test. If no main breaker is present, disconnect the supply conductors.

.10 Open all load breakers.

.11 Test voltage for all 600/347 V panelboards to be 1000 Vdc.

.12 Test voltage for all 120/208 V panelboards to be 500 Vdc.

3.11 GROUNDING SYSTEM

.1 Inspection and testing shall be comprised of the following:

.1 Perform resistance tests between the main grounding electrode and grounded points in the electrical distribution system located in the P&C Panel, 200A CSTE, etc. Investigate connections with a resistance greater than 0.5 milliohms.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2 No. 47, Air-Cooled Transformers (Dry Type).

.2 CSA C9, Dry-Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

1.3 PRODUCT DATA

.1 Submit product data in accordance with Contract Document.

Part 2 Products

2.1 TRANSFORMERS

.1 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA C22.2 No. 47.

.2 Design 1 – 600V Input.

.1 Type: ANN.

.2 Single phase, 7.5 kVA, 600V input, 120/240 V output, 60 Hz.

.3 Voltage taps: 2.5% full capacity above and below normal.

.4 Windings: copper.

.5 Insulation: Class H, 220ºC.

.6 Temperature rise: 115ºC at continuous full load.

.7 Basic Impulse Level (BIL): 10 kV.

.8 Hipot: 4kV.

.9 Average sound level: To meet the local municipal & building codes and meet at minimum the following criteria:

45 dB max. up to 45 kVA

50 dB max. up to 150 kVA

.10 Impedance at 170 degrees C: standard

.11 Mounting: wall mounted.

.12 Nameplate to include actual transformer impedance (%Z).

.13 Encapsulated outdoor rated. NEMA 4X.

.14 Finish: in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Label size: 7.

.3 Indicate equipment identifier, KVA rating, primary and secondary voltage.

Part 3 Execution

3.1 INSTALLATION

.1 Mount dry type transformers up to 75 kVA. Provide brackets and bolts for wall mounted transformers. Ensure all transformers have good ventilation.

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Install non-combustible insulating board, extending 300mm around transformer on all sides, behind transformer to meet CEC code requirements.

.5 Remove shipping supports only after transformer is installed and just before putting into service.

.6 Loosen isolation pad bolts until no compression is visible.

.7 Make primary and secondary connections in accordance with wiring diagram.

.8 Mount transformers to reduce direct and transmitted noise. Mount core and coils of transformers.

.9 Make connections to transformers in flexible conduit, entering the enclosure below the coils.

.10 Energize transformers after installation is complete.

.11 Adjust tap connections to give a continuous secondary voltage of 120 volts phase to neutral, under load.

3.2 TESTING

.1 Utilize test form provided. Complete test form in full.

.2 Perform an insulation-resistance test. Individually test each winding with all other windings grounded, and test winding to winding, with both windings ungrounded. The test voltage shall be 1000 VDC, unless otherwise indicated by the manufacturer. The test duration shall be one minute.

.3 Measure and record the voltage on the primary and secondary of the transformer. Adjust the tap position as required. Record final tap position and voltage.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.29, Panelboards and enclosed Panelboards.

1.3 SHOP DRAWINGS

.1 Submit product data in accordance with Contract Document.

.2 For SPD units:

.1 Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (In).

.2 For side-mount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

1.4 O&M Manual

.1 Include SPD Operation and maintenance manuals.

Part 2 Products

2.1 PANELBOARDS, 240 V OR LESS

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

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

.2 240 V panelboards: bus and breakers rated for 10 kA (symmetrical) interrupting capacity.

.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.

.5 Main Breaker:

.1 Main Breaker if required to be top mounted.

.2 Back-fed main breakers are not acceptable.

.6 Two (2) keys for each panelboard and key panelboards alike.

.7 Copper bus with neutral of same ampere rating as mains.

.8 Trim with concealed front bolts and hinges.

.9 Trim and door finish: baked grey enamel.

.10 Enclosure: 508mm (20") wide

.11 Acceptable manufacturers:

.1 Square D (Schneider).

.2 Cutler-Hammer (Eaton).

.3 Siemens.

2.2 PANELBOARD, 600 V

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

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

.2 Provide panelboard as follows:

.1 Service type: 3 phase, 3 wire

.2 Bus and breakers rated for 22 kA (symmetrical) interrupting capacity.

.3 Continuous bus rating: 200 A

.4 Main moulded case service entrance type breaker:

.1 100 Amp rated.

.2 High instantaneous automatic trip.

.3 Bottom mounted.

.4 Back-fed main switch is not acceptable.

.5 Main switch enclosure to be sized to allow for installation of moulded case circuit breaker in future.

.6 Service entrance separating main switch from branch circuit breakers.

.7 Solidly bonded equipment ground bar, suitable for termination of 2/0 AWG ground conductors.

.8 Mounting space for, at minimum, eight 3-pole branch circuit breakers with provision for two 3-pole additional branch circuit breakers in future via installation of appropriate mounting hardware.

.9 Include three-phase electronic power meter as specified in this Section.

.1 Include three CTs, 300:5A

.10 Trim and door finish: baked grey enamel.

.11 Enclosure:

.1 Minimum 1016 mm (40”) wide

2.3 BREAKERS

.1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards.

2.4 SURGE PROTECTIVE DEVICE

.1 Supply and install a Surge Protective Device (SPD) where shown on the drawings.

.2 Requirements:

.1 SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd 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 SPD must protect all modes of the electrical system being utilized. The required protection modes are:

.1 3Ø, 3W System: L-L, and L-G

.2 3Ø, 4W Wye System: L-L, L-N, L-G, and N-G

.3 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 145kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 145kA 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:

.1 120/208 V: 700V

.2 347/600 V: 1500V

.2 L-L:

.1 120/208 V: 1200V

.2 347/600 V: 3000V

.3 SPD Design

.1 Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs 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 SPD 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 SPD 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.

.4 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.

.5 Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

.1 600V Equipment –Service Entrance: 25 kA

.2 600V Panelboards – Not Service Entrance: 18 kA

.3 240V or less Panelboards –Service Entrance: 10 kA

.4 240V or less Distribution Panelboards – Not Service Entrance: 10 kA

.6 Panelboard Installation Requirements:

.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 30A circuit breaker.

.5 The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard where shown on the drawings.

.1 The complete panelboard including the SPD shall be CSA/cUL listed.

.6 Where shown on the drawings, a SPD may be installed external to the panelboard.

.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.

2.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Nameplate for each panelboard size 7 engraved as follows:

.1 Line 1 is to be the panel identifier on the drawings, for example “PNL-L10”.

.2 Line 2 is to be the voltage, for example “120/240V, 1Ø”.

.3 Complete circuit directory with typewritten legend.

.4 Provide lamacoid for each breaker in 600V panelboards.

Part 3 Execution

3.1 INSTALLATION

.1 Locate panelboards 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 of two (2) metres to top of cover, as required by Code.

.4 Connect loads to circuits.

3.2 TESTING

.1 Test in accordance with Section 26 08 05.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 REFERENCES

.1 Canadian Standards Association (CSA International):

.1 CAN/CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Wiring Devices.

.2 CAN/CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-National Standard, with UL 514D).

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

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

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Contract Document.

Part 2 Products

2.1 SWITCHES

.1 15 A, 120 V, single pole switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111.

.2 Manually-operated heavy-duty AC switches with following features:

.1 Heavy-duty mounting strap.

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

.3 Silver alloy contacts.

.4 One-piece Lexan toggle, lever, and cam.

.5 Suitable for back and side wiring.

.6 Green hex head grounding terminal.

.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 manufacturer:

.1 Arrow Hart 1201 series or approved equal in accordance with B7.

2.2 RECEPTACLES

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

.1 Heavy-duty nylon face with steel reinforcing plate in centre.

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

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

.4 Receptacle contacts to utilize spring steel clips to reduce contact fatigue.

.2 Receptacles of one manufacturer throughout project.

.3 Acceptable manufacturer:

.1 Hubbell 8200 or approved equal in accordance with B7.

2.3 COVER PLATES

.1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.

.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, 1 mm thick cover plates wiring devices mounted in flush-mounted outlet box.

.5 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles.

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 duplex receptacles vertically.

.3 Mount receptacles at height in accordance with Section 26 05 01 - Common Work Results - Electrical.

.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.

.4 Install a permanent label or lamacoid for all wiring devices indicating the circuit(s) contained within.

.1 Example: L10-2 (Panel L10, circuit 2)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for non-fused disconnect switches.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International):

.1 CAN/CSA C22.2 No.4, Enclosed and Dead-Front Switches (Tri-National Standard, with NMX-J-162-ANCE-2016 and UL 98).

1.3 SUBMITTALS

.1 Submit product data in accordance with Contract Document.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Non-fusible, disconnect switch in CSA Enclosure Type 12, to CAN/CSA C22.2 No.4.

.2 Horsepower rated.

.3 100% load break, load make rated.

.4 Provision for padlocking in the OFF switch position.

.5 Mechanically interlocked door to prevent opening when handle in ON position.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

.8 Form A auxiliary contact.

.9 Neutral and ground bars, with a minimum ampere rating equal to the disconnect switch.

.10 Acceptable manufacturers:

.1 Square D.

.2 Cutler Hammer.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Indicate equipment identifier, as shown on the drawings, on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches.

.2 Connect line and load cables to all disconnect switches.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers and circuit breakers.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489 and NMX-J-266-ANCE-2016).

1.3 SUBMITTALS

.1 Submit product data in accordance with Contract Document.

Part 2 Products

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers, and Circuit breakers to CSA C22.2 No. 5

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

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

.4 Circuit breakers to have minimum 10kA symmetrical rms interrupting capacity rating, or higher.

.5 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.

.6 Include:

.1 On-off locking device.

.2 Neutral and Ground bus bars, fully rated.

2.2 CB-POWER PANEL AA

.1 Requirements:

.1 Frame Size: as required.

.2 Trip Rating: 100 amperes.

.3 Interrupting Rating: 25 KAIC.

.4 Type: as required.

.5 Long Time PU: not applicable.

.6 Long Time Delay: not applicable.

.7 Short Time Pickup: not applicable.

.8 Short Time Delay: Inst – not applicable.

.9 Instantaneous Override: not applicable.

.10 Model: Cutler Hammer or Schneider Square D.

2.3 ACCESSORIES

.1 All power panels are to include three (3) permanently fixed attachment for padlocking the breakers in the OFF position.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers.

.2 Identification: In accordance with Section 26 05 01 – Common Work Results – Electrical, provide lamacoid plate on or adjacent to each breaker showing load being fed. Example: “XFMR-L10”.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Contract Document.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide shop drawings: in accordance with Contract Document.

.1 Provide shop drawings for each type of starter to indicate:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout and components.

.4 Enclosure type.

1.2 CLOSEOUT SUBMITTALS

.1 Provide maintenance materials in accordance with Contract Document.

.2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.

.3 Extra Materials:

.1 Provide listed spare parts for each different size and type of starter.

.1 All control fuses.

.2 1 indicating lamp bulb.

Part 2 Products

2.1 REVERSING AND FULL VOLTAGE MAGNETIC STARTERS

.1 UL/CSA listed, NEMA size as shown on the drawings.

.1 Smallest size of starter: NEMA size 1.

.2 IEC rated starters are not acceptable.

.2 Magnetic of size, type, rating and enclosure type as indicated with components as follows:

.1 All coils to be epoxy coated.

.2 Contactor solenoid operated, rapid action type.

.3 Mechanical and electrically interlock to defeat simultaneous starting the 2 contactors for reversing starters.

.4 Motor overload protective device in each phase, manually reset from outside enclosure.

.5 Wiring and schematic diagram inside starter enclosure in visible location.

.6 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.3 Accessories:

.1 Selector switches and Pushbuttons: heavy-duty oil tight labelled as indicated.

.2 Indicating LED lights: heavy-duty oil tight type and color red and green.

.3 1-N/O spare auxiliary contact.

2.2 CONTROL TRANSFORMER

.1 100VA minimum single phase, dry type, control transformer with primary voltage as indicated and 120 V
secondary, complete with primary and secondary fuses, installed in with starter.

.2 Size control transformer as required.

2.3 ACCESSORIES

.1 Pushbutton: heavy duty, oil tight.

.1 Pushbuttons to have standard heads; color to be determined by the City.

.2 Emergency stop pushbutton to have large red mushroom head.

.2 Selector switches: heavy duty, oil tight.

.3 Indicating LED lights: heavy duty, oil tight, type and colour red and green.

2.4 FINISHES

.1 All enclosures shall suit the environment where they are installed as follows:

.1 CSA/ NEMA 1 metal enclosures when installed inside panel

.2 CSA/ NEMA 4 (WP) stainless steel enclosures when installed outdoors

.3 CSA/ NEMA 7 (XP) metal enclosures when installed in hazardous classified areas.

.2 Apply finishes to enclosure in accordance with Section 26 05 01 - Common Work Results for Electrical.

2.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results for Electrical.

.2 Magnetic starter designation label, white plate, black letters, size 5 engraved on lamacoid schedule.

2.6 SPARE PARTS

.1 Fuses: two of each rating.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters and control devices in accordance with manufacturer's instructions.

.2 Install and wire starters and controls as indicated.

.3 Ensure correct fuses installed.

.4 Confirm motor nameplate and adjust / replace overload device to suit.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results for Electrical and manufacturer's instructions.

.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

.2 Section 40 95 13 – Control Panels

1.2 DESCRIPTION OF WORK INCLUDED

.1 Work of this Section consists of supply and installation of instrumentation and control equipment as specified and as shown on the plans.

.2 The work includes, but is not necessarily limited to, the following:

.1 Wiring of all process instrumentation including those devices supplied by other divisions.

.2 Training for plant operators as specified herein.

.3 Commissioning.

.3 This section does not include devices or equipment for installation in the control panel as specified in Section 40 95 13 – Control Panels.

1.3 SUBMITTALS

.1 In addition to the requirements of drawings 5516047-I01-I18, the Contractor shall provide the following instrumentation plans as a minimum:

.1 Fully itemized instrument loop plans for all analog process loops, digital, and motor control, to be generally in accordance with ISA.S54 Format.

.2 Completed instrument record sheets.

.3 Communications system interface connection diagrams.

.4 Instrument calibration records.

.5 Instrumentation installation in process line detail plans.

Part 2 Products

2.1 GENERAL INSTRUMENT REQUIREMENTS

.1 Unless otherwise specified, the Contractor shall provide instruments in accordance with the following general requirements:

.1 Provide indicating transmitters on nearby wall in the vicinity of the instruments. Where there are multiple instruments in proximity, group indicating transmitters.

.2 Locate in a logical arrangement. For transmitter layout, mimic physical layout of process and/or process sequence.

.3 Provide CSA 4X enclosure for all instruments.

.4 Power supply is 120 VAC unless otherwise noted.

.5 For analogue instruments, provide 4 - 20 mA, linear, isolated output, capable of driving a minimum of 600 ohms.

.6 Instrumentation cable: to manufacturer's recommendations and Code requirements.

.7 Provide all necessary brackets or stands to mount instrument.

.8 Supply any spare parts or calibration instruments required to commission instruments.

.9 Instrument tags will be generally to ISA 5.1, and supplied by instrument system supplier as required.

.10 All instruments in contact with the water shall be NSF 61 certified.

.11 Provide instruments with features and options to suit good practice in all applications.

2.2 LEVEL SWITCHES

.1 ULTRASONIC LEVEL CONTROLLER

.2 Level controller shall consist of a microprocessor based electronic unit, non-contacting ultrasonic transducer measuring head and temperature compensation probe as a complete assembly.

.3 Outputs:

.1 Modbus RTU communications port, RS-485.

.2 Level monitor shall be capable of outputting two(2) isolated 4 - 20 mA signals with loop load limit of 600 ohms minimum at 24 VDC.

.3 Two (2) form C (SPDT/CO) contacts, and four(4) form A (SPST/NO) contacts; contacts rated 230VAC, 5A; operation of each relay to have independent settings for 'ON' and 'OFF' functions, alternating and latching capabilities.

.4 Supply voltage shall be 120 VAC, 60 Hz.

.5 Enclosures shall be suitable for panel mounting or wall mounting as indicated on the plans. Wall mounted units shall be constructed to resist the effects of high humidity locations. Rated for operating in temperature range of -40^{o} to 60^{o}C.

.6 Accuracy shall be ± 0.25% of span.

.7 Transducer shall be equipped with aiming kit and bracket for mounting at location indicated.

.8 Unit to be capable of programming filters to eliminate echoes from agitator blades or variations in level from surface waves.

.9 Transducer shall be capable of being completely submerged. Unit shall resume operation following submerged condition.

.10 Contractor shall review and coordinate installation location and ensure location is suitable for ultrasonic device and is free from interfering pipes, ladders, walls, turbulence, equipment.

.11 Ensure transducer detection range is adequate.

.12 Transducer shall be complete with temperature compensation.

.13 Standard of acceptance for level controller: Milltronics MultiRanger 200 c/w programmer module. Acceptable manufacturers Milltronics, Rosemount 3100, Siemens Sitran, Krohne.

.14 Standard of acceptance for ultrasonic level transducer: Milltronics XRS-5C c/w cables as required. Acceptable manufacturers Milltronics, Rosemount 3490, Siemens Sitran, Krohne.

2.3 INCLINOMETER

.1	Range:	Configured from -5 to +55º
.2	Output:	4-20 mA-2 wire loop powered
.3	Minimum Terminal Voltage:	8.5 VDC
.4	Maximum Terminal Voltage:	28 VDC
.5	Accuracy:	0.30º
.6	Resolution:	0.15º
.7	Temperature Drift:	0.02º per ºC typ.
.8	Bandwidth:	DC – 8 Hz
.9	Enclosure:	Stainless Steel NEMA Type 4X, IP68
.10	Conduit Entries:	1/2” NPT
.11	Sensor:	MEMS Triaxial Accelerometer
.12	Operating Temp.:	-40 to 85ºC
.13	Manufacturer and Model:	RST Instruments, Model #ICEX360A

Part 3 Execution

3.1 MATERIAL CONTROL

.1 The Contractor shall provide all components (and software where required) as outlined in this Specification and shown on the Plans.

.2 The Contractor shall co-ordinate with component and software suppliers and subcontractors to allow for timely and coordinated delivery, construction, testing, installation and programming of the control system as outlined in this Specification.

.3 The Contractor shall identify all field instruments with a permanent, weatherproof label showing tag number and service. Use engraved lamacoid, or stamped stainless steel and fix with non-rusting screws or wire, or chain.

3.2 FABRICATION

.1 The plans have been prepared using the latest information available from the component suppliers. Check these plans against the plans supplied with the components and make any necessary changes.

.2 Obtain from the component suppliers, the manufacturer's wiring diagrams to determine the equipment terminals and record these terminal numbers on the wiring diagrams.

.3 Identify jumper settings, switch settings, program entries, etc. necessary to complete the installation.

3.3 EQUIPMENT IDENTIFICATION

.1 Refer to Section 26 05 01 – Common Work Results - Electrical.

3.4 INSTALLATION

.1 Install according to supplied instructions. Follow manufactures recommendations regarding installation locations, mounting methods, connection methods, etc.

.2 Commission all field wiring before terminating.

.3 Do not energize the control system until authorized to do so by the Contract Administrator.

.4 The Contractor shall co-ordinate the components of the instrumentation and control system to achieve a complete working system to the intent of this specification.

.5 The Contractor shall provide supports or frames if not already supplied by the manufacturer of the equipment.

.6 The Contractor shall obtain written permission from the Contract Administrator before fixing supports or frames to structural members.

.7 Mount instruments in strict accordance with manufacturer's recommendations. The Contractor shall not mount any equipment on vibrating structures (eg. handrails) or below lines carrying corrosive chemicals or where condensation may occur.

.8 The Contractor shall ensure instruments and their associated sensors are easily accessible for maintenance, calibration, withdrawal or replacement.

.9 The Contractor shall install instruments as specified in accordance with plans and as required by process schematic.

.10 Instruments are shown on the plans in their approximate locations. Exact location shall consider visibility, work space, and any special installation instructions.

.11 Attach permanent tags.

3.5 INSTALLATION ACCEPTANCE FIELD TESTING, FINAL COMMISSIONING

.1 The Contractor shall provide the services of qualified instrument technicians to commission and demonstrate the operation of the control system. The technicians shall include commissioning of all equipment including but not limited to equipment supplied in the Contract, existing equipment, City of Winnipeg supplied equipment, and equipment supplied by others.

.2 Where specialized vendor assistance may be required, the Contractor shall ensure this is available during proposed commissioning period and pay for all costs associated with this assistance. This shall include assistance from the panel builder and system programmer.

.3 All the equipment in this Contract shall be supplied so that installation can be carried out in a reasonably expeditious manner. The Contractor shall cooperate with the Contract Administrator, the City of Winnipeg and other trades and shall provide off-site and on-site installation supervisory assistance during the course of the work as detailed herein.

.4 The Contractor shall complete instrument record sheets at the time of calibration and ensure all instruments meet specifications. The Contractor shall make record sheets available to the Contract Administrator during construction/installation period.

.5 The Contractor shall confirm correctness of operation of all instrumentation and end devices.

.6 The Contractor shall confirm correctness of operation of all instruments and end devices feeding into the control system PLC, HMI, or SCADA.

.7 Mass balance shall be demonstrated under all operating scenarios. Flow, level, and pressure values shall be in agreement.

.8 Prior to the commencement of software commissioning, the Contractor shall ensure that all deficiencies have been corrected without undo delay to the schedule of work.

.9 The Contractor shall certify the following:

.1 That the equipment has been installed in accordance with the Contract Administrator's plans and recommended installation procedures, with any discrepancies reported to the Contract Administrator.

.2 That the equipment power and grounding requirements have been satisfied, with any discrepancies reported to the Contract Administrator.

.3 That all terminations to the equipment have been properly installed, with any discrepancies reported to the Contract Administrator.

.4 Calibration and adjustment of the equipment as required to place the equipment in trouble-free operation. Certified calibration reports for each instrument shall be provided. This calibration work shall be in addition to the factory calibration provided with each device when shipped.

.5 That the system is ready for final commissioning and program testing.

.10 The Contractor shall prepare the various reports and certificates specified in this Section. One copy of each report and certificate shall be forwarded to the Contract Administrator and to the City of Winnipeg. Any discrepancies which require further action on the part of the Contract Administrator or the City of Winnipeg shall be clearly identified on the report or certificate.

.11 Prior to commencement of PLC software commissioning, the Contractor shall ensure that all spare parts, expendables and test equipment pertinent to the equipment supplied by this section and being tested, are on site.

.12 Test equipment shall include all necessary multi-meters, process instrument calibrators for 4 - 20 mA, 24 VDC devices, thermocouples signal generators. Test equipment shall be provided by the Contractor and shall remain the property of the Contractor at the end of all testing.

.13 The Contractor shall provide assistance during commissioning and start-up related to any equipment supplied by the Contractor. This shall include the manual or automatic activation of field devices.

.14 The Contractor shall demonstrate the integrity and functional operation associated with the wiring and equipment supplied by the Contractor, which is required to operate with the PLC software.

.15 Refer to Section 40 95 13 – Control Panels, for testing and commissioning to be performed under that section which may require co-operation by verification personnel under this section.

.16 The Contractor shall submit details on instrument wiring to Contract Administrator on request. Include information on raceway materials and sizes, cable and wire type and numbers, manufacturer, model, markings, ratings, listings, etc. Indicate presence or absence of grounding, bonding, screening, and drain layers in cable construction. Indicate grounding arrangements on a per cable basis.

3.6 TRAINING

.1 The Contractor shall provide one (1) day training to the City of Winnipeg's operating staff on the operation and maintenance of the system.

.2 Training shall include for the use of both hardware, software and plant operations.

.3 Training shall be on site with the installed equipment.

3.7 SPARES

.1 The Contractor shall provide the following spare parts:

.1 One (1) years supply of expendable parts, or parts requiring regular replacement.

.2 Two of each type of fuse on equipment supplied under this section.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 This Section covers items common to Sections of Division 40. This section supplements requirements of Division 1.

1.2 CODES AND STANDARDS

.1 Do complete installation in accordance with CSA C22.1-15 except where specified otherwise.

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

1.3 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 B4.

1.4 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.

1.5 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.

1.6 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Contract Document.

.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 12 unless otherwise specified.

1.7 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 indoor switchgear and 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.

1.8 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates as follows:

.2 Nameplates:

.1 Lamicoid 3 mm thick plastic lamicoid 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

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

.4 Allow for average of twenty-five (25) letters per nameplate.

.5 Identification to be English.

1.9 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings on both ends of phase conductors of feeders and branch circuit wiring.

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

1.10 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

.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.

1.11 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.

1.12 O&M MANUAL

.1 Operations and Maintenance Manuals:

.1 Refer to Contract Document 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.

.7 Testing documentation including:

.1 Loop Check Report

.2 PLC Software Operation and Maintenance Manual:

.1 Provide a manual that contains, at minimum, all pertinent information, drawings and documents associated with the PLC program and associated integration, including:

.1 Printout of the entire PLC program. Printout to be sealed by a Professional Engineer licensed to practice in Manitoba.

.2 Repair instructions for common issues

.3 Printout of any related design documents, such as interface lists, etc.

.4 CD in a sleeve containing the latest PLC program including configuration software.

.3 Wireless Modem Operation and Maintenance Manual:

.1 Provide a manual that contains, at minimum, all pertinent information, drawings and documents associated with the PLC program and associated integration, including:

.1 Complete step-by-step procedures for operation of system including required actions via the HMI.

.2 Operation of computer peripherals, and associated input and output formats.

.3 Emergency, alarm and failure recovery procedures.

.4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.

.5 Repair instructions for common issues.

.6 CD in a sleeve containing the latest HMI programs and configuration software.

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 DEFINITIONS

.1 FAT Factory Acceptance Test.

1.2 DESIGN REQUIREMENTS

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

1.3 SUBMITTALS

.1 Submittals in accordance with Section E11.

.2 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.

.3 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.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DEMONSTRATION AND TESTING

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

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

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

1.6 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.

.2 Schedule additional re-tests until approval is obtained.

Part 2 Products

2.1 NONE USED.

.1 None Used.

Part 3 Execution

3.1 PROCEDURES

.1 All tests shall be documented.

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

.3 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 Complete demonstration of meeting the requirements of the applicable Functional Requirements Specification.

.2 Response times to operator actions.

.3 Controller processor spare capacity.

.4 Wireless Modem receiving and sending operation.

.5 Alarm system capabilities.

.6 System programming and configuration capability.

.4 The Contract Administrator may request additional tests and simulations at the FAT.

.5 Incorporate comments and feedback from the Contract Administrator into the system design.

3.2 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 SUBMITTALS

.1 Submittals in accordance with Section Contract Document.

.2 Submit commissioning plans and procedures, in writing, at least 10 Working days prior to commissioning.

1.2 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 in accordance with Contract Document.

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

1.3 COMMISSIONING FORMS

.1 The Contract Administrator will provide the required commissioning forms.

.2 Supplement the provided forms as required to make a complete commissioning report package.

1.4 COMMISSIONING

.1 Carry out commissioning under direction of the Contract Administrator 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.

1.5 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 EQUIPMENT

.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.

.2 Test instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.

.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 6 months prior to tests.

Part 3 Execution

3.1 STATUS PRIOR TO COMMISIONING

.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.

3.2 PROCEDURES

.1 Provide a minimum of one qualified technician to test and commission the control system.

.2 Test each I/O point from the instrument to the 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 Completely test the E-Stop functionality of each piece of equipment, as provided.

.5 All modifications to the software program, to bypass interlocks or sensors, shall be recorded and documented clearly in a separate document, and the software.

.1 Any software bypasses that remain, prior to leaving site, must be authorized by the Contract Administrator.

.6 All deficiencies must be corrected by the Contractor.

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

.8 Optimize operation and performance of systems by fine-tuning control loops and PID values.

3.3 SYSTEM SOFTWARE

.1 Load PLC system with appropriate program, fully tested and approved as part of the software FAT.

.1 Any changes made to the software after the FAT must be submitted for review and approval of the Contract Administrator.

.2 Any issues identified on site must be communicated to the Contract Administrator. Approval is required prior to making any modifications.

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

3.4 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

3.5 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 SUBMITTALS

.1 Submittals in accordance with Contract Document.

.2 Submit commissioning plans and procedure, in writing, at least 10 Working days prior to commissioning.

1.2 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 in accordance with Contract Document.

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

1.3 COMMISSIONING FORMS

.1 The Contract Administrator will provide the required commissioning forms.

.2 Supplement the provided forms as required to make a complete commissioning report package.

1.4 COMMISSIONING

.1 Carry out commissioning under direction of the Contract Administrator 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.

1.5 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 EQUIPMENT

.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.

.2 Test instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.

.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 6 months prior to tests.

Part 3 Execution

3.1 STATUS PRIOR TO COMMISIONING

.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.

3.2 PROCEDURES

.1 Provide a minimum of one qualified technician to test and commission the control system.

.2 Test each I/O point from the instrument to the Wireless Modem.

.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 Completely test the E-Stop functionality of each piece of equipment, as provided.

.5 All modifications to the software program, to bypass interlocks or sensors, shall be recorded and documented clearly in a separate document, and the software.

.1 Any software bypasses that remain, prior to leaving site, must be authorized by the Contract Administrator.

.6 All deficiencies must be corrected by the Contractor.

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

.8 Optimize operation and performance of systems by fine-tuning control loops and PID values.

3.3 SYSTEM SOFTWARE

.1 Load PLC system with appropriate program, fully tested and approved as part of the software FAT.

.1 Any changes made to the software after the FAT must be submitted for review and approval of the Contract Administrator.

.2 Any issues identified on site must be communicated to the Contract Administrator. Approval is required prior to making any modifications.

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

3.4 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.

3.5 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 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA C22.2 No. 205-17, Signal Equipment.

.2 International Electrotechnical Commission (IEC).

.1 IEC 61131, Programmable Controllers.

1.2 DEFINITIONS

.1 PLC Programmable Logic Controller.

1.3 PLC SYSTEM DESCRIPTION

.1 The PLC consists of a controller rack, mounted in control panel CP.

.2 The City utilizes a remote SCADA system that interfaces with the pumping station control system via a Control Microsystems SCADA Pack RTU.

.1 Currently only SCADA monitoring and alarming is implemented.

.2 The Contractor's responsibility on the SCADA system is limited to:

.1 Installation of CP containing the RTU.

.2 Installation of conduit and wiring to CP.

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

1.4 SYSTEM ARCHITECTURE

.1 Single PLC:

.1 No remote I/O.

.2 Connected to the following:

.1 SCADA RTU via wireless modem.

1.5 SOFTWARE OWNERSHIP

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

.1 Modification and revision.

.2 Use at other City facilities.

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

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

.1 Source code for base function blocks provided by the PLC manufacturer are not required.

1.6 DESIGN REQUIREMENTS

.1 Design and implement a complete operating PLC system.

.2 The design is to be based upon the supplied Functional Requirements Specification.

.1 Utilize a tag naming convention that extends, and does not conflict with the tag scheme utilized in the Functional Requirements Specification.

.3 The PLC is utilized to control submersible pump and sluice gate actuator for a municipal application. The consequences of system failure could be significant, and thus a high level of care, attention to detail, and testing is expected.

.4 The PLC software design is to be supervised and approved (sealed) by a Professional Engineer licensed to practice in Manitoba.

.5 Do not assume that the Contractor's internal standards or standard programming methodology will be acceptable for this project. No additional payment will be made for assumptions made regarding standard methods utilized by the Contractor.

.6 The Contract Administrator will review the overall design. Make changes as requested by the Contract Administrator.

1.7 SUBMITTALS

.1 All submittals to be in accordance with Contract Document.

.2 Stage 1:

.1 Submit product datasheets.

.3 Stage 2:

.1 Submit a PLC design criteria prior to initiating programming which includes:

.1 The general PLC program structure.

.2 The programming languages (i.e. ladder, function block) to be utilized.

.3 A sample section of code.

.4 Wireless Modem interface.

.5 Variable naming methodology.

.4 Stage 3:

.1 Submit a 25% complete submittal, including:

.1 Software logic printout.

.2 The primary purpose of this submittal is to ensure that the methodology being utilized is as per requirements prior to the bulk portion of the work being completed. At this point, copies of code for similar pieces of equipment should not be completed.

.5 Stage 4:

.1 Submit a 99% complete submittal a minimum of 20 Working days prior to the FAT, including:

.1 Complete software logic printout.

.2 Wireless Modem interface.

1.8 O&M MANUALS

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

.1 Product datasheets.

.2 Hardware and software user manuals.

.3 Letter stating that the PLC application has been reviewed and approved. The letter is to be signed and sealed by a Professional Engineer licensed to practice in Manitoba.

.4 Wireless Modem interface map.

.5 PLC database listing and logic printout.

.6 CD sleeve with CD containing PLC application program.

Part 2 Products

2.1 PROGRAMMABLE LOGIC CONTROLLER

.1 Suitable product will be a PLC system produced by a major, international industrial automation vendor.

.2 Modularity

.1 The construction of the PLC is to be modular, utilizing separated modules, that are located within or on a common substructure such as a rack or a DIN rail.

.2 Utilize separate modules for power supplies, fans, processor, and I/O.

.3 Each module to visibly indicate relevant module status information.

.4 Common components within the controller system, such as racks or rails, which cannot be removed and replaced on-line to have a minimum of active components.

.5 Keying systems to be utilised to prevent improper module insertion.

.6 Module set-up is to be universal and not rely on the use of removable components such as jumpers or shorting bars, or require permanent changes to module components.

.7 The organisation of the modules to follow consistent design practices.

.3 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.

.4 Physical Size Requirements

.1 The PLC must fit with the control panel dimensions. Drawings show only minimum dimensions.

.5 Processor:

.1 Physical Size: To fit in rack.

.2 I/O Processing Requirements (minimum).

.1 Discrete I/O: 1024 (in rack).

.2 Analog I/O: 256 (in rack) where applicable.

.3 Integrated Ethernet port, 10/100 Mb.

.1 Capable of native Modbus TCP communication.

.1 Use of a Modbus TCP communication module with configurable mapping to internal variables is not acceptable.

.4 Internal RAM: 4096 kB.

.5 Flash memory card to contain application program.

.1 8 MB minimum or as required to contain application program with 25% spare space.

.1 Application program on memory card to contain all program documentation, provided there is space.

.6 Processing power (minimum).

.1 8100 instructions per ms.

.7 Display on front including:

.1 Running status.

.2 Processor error status.

.3 I/O fault status.

.4 Serial communication activity.

.5 Memory card missing or faulty.

.6 Activity on the Ethernet Modbus/TCP network.

.7 Ethernet Modbus/TCP network status.

.8 Ethernet Modbus/TCP data rate (10 or 100 Mbps).

.8 Real-time clock.

.6 Power Supply

.1 Redundancy: not required.

.2 Requirements:

.1 Supply Voltage: 24 VDC.

.2 Supply Protecting: Integral fuse or breaker.

.3 Size: As required.

.4 Output Voltage: As required.

.5 Output Current: As required, with a minimum of 20% spare capacity above rated current draw of all loads. Calculate power supply loads with all points energised and all installed input and output points used or spare carrying a maximum connected load.

.6 Integrated protection against overloads, short circuits, and overvoltages.

.7 Backplane / Rack:

.1 Number of slots: as required.

.2 Provide protective covers for all unused slots.

.8 Input / Output Modules:

.1 General

.1 Functionality

.1 Provide physical interface between field signals and the control equipment.

.2 Provide electrical isolation of circuits between the field and the controller.

.3 Perform validity checks of all input values.

.4 Perform input and output conditioning, including square root extraction.

.5 Perform self-diagnostics.

.6 Perform reporting and responding to the controller.

.7 Display an appropriate alarm on the HMI upon an I/O module failure.

.2 I/O Module Installation:

.1 Capable of being removed from or inserted into their rack slot while under power and without disturbing external wiring.

.2 On-line removal and replacement of a failed module will not require personnel to reconfigure system software, alter system wiring or cabling, de-energize the system module, or re-initialize the controller.

.3 Field Wiring:

.1 Terminals at the module, or

.2 Multi-pin connector on the module.

.1 Provide corresponding pre-manufactured cable, minimum 1 meter long, with multi-pin connector at one end and loose wires at the other end.

.2 Discrete Input (DI) Modules:

.1 Requirements:

.1 Voltage: 24 VDC.

.2 Current sinking.

.3 Minimum channels per module: 16.

.4 Meet IEEE C37.90.1 surge withstand capability.

.5 Isolation: Isolated from logic or processor circuitry via optical coupling or other equivalent means.

.6 Indicating LEDs:

.1 Channel status (on/off) for each I/O channel.

.2 Module Error/Fault.

.3 Discrete Output (DO) Modules – 16 Channel.

.1 Requirements:

.1 Voltage: 24 VDC.

.2 Current sourcing.

.3 Current capacity: 0 – 0.5A.

.4 Meet IEEE C37.90.1 surge withstand capability.

.5 Protection against current overloads.

.6 Minimum channels per module: 16.

.7 Isolation: Isolated from logic or processor circuitry via optical coupling or other equivalent means.

.8 Configurable fail state: Freeze in the present state (fail-last) or turn off (fail-off), upon a controller or Remote I/O communication failure.

.9 Indicating LEDs:

.1 Channel status (on/off) for each I/O channel.

.2 Module Error/Fault.

.4 Required Accessories:

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

.2 Include a second memory card (in addition to the one installed in the processor) that is of the same memory capacity.

.5 Acceptable Products:

.1 Schneider Electric M580 PLC series.

2.2 PLC PROGRAMMING SOFTWARE

.1 Supply PLC programming software enabling the City to develop, debug, and monitor application programs.

.2 Requirements:

.1 Operate on Microsoft Windows XP®.

.2 Menu driven.

.3 Integrated help functions to assist the user.

.4 Programming software to be fully compliant with the IEC 61131-3 control languages and include:

.1 Ladder Logic (LD).

.2 Function Block Diagram (FBD).

.3 Sequential Function Chart (SFC).

.4 Structured Text (ST).

.5 Instruction List (IL).

.5 System diagnostics/fault status.

.6 Program documentation/cross-reference printout.

.7 Hardware Configuration.

.8 On-line data changes.

.9 Input/output forcing.

.10 Support both on-line and off-line programming.

.3 Program Instruction Set:

.1 Minimum requirements:

.1 Math Instructions: add, subtract, multiply, divide, square root; ladder logic programming to provide integer and floating point math.

.2 Comparison Elements: Less Than, Greater Than, Equal to, Less than or Equal to, Greater than or Equal to, Not Equal, Relational Contacts.

.3 Timer and Counter Elements: Counterup, Countdown, Time up, Time down (with accumulator, preset and time-base sub-elements); time base from .01 sec to hours) counter scale factors from X1 to X1000.

.4 Relay Contact Elements: N.O., N.C., Transition on, Transition off, (positive/negative).

.5 Relay Coil Elements: Standard, Latch, Unlatch.

.6 Control Algorithms: PID.

.4 PLC Simulator:

.1 Provide software to simulate a PLC on a PC.

.5 Licence:

.1 Requirements:

.1 One user.

.2 Fully capable of programming all features for PLC supplied.

.3 Licence does not expire.

.6 Acceptable Products:

.1 Schneider Electric Unity Pro Small (Latest version available.)

2.3 ACCESSORIES

.1 Include the following accessories:

.1 One Flash card, installed in the PLC processor, for running the application program.

.2 One spare Flash card, of the same size and configuration as that utilized in the processor.

.3 Serial or USB Transfer cable for downloading program.

2.4 USB MEMORY STICK

.1 Provide a USB memory stick as part of the Commissioning process, with the following:

.1 Latest application program, with documentation.

.2 PLC hardware user manuals

.3 PLC software user manuals.

.4 HMI hardware user manuals.

.5 HMI software user manuals.

.2 Locate the memory stick in a pocket in the control panel.

2.5 SPARE PARTS

.1 Supply the following spare parts:

.1 One power supply module.

.2 One backplane.

.3 One processor module.

.4 One DI 24 VDC I/O module.

.5 One DO 24 VDC I/O module.

.6 One AI module – price only.

.7 One AO module – price only.

.2 Complete set of spare parts to be supplied prior to commissioning.

Part 3 Execution

3.1 HARDWARE INSTALLATION

.1 Install the PLC in control Panel CP-L1 as per manufacturer instructions and recommendations.

.2 Update the processor and all updatable modules with the latest firmware.

3.2 PLC PROGRAMMING SERVICES

.1 General Requirements:

.1 Program in a manner to make the program easy to follow and maintain.

.2 Insert comments into the program to clarify all items not readily apparent.

.3 Utilize commonly accepted good programming practices.

.4 Utilize function blocks to encapsulate common systems and sections of code.

.5 All field inputs to be checked against range limits. If a field input is outside of its range limits or the data cannot be otherwise propagated because of an equipment fault, the data is to be declared “bad” within the Control System.

.6 All tag names are to be named and identified using positive logic. Where required, provide comments to clarify the states.

.7 Program PID Control loops to provide bumpless transfer when switching between automatic and manual control modes.

.8 Configure alarms generated in the PLC into two types:

.1 Automatic reset alarms clear upon the alarm condition being removed. Provide logic as required to ensure that fast cycling of the alarm does not occur.

.2 Manual reset alarms require reset from the HMI. Utilize manual reset alarms where the initiating condition would be removed by the action resulting from the alarm. Ensure that manual reset alarms are configured such that a reset signal from the HMI will not clear the alarm, unless the initiating condition is cleared.

.9 For any piece of equipment that has control from the PLC, provide a Manual and Auto control mode selector buttons on the equipment faceplate, and allow for manual control of the equipment from the HMI. Provision of a hardwired local, hand, or manual control mode in the field does not eliminate this requirement.

.1 Provide all required PLC programming as per the Functional Requirements Specification.

END OF SECTION

Part 1 General

1.1 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 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.

1.2 SEPARATE ALTERNATE PRICE

.1 The Control Panel with RTU and related components as shown on the drawing shall be CSA 1 rated and mounted inside P&C Panel with other individually enclosed power panels, transformer, starter, etc.

.2 The bidder shall submit a separate price for alternate stainless steel CSA 4 rated Control Panel with RTU and related components to be installed besides Power Panel with only power related equipment but on a common concrete base.

1.3 SUBMITTALS

.1 Prior to construction:

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

.2 Submit stamped dimensioned drawings showing all exterior and interior features/ devices and wait for approval, prior to construction of the Control Panels.

.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.

1.3 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.

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.

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

.7 Component mounting plates shall be three (3) mm thick steel and shall be painted with one (1) coat of primer and one (1) coat of white baked enamel.

.8 All Control Panel doors shall open through 180 degrees without restriction.

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

.10 Enclosure brand shall be Hoffman or an approved equivalent.

.11 The overall size shown on the drawings shall be considered as minimum. When sizing, the panel provide 20% spare physical space within for future expansion.

2.3 POWER SOURCE

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

.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 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.

.2 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.

.3 Ground Bus Bar:

.1 Supply a ground bus bar in each control panel.

.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.

.4 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 Allen-Bradley or approved equivalent.

.5 Programmable Logic Controllers:

.1 As per section 40 94 43.

.6 Wireless Modem:

.1 As per Contract Document.

.7 General Purpose Relays:

.1 Type: DPDT or as shown on drawings.

.2 Indication: LED.

.3 Coil Voltage: As per drawings.

.4 Contact Rating: 5A (120 VAC), 5A (24 VDC).

.5 Approvals: CSA.

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

.8 24 VDC Power Supplies:

.1 Size: As shown on the drawings.

.2 Supply Voltage: 120 VAC, 1ph.

.3 Approvals: CSA.

.4 Manufacturer: Sola or approved equal in accordance with B7.

.9 Uninterruptible Power Supply:

.1 Size: 216 VA.

.2 Type: Offline.

.3 Input Voltage: 120 VAC, 1ph.

.4 Output Voltage: 24 V DC.

.5 Manufacturer: Trio-Ups by Phoenix Contract.

.10 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.

.11 Wiring:

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

.2 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.

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

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

.1 Label both ends of each wire.

.2 Utilize machine printed non-slip labels.

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

.4 Individual conductors or wires exiting a cable shall be identified using non-erasable markers.

.5 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. 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.

.6 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.

.7 All 24 VDC or 120 VAC discrete signal panel wiring shall be 16 AWG TEW stranded conductor.

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

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

.9 The panel builder shall group and form wiring into a loop when going from a fixed part of the panel to a door. Each end of the loop shall be properly supported.

.10 Wiring Duct:

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

.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 4-20mA wires, but can cross their path.

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.

.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.

3.2 IDENTIFICATION

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

.2 Label terminals as shown on drawings.

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

3.3 TESTING

.1 Send invitation to the City with 5 days advanced notice and submit with it agenda with list of all tests and procedures. If the City declines the invitation then submit test results for their review and approval prior to shipment.

.2 Testing of the control panels shall be fully completed 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 E-stop system component functionality.

.7 Receptacle and lighting functionality.

.8 Wireless Modem transceiver functionality.

3.4 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 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.

1.2 QUALITY ASSURANCE

.1 Provide competent instructors thoroughly familiar with all aspects of the instrumentation system installed in the facility.

.2 Contract Administrator reserves right to approve instructors.

1.3 INSTRUCTION

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

1.4 TRAINING MATERIALS

.1 Provide equipment, visual and audio aids, and materials for classroom training at City's site.

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

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

1.5 TRAINING PROGRAM

.1 Operations Training:

.1 Location: At a facility provided by the City.

.2 Duration: Four hours.

.3 Number of trainees: Coordinate with Contract Administrator prior to training.

.4 Audience: Operations and maintenance personnel.

.5 Content:

.1 General system overview.

.2 Description of system components.

.3 Presentation of the system operation.

.1 Use of the system.

.2 Navigation.

.3 Alarm system use.

1.6 MONITORING OF TRAINING

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

Part 2 Products

2.1 GENERAL

.1 Not Applicable.

Part 3 Execution

3.1 TRAINING

.1 Provide on-site training to City personnel.

END OF SECTION

Part 1 General

1.1 MAINTENANCE SERVICES

.1 Not required.

1.2 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.

.3 Wireless Modem systems.

.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