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 C22.1-2015 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 Where services of a manufacturer’s factory service engineer is required, arrange and pay for services to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

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

1.5 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 Section 01 61 00 - Common Product Requirements.

.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.

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 1-0127A-E0002 Single Line Diagram

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 or indicated otherwise.

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

.3 Install electrical equipment at following heights unless indicated otherwise.

.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: 1500 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 CUTTING AND PATCHING

.1 Provide all cutting a patching required.

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

.3 Exercise care where cutting holes existing concrete elements so as not to damage existing reinforcing.

.1 Locate existing reinforcing utilizing a reinforcing bar locator and mark out on the surface of the concrete.

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

.3 Firestop and seal all penetrations, regardless of whether the penetration requires a fire rating.

1.18 ANCHOR INSTALLATION

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

1.19 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.

1.20 TESTING

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

1.21 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.

1.22 AS-BUILT 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 As-Built Drawings. As the Work on-site proceeds, the Contractor shall clearly record in Red Pencil all as-built conditions, which deviate from the original Contract Documents. As-Built Drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 131-07, Type TECK 90 Cable.

.2 National Electrical Manufacturers' Association (NEMA)/Insulated Cable Engineers Association (ICEA)

.1 ICEA S-93-639/NEMA WC74-06, 5-46 KV Shielded Power Cable for Use in the Transmission and Distribution of Electrical Energy.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

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

.3 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria.

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 5/8 kV CABLE

.1 Stranded copper conductor(s), size as indicated.

.2 Extruded Strand Sheild: Extruded thermoset semi-conducting stress-control layer over conductor.

.3 Insulation: EPR or EPDM:

.1 133% insulation level at 5kV

.2 100% insulation level at 8kV.

.4 Extruded Insulation Shield: Thermoset semi-conducting polymeric layer free stripping from insulation.

.5 Metallic Shield: 5 mil annealed copper tape with an overlap of 25%.

.6 Jacket: Lead-free, flame-retardant moisture- and sunlight-resistant PVC.

.7 Temperature rating: 105°C.

.8 Approvals: CSA or equivalent.

Part 3 Execution

3.1 INSTALLATION

.1 Install power cable in ducts as indicated and in accordance with manufacturer's instructions.

.2 Install power cable in trenches as indicated.

.3 Provide supports and accessories for installation of high voltage power cable.

.4 Install stress cones, terminations and splices in accordance with manufacturer's instructions

.5 Install grounding in accordance with local inspection authority having jurisdiction.

.6 Provide cable identification tags and identify each phase conductor of power cable.

3.2 FIELD QUALITY CONTROL

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

.2 Use of qualified tradespersons for installation, splicing, termination and testing of high voltage power cables.

.3 Test high voltage power cable after it is routed. Submit test result and inspection certificate.

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 Section 01 33 00 - Submittal Procedures.

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 or RWU90.

.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, 1000 V.

.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 Cable Fittings:

.1 Minimum requirement: Watertight, approved for TECK cable.

.2 Hazardous Locations:

.1 CSA approved.

.2 Watertight type with:

.1 an elastomeric bevelled bushing.

.2 a funnel entry, splined gland nut.

.3 a non-magnetic, stainless steel grounding device with dual grounding action.

.4 a taper threaded hub.

.5 a hexagonal body and gland nut

.3 Integral seal type with metal-to-metal contact construction.

.4 Sealing of multi-conductor cable shall be accomplished with a liquid type polyurethane compound.

.5 The fitting must:

.1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.

.2 Allow the possibility of disconnection without disturbing the environmental seal, the electrical bonding or the explosionproof seal.

.6 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily-removable armour stop

.7 (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.

.8 Approved products:

.3 T&B Startech XP series

2.3 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.

.4 Shielding as indicated on the drawings.

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, unless otherwise indicated.

.2 Perform an insulation-resistance test on each conductor, prior to termination, utilizing a megohmmeter with a voltage output of 1000 volts DC. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 50 megaohms, 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.

3.8 TESTING

.1 Test all power conductors 10 AWG and larger in accordance with 26 08 05.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

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

Part 2 Products

2.1 MATERIALS

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

.2 Conductors: bare, stranded, medium hard drawn copper wire.

.1 Size: as shown on the drawings or 2/0 AWG minimum for grounding electrode connections.

Part 3 Execution

3.1 INSTALLATION

.1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.

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

.3 Protect exposed grounding conductors during and after construction.

3.2 ELECTRODE INSTALLATION

.1 Install ground rod electrodes.

.1 Location of rods are as per the drawings.

.2 Top of rods to be at least 150mm below finished grade.

.3 Accurately measure and mark the location of the actual ground electrodes on the as-built drawings.

.2 Install 2/0 AWG copper wire to connect ground electrodes.

.1 Connect each electrode to all others.

.2 Connect two electrodes back to the building via separate copper wire connections.

.1 Install separate parallel copper wires in separate trenches, in a manner that simultaneous disconnection of both conductors by inadvertent digging is unlikely.

.2 Minimum separation to be 1 metre, until wire in conduit against the building.

.3 Install 27mm PVC conduit to 300mm below grade, with LB type fitting above main floor level.

.4 Entrance to the building may be via one or two wall penetrations. If one wall penetration is utilized, provide T conduit fitting above grade to two below grade conduit stubs.

.3 Provide sufficient slack between ground rods and connections to the building to avoid breaking stresses.

.4 Minimum depth of burial: 450mm

.3 Make required grounding connections.

.1 Utilize thermo-weld or Burndy compression connections to the ground rods.

.2 Utilize thermo-weld connections or Burndy compression connections for underground wire to wire connections.

.3 Where Burndy compression connections are used:

.1 Submit product data of compression tool, die, and compression connectors to the Contract Administrator for review.

.2 All compression connections shall have the die index number embossed into the compression connector after installation, demonstrating that the proper compression pressure has been obtained.

.4 Install ground rod electrodes at location shown on the drawings.

END OF SECTION

Part 1 General

1.1 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 Products

2.1 EQUIPMENT

.1 Grounding conductors: bare stranded copper, soft annealed, size as indicated.

.2 Insulated grounding conductors: green, type RW90.

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

.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Bolted type conductor connectors.
.4 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

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

.2 Protect exposed grounding conductors from mechanical injury.

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

.4 Use Burndy compression connectors or approved equal in accordance with B7 for all grounding splices and terminations, unless otherwise indicated.

.5 Soldered joints not permitted.

3.2 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 2/0 AWG power conductors.

.4 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.

3.3 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, 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 As per 26 05 34.

.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.

.14 Touch up abraded surfaces and cut ends of galvanized members with an approved galvanizing repair compound.

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

1.3 SUBMITTALS

.1 Submit shop drawings for JB-A72 (Temporary Generator Junction Box) in accordance with Section 01 33 00 – Submittal Procedures.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

.1 Type and size as indicated on the drawings, or sized as per code requirements.

.2 Utilize stainless steel construction for NEMA 4X junction and pull boxes.

2.2 TEMPORARY GENERATOR CONNECTION JUNCTION BOX (JB-A72)

.1 Requirements:

.1 Enclosure:

.1 Mounting: Wall / Surface

.2 Type: NEMA Type 3

.3 Lockable via pad lock (pad lock to be supplied by City).

.2 Ungrounded Terminals:

.1 Type: Feed-through lugs with Allen-head set screws

.2 Rating: 200 A, 600 VAC (minimum)

.3 Size: Suitable for 4/0 AWG cable

.4 Quantity: 4

.3 Grounded Terminals:

.1 Type: Feed-through lugs with Allen-head set screws

.2 Rating: 100 A, 600 VAC (minimum)

.3 Size: Suitable for 4 AWG cable

.4 Quantity 1

.4 Cable Entry:

.1 Permanent Connection to MCC

.1 Location: Rear of enclosure

.2 Type: Conduit

.2 Temporary Generator Connection

.1 Location: Bottom of enclosure

.2 Size: Suitable for 4/0 AWG cable

.3 Provide 76 mm hole at bottom of enclosure for incoming generator cable. Seal hole with hole cover.

.5 Lamacoids:

.1 Mounted on front of panel door: JB-A72

.6 Junction box to be CSA approved and constructed by a CSA approved panel shop.

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.

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, or loop number for control wiring.

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

.1 Example: A73-2 (Panel A73, circuit 2)

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1, 20th 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.

.6 Material Requirements:

.1	Outdoor and Buried:	PVC
.2	Main Floor:	PVC
.3	Comminutor Chamber:	PVC
.4	Stairwells:	Metal
.5	Motor Room:	Metal
.6	Pump Room:	Metal

.7 Where conduit serves an area where metal material is required, utilize metal conduit, boxes, and fittings for the entire conduit run.

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 Finish

.1 Epoxy Enamel

.3 Suitable for threaded rigid conduit

.4 Mounting lugs as required.

.5 Wet location covers for all locations unless otherwise approved by the Contract Administrator.

.6 To CSA 22.2

.2 Round Boxes:

.1 100mm (4") round.

.2 Tapped conduit openings and plugs.

.3 Manufacturer / Model:

.1 Crouse Hinds VXF series

.3 Device Boxes

.1 FS or FD cast aluminum boxes with factory threaded hubs and mounting feet for surface wiring of receptacles.

.2 Single gang unless specified otherwise.

.3 Manufacturer / Model:

.1 Crouse Hinds FS/FD series

2.3 SURFACE MOUNTED OUTLET BOXES FOR PVC CONDUIT

.1 General Requirements:

.1 To CSA C22.2 No. 18.

.2 Acceptable materials:

.1 PVC

.3 Grounding stud.

.4 Mounting lugs as required.

.5 NEMA 4X, unless otherwise indicated.

.2 Specific Requirements:

.1 Ceiling Outlets:

.1 IPEX OB series

.2 Device Boxes:

.1 IPEX FS/FD series

2.4 CONDUIT BOXES FOR METAL CONDUIT

.1 FS or FD cast aluminum boxes with factory-threaded hubs and mounting feet for surface wiring.

2.5 CONDUIT BOXES FOR PVC CONDUIT

.1 Non-metallic PVC boxes with mounting feet for surface wiring of devices.

.2 Acceptable products: Ipex

2.6 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 Provide boxes sized as required by the Canadian Electrical Code.

.2 Support boxes independently of connecting conduits.

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

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

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

.1 Example: A73-2 (Panel A73, 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 CSA C22.2 No. 45, Rigid Metal Conduit.
- .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 211.2, Rigid PVC (Un-plasticized) Conduit.
- .5 CAN/CSA C22.2 No. 227.3, Flexible Non-metallic Tubing.

.2 Submittals

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures for the following:
  - .1 Metal conduit fittings.
  - .2 Fittings for hazardous locations.

Part 2 Products

2.1 GENERAL

.1 Material Requirements:

.1	Outdoor and Buried:	PVC
.2	Main Floor:	PVC
.3	Comminutor Chamber:	PVC
.4	Stairwells:	Rigid Metal
.5	Motor Room:	Rigid Metal
.6	Pump Room:	Rigid Metal

.7 Conduits that transition into areas requiring metal conduit must be Rigid Metal conduit in their entirety.

2.2 RIGID METAL CONDUIT

.1 Meets CSA C22.2 No. 45, aluminum threaded.

.2 Minimum conduit size: 19 mm, unless specifically indicated on the drawings or approved by the Contract Administrator.

2.3 RIGID PVC CONDUIT

.1 Meets CSA C22.2 No. 211.2.

.2 Minimum conduit size: 19 mm, unless specifically indicated on the drawings or approved by the Contract Administrator.

2.4 FLEXIBLE METAL CONDUIT

.1 To CSA C22.2 No. 56, liquid-tight flexible metal.

.2 Minimum conduit size: 19 mm, unless specifically indicated on the drawings or approved by the Contract Administrator.

2.5 CONDUIT FASTENINGS

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

.2 Strap material to match conduit material.

.3 Beam clamps to secure conduits to exposed steel work.

.4 Channel type supports for two or more conduits or as shown in the drawings.

.5 Threaded rods, 6 mm dia., to support suspended channels.

2.6 CONDUIT SPACERS

.1 PVC coated malleable iron spacers, CSA approved for the purpose.

.2 Aluminum channel may be utilized where conduits are grouped, however a non-metallic spacer must be provided between the aluminum channel and concrete.

2.7 CONDUIT FITTINGS

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

.2 All fittings to be liquid and dust tight.

.3 Enclosure Connections

.1 Connections in dry locations (bottom or side)

.1 Locknuts inside and outside enclosures.

.2 Insulated bushings Thomas & Betts Series 222.

.2 Connections in wet locations and tops of enclosures in dry locations

.1 Liquid-tight threaded hubs

.2 Insulated bushings Thomas & Betts Series 222.

.3 Utilize insulated grounding bushings at all non-metallic enclosure entries for metallic conduit, or as required for bonding in accordance with Code and good practice.

.4 Elbows:

.1 Utilize factory elbows for 27mm and larger conduits.

.5 Threaded Hubs for Metal Conduit

.1 liquid and dust tight with insulated throat

.2 Approved products

.1 Thomas & Betts "Bullet Hub" 370AL Series.

.6 Fittings for Metal Conduit

.1 Cast metal

.2 Gasketted covers.

.3 Approved products

.1 Crouse-Hinds Canada Ltd. "Condulet" series.

.7 Explosion proof conduit sealing fittings:

.1 CSA Certified suitable for Hazardous Locations – Class I, Zone 1, Group IIA.

.2 Material: Cast aluminum.

.8 Sealing Compound. As recommended by manufacturer.

2.8 FISH CORD

.1 Polypropylene

Part 3 Execution

3.1 ROUTING

.1 Locate conduits containing communication and low voltage conductors away from conduits containing power wiring.

.2 Route conduits on existing or new pipe rack or suspended channels where possible.

.3 Avoid routes that would interfere with any potential maintenance activities.

.4 Where not specifically shown in detail on the drawings, review proposed conduit routing with Contract Administrator prior to installation. Comply with all routing changes requested by the Contract Administrator.

3.2 INSTALLATION - GENERAL

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

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

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

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

.5 Ensure electrical continuity in all metallic conduit systems.

.6 All conduit shown exposed in finished areas is to be free of unnecessary labels and trademarks.

.7 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.

.8 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.

.9 Install fish cord in empty conduits.

.10 Dry conduits out before installing wire.

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

.12 Underground Conduits

.1 Slope conduits to provide drainage.

.13 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 Install spacers as required to provide a space between the conduits and the supporting surface, with a minimum space as follows:
.1 Above grade spaces not classified as CEC Category 1 or 2:
.1 Drywall / Wood surfaces: no space required
.2 Masonry / concrete surfaces: 6 mm
.2 Below grade spaces: 12 mm

.14 Colour Coding

.1 Apply plastic tape or paint colour coded bands to conduits at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.
.2 Bands: 38 mm wide prime colour and 19 mm wide auxiliary colours
.3 Band colours as per the following table.

System	**Prime Band**	**Aux. Band**
Medium Voltage (>750 V)	Orange	
347/600 V	Yellow	
120/208/240 V Power	Black	
UPS 120/208/240 V Power	Black	Green

Control Wiring (120 V)	Black	Orange
Fire Alarm	Red	
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring (<50 V)	Blue	Orange
Intrinsically Safe	Blue	White

3.3 PVC CONDUIT

.1 Concrete Penetrations:

.1 Seal and firestop penetration around conduit with ULC approved assembly for the installation conditions.

.2 Maximum spacing between supports for rigid PVC conduit:

.1	27mm conduit	0.75 m
.2	35mm conduit	0.75 m
.3	41mm conduit	1.2 m
.4	53mm conduit	1.5 m
.5	63mm conduit	1.5 m
.6	78mm conduit	1.5 m
.7	91mm conduit and larger	2.0 m

3.4 METAL CONDUIT

.1 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.2 Mechanically bend conduits over 19 mm in diameter.

.3 Concrete Penetrations:

.1 Sleeves for Aluminum Conduit

.1 Install schedule 40 galvanized steel pipe, sized for free passage of conduit.

.2 Seal and firestop penetration around conduit with ULC approved assembly for the installation conditions.

.3 For wall, partitions, and ceilings the sleeve ends shall be flush with the finish on both sides but for floors they shall extend 50 mm above finished floor level or housekeeping pad level.

.4 Maximum spacing between supports for rigid metallic conduit:

.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

3.5 LIQUID-TIGHT FLEXIBLE CONDUIT

.1 Use as raceways at all motors, pipe-mounted control devices, and other devices subject to movement or water.

.2 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.

3.6 INSTALLATIONS IN CATEGORY 1 LOCATIONS

.1 Arrange to provide drainage at frequent intervals to suitable locations.

.2 Equip with approved fittings to permit the moisture to drain out of the system.

.3 Install the conduit with a minimum of 12 mm space from the supporting surface.

.4 Install every joint to be water-tight.

.5 Where conduit leaves a warm room and enters a cooler atmosphere, seal the conduit and arrange the conduit in a manner to avoid condensation accumulation at the seal.

3.7 INSTALLATIONS IN CATEGORY 2 LOCATIONS

.1 Comply with all requirements of Category 1 locations.

3.8 INSTALLATIONS IN CATEGORY 2 WET LOCATIONS

.1 Comply with all requirements of Category 1 locations.

3.9 INSTALLATIONS IN HAZARDOUS ZONE 1 LOCATIONS

.1 Explosion proof conduit sealing fittings:

.1 Install sealing fittings as indicated and on all new conduit installations to meet CEC requirements.

.2 Add sealing compound following manufacturer’s instructions.

3.10 INSTALLATIONS IN HAZARDOUS ZONE 2 LOCATIONS

.1 Explosion proof conduit sealing fittings:

.1 Install sealing fittings as indicated and on all new conduit installations to meet CEC requirements.

.2 Add sealing compound following manufacturer’s instructions.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.1 No.126.1-02, Metal Cable Tray Systems.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA VE 1-2002, Metal Cable Tray Systems.

.2 NEMA VE 2-2001, Cable Tray Installation Guidelines.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.

.3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.

.4 Identify types of cable tray and cable channels used.

.5 Show actual cable tray and cable channel installation details and suspension system.

Part 2 Products

2.1 CABLE TRAY

.1 Cable tray and fittings: to NEMA VE 1 and CAN/CSA C22.1 No. 126.1.

.2 Ladder type, Class C1 to CAN/CSA C22.2 No. 126.1.

.3 Trays: extruded steel, galvanized, width as indicated on the drawings.

.1 Side rail height: 150mm unless otherwise indicated.

.4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cable tray supplied.

.1 Radii on fittings: 300 mm minimum.

.5 Barriers where different voltage systems are in same cable tray.

.6 Ground cable trays with 2/0 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.

2.2 CABLE CHANNEL

.1 Cable channel and fittings: to NEMA VE 1 and CAN/CSA C22.1 No. 126.1.

.2 Ventilated trough type.

.3 Channels: extruded steel, galvanized, width and depth as required.

.4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reduces where required, manufactured accessories for cable channel supplied.

.5 Ground cable channels with #6 AWG bare copper conductor attached to each channel section in accordance with CEC requirements.

2.3 SUPPORTS

.1 Provide splices, supports as required.

.2 Supports to be located minimum one-quarter span from points of coupling, where practicable.

Part 3 Execution

3.1 INSTALLATION

.1 Install complete cable tray and cable channel system in accordance with NEMA VE 2.

.2 Support cable tray and cable channel on both sides at 2000 mm maximum spacing.

.3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

.4 Provide fire stop material at firewall penetrations.

.5 Install permanent, legible warning notice carrying the words “DANGER – 4160V” on all cable trays containing 5kV conductors, with a maximum spacing between warning notices of 10 meters.

3.2 CABLES IN CABLE TRAY

.1 Install cables individually.

.2 Lay cables into cable tray. Use rollers when necessary to pull cables.

.3 Secure cables in cable tray at 6 m centres, with nylon ties.

3.3 CABLES IN CABLE CHANNEL

.1 Install cables individually.

.2 Lay cables into cable channel.

.3 Secure cables in cable channel at 2 m centres, with nylon ties.

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 CABLES

.1 After sand bed specified in Section 31 23 10 - Excavating, Trenching and Backfilling, is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.

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

.3 Underground cable splices not acceptable.

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

.5 Cable separation:

.1 100%, or as shown on drawings.

.6 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.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 NETA Acceptance Testing Specifications, 2003 (ATS-2003)

1.2 TESTING REPORT

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

.2 The Contractor shall furnish paper copies in the hard-copy O&M Manuals and electronic copies on CD for the electronic (soft-copy) O&M Manual.

.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 All medium voltage cables,

.2 All low voltage cables 1/0 AWG or larger,

.3 Grounding system,

.4 5kV Fusible Disconnect FDS-A70,

.5 Medium Voltage Service Transformer XFMR-A70,

.6 Customer Service Termination Enclosure CSTE-A70,

.7 Motor Control Centres MCC-A71 and MCC-A72, including but not limited to:

.1 Surge Protector
.2 Power Meter
.3 CTs (if present)
.4 PTs (if present)
.5 Circuit breakers
.6 Contactors
.7 Control Power Transformers
.8 Motor controllers

.8 Panelboard PNL-A73,

.9 Low Voltage Transformer XFMR-A73,

.10 Sanitary Lift Pump Motor MTR-L01 (existing),

.11 Sanitary Lift Pump Motor MTR-L02 (existing),

.12 Flood Pump Motor MTR-F01 (existing),

.13 Flood Pump Motor MTR-F02 (existing),

.14 Flood Pump Motor MTR-F03 (existing),

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 the existing 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 utilizing the following:

.1 To correct to 20°C, utilize Table 260805-1.

.2 To correct to 40°C, utilize Table 260805-2.

Table 260805-1

Insulation Resistance Correction Factors (20 °C)

Measured Temperature (°C)	Oil Immersed Insulation	Solid Insulation
-10	0.125	0.25
-5	0.18	0.32
0	0.25	0.40
5	0.36	0.50
10	0.50	0.63
15	0.75	0.81
16	0.80	0.85
17	0.85	0.89
18	0.90	0.92
19	0.95	0.96
20	1.00	1.00
21	1.08	1.05
22	1.16	1.10
23	1.24	1.15
24	1.32	1.20
25	1.40	1.25
30	1.98	1.58
35	2.80	2.00
40	3.95	2.50
45	5.60	3.15
50	7.85	3.98
55	11.20	5.00
60	15.85	6.30

Table 260805-2

Insulation Resistance Correction Factors (40 °C)

Measured Temperature (°C)	Oil Immersed Insulation	Solid Insulation
-10	0.03	0.10
-5	0.04	0.13
0	0.06	0.16
5	0.09	0.20
10	0.13	0.25
15	0.18	0.31
16	0.19	0.33
17	0.21	0.34
18	0.22	0.36
19	0.24	0.38
20	0.25	0.40
21	0.27	0.42
22	0.29	0.44
23	0.31	0.46
24	0.33	0.48
25	0.35	0.50
30	0.50	0.63
35	0.71	0.79
40	1.00	1.00
45	1.41	1.26
50	2.00	1.59
55	2.83	2.00
60	4.00	2.52

.3 Perform winding resistance temperature correction calculations utilizing the following:

.1 $$R_C = R_M \frac{T_C + T_K}{T_M + T_K}$$

.2 Where, RC = Resistance at corrected temperature.

RM = Resistance at measured temperature.
TC = Temperature to correct to in °C.
TM = Measured temperature in °C.
TK = Temperature Resistance Constant
(234.5 °C for copper, 226.0 °C for aluminum)

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

.1 Inspection and testing shall consist 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 MOTOR CONTROL CENTRE AND DISTRIBUTION SWITCHBOARDS, 600 V

.1 Inspection and testing shall consist of the following:

.1 Inspect the MCC/switchboard physical, electrical, and mechanical condition including evidence of moisture or corona.

.2 Verify appropriate anchorage, required area clearances, physical damage, and correct alignment.

.3 Inspect all doors, panels, and sections for dents, holes, fit, and missing hardware.

.4 Verify that fuse and / or circuit breaker sizes and types correspond to drawings and coordination study as well as to the circuit breaker’s address for microprocessor-communication packages.

.5 Verify that current and potential transformer ratios correspond to drawings.

.6 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.

.7 Confirm correct operation and sequencing of electrical and mechanical interlock systems.

.8 Attempt closure on locked-open devices. Attempt to open locked-closed devices.

.9 Make key exchange with all devices included in the interlock scheme as applicable.

.10 Vacuum debris from interior of MCC / switchboard. Clean off all dust and adhesive residue from MCC / switchboard.

.11 Use appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

.12 Inspect insulators for evidence of physical damage or contaminated surfaces.

.13 Verify correct barrier and shutter installation and operation.

.14 Exercise all active components.

.15 Inspect all mechanical indicating devices for correct operation.

.16 Verify that filters are in place and / or vents are clear.

.17 Test operation, alignment, and penetration of instrument transformer withdrawal disconnects, current-carrying and grounding contacts.

.18 Perform point to point ground-resistance tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and / or derived neutral points. Investigate point-to-point resistance values which exceed 0.5 ohm.

.19 Perform insulation-resistance tests at 1000 Vdc for one minute on each bus section, phase-to-phase and phase-to-ground.

.20 Inspect all surge arrestors if available.

.21 Inspect control power transformers.

.22 Inspect all current instrument transformers.

.23 Inspect potential transformers.

.24 Inspect all metering devices.

.25 Inspect and test air circuit breakers.

.26 Inspect and test protective relays.

.27 Inspect and test all associated motor starters.

.28 Inspect and test all moulded case feeder breakers. Feeder breakers with a frame size less than 250A, and without long, short, or ground fault settings, may be recorded on the MCC/Switchboard inspection form. Record test results on other breakers on the appropriate inspection form.

.1 Inspect and test all capacitors.

.2 Perform a system function test to prove the correct interaction of all sensing, processing, and action devices. Perform system function tests upon completion of the maintenance tests defined, as system conditions allow.

.29 Perform tests for the purpose of evaluating performance of all integral components and their functioning as a complete unit within each MCC cell.

.30 Verify the correct operation of all interlock safety devices for fail-safe functions in addition to design function.

.31 Verify the correct operation of all sensing devices, alarms, and indicating devices.

.32 Affix an inspection sticker or inspection tag to each MCC line-up or switchboard in an appropriate place so that it will be conspicuous to all authorized personnel. This inspection notice must include, but is not limited to, equipment identifier,

testing company name, date of inspection and the inspector's name. The sticker shall not obscure any equipment nameplates, readouts, or indicators.

3.5 SURGE ARRESTORS, LOW VOLTAGE

.1 Inspection and testing shall consist 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.

3.6 CONTROL POWER TRANSFORMERS, < 1000 V

.1 Inspection and testing shall consist of the following:

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

.2 Inspect physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

.3 Verify that primary and secondary fuse ratings or circuit breakers match available drawings. Where drawings are not available, note fuses that appear to be sized incorrectly, based upon application of the Canadian Electrical Code. Mark fuse sizes and type on the drawings, where not shown.

.4 Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be:

.1 windings < 250 V: 500 Vdc

.2 windings > 250 V: 1000 Vdc

3.7 CURRENT INSTRUMENT TRANSFORMERS

.1 Inspection and testing shall consist of the following:

.1 Inspect physical and mechanical condition.

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

.3 Ensure that CT shorting bars are removed or installed as required.

.4 Verify that current circuits are grounded and have only one grounding point in accordance with ANSI/IEEE C57.13.3.

.5 Perform an insulation resistance test of the current transformer primary and secondary windings, and wiring to ground at 1000 Vdc. Do not perform this test on solid-state devices. Investigate any resistance values less than 25 megaohms.

.6 Perform a polarity test of each current transformer in accordance with ANSI/IEEE C57.13.1.

.7 Perform a ratio-verification test using the voltage or current method in accordance with ANSI/IEEE C57.13.1. Note any ratio accuracies not within 0.5% of nameplate or manufacturer's published data.

.8 Perform an excitation test on transformers used for protection or relaying applications in accordance with ANSI C57.13.1.

3.8 METERING DEVICES, DIGITAL

.1 Inspection and testing shall consist 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.

3.9 MOTORS, INDUCTION, AC, 600 V

.1 Inspection and testing shall consist 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 For motors > 150kW (200 HP), the test duration is to be ten (10) minutes. Calculate the dielectric absorption ratio and polarization index.

.5 Correct test results to 40 °C.

.6 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.

3.10 MOTOR STARTERS, 600 V

.1 Inspection and testing shall consist 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.

3.11 CIRCUIT BREAKERS, INSULATED-CASE/MOULDED 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.

3.12 TRANSFORMERS, LOW VOLTAGE, DRY-TYPE

.1 Inspection and testing shall consist 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.

3.13 PANELBOARDS, LOW VOLTAGE

.1 Inspection and testing shall consist 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.

3.14 GROUNDING SYSTEM

.1 Inspection and testing shall consist of the following:

.1 Perform resistance tests between the main grounding electrode and grounded points in the electrical distribution system. 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 Section 01 33 00 - Submittal Procedures.

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 Requirements:

.1 Type: ANN.

.2 Three phase, kVA as indicated, 600V input, 120/208 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 Enclosure: as indicated in Schedule 261217-1 (below).

.12 Mounting: as indicated on the drawings.

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

.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 as indicated on the drawings. 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.

Schedule 261217-1 : Transformers

Identifier	Location	Size	Voltage	Enclosure Type
Marion Wastewater Pumping Station				
XFMR-A73	Electrical Room	30 kVA	600:120/208V, 3Ø	CSA 1

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 ANSI/IEEE 386-95(R2001), Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.

.2 Canadian Standards Association (CSA International)

.1 CAN/CSA-C2.1-2006, Single-Phase and Three Phase Distribution Transformers, Types ONAN and LNAN.

.2 CSA C227.4-2006, Three-Phase Dead Front Pad-Mounted Distribution Transformers.

.3 CSA C802.1-13, Minimum Efficiency Values for Liquid-Filled Distribution Transformers.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, and limitations.

.3 Submit shop drawings and indicate:

.1 Anchoring method and dimensioned foundation template.

.2 Dimensioned cable entry locations.

.3 Dimensioned cable termination height.

.4 Identified internal and external component layout on assembly drawing.

.5 Insulating liquid type and capacity.

.6 Submit primary fuse time-current characteristics.

.7 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.8 Closeout Submittals:

.1 Provide operation and maintenance data for pad mounted distribution transformers for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Include insulating liquid maintenance data.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Transformer may be temporarily stored at the City of Winnipeg storage facility

1.4 MAINTENANCE

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 MEDIUM VOLTAGE SERVICE TRANSFORMER, XFMR-A70

.1 Low profile single-phase pad mounted distribution transformers: to CAN/CSA-C227.3.

.2 Three phase dead front pad mounted distribution transformers: to CSA C227.4.

.3 Separable insulated connectors for power distribution systems above 600 V: to ANSI/IEEE 386.

.4 Oil filled pad mounted distribution transformer complete with primary and secondary cable compartments, primary fusing, options and accessories to form complete factory assembled, self contained, steel fabricated unit for mounting on concrete pad.

.5 High voltage bushings or high voltage bushing wells for connection to distribution system through separable insulated connectors for dead front operation.

.6 Primary voltage: 4160 V, 60 Hz, delta connected, 3 phase, un-grounded.

.7 Secondary voltage: 600 V, wye connected, 3 phase, 4 wire, neutral grounded.

.8 Capacity: 750 kVA.

.9 High-Voltage Connections:

.1 Feed configuration: Radial.

.2 HV bushing inserts for load break elbows.

.10 Low-Voltage Connections:

.1 4 hole spades for connection to secondary cables.

.11 Primary protection: Bay-O-Net and current limiting fuses, sizing as per manufacturer recommendations.

.12 High-voltage side basic impulse level (HV BIL): 60 kV or higher.

.13 Low-voltage side basic impulse level (LV BIL): 30 kV or higher.

.14 Impedance: not less than 4%, not more than 5%.

.15 Voltage Taps: Four-2.5% taps, 2-FCAN, 2-FCBN.

.16 Temperature Rise: 65°C.

.17 Efficiency: 99.15% minimum, meeting C801.2(13).

.18 Cooling: KNAN (FR3)

.19 Mechanical Kirk-Key interlock with fusible disconnect FDS-A70 to prevent access to transformer HV compartment unless primary supply is isolated.

.20 Stays to hold compartment doors in 110 degrees open position.

.21 Sound level: maximum 58 dB

.22 Accessories:

.1 Liquid temperature gauge.
.2 High temperature switch (dry contact).
.3 Liquid level gauge.
.4 Low oil level switch (dry contact).
.5 Pressure relief device.
.6 25 mm drain valve.
.7 25 mm filler plug.

.23 Grounding:

.1 Copper grounding bus size 4 mm x 6 mm, minimum.
.2 Connectors for grounding conductors compatible with 2/0 AWG wire.

.24 Finish

.1 Painted, seafoam green.

.25 Acceptable Manufacturer:

.1 CARTE,
.2 Or approved equal in accordance with B7.

2.2 EQUIPMENT IDENTIFICATION

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

.2 Nameplate showing information in accordance with CSA C2.

2.3 WARNING SIGNS

.1 Provide warning signs in accordance with Section 26 05 00 - Common Work Results - for Electrical.

2.4 SOURCE QUALITY CONTROL

.1 Submit to the Contract Administrator standard factory test certificates of each transformer and type test of each transformer with high voltage accessories in accordance with CSA C2.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSPECTION

.1 Check factory made connections of transformer unit for mechanical security and electrical continuity.

.2 Check transformer insulating liquid for correct quantity and specification according to manufacturer's instructions.

3.3 INSTALLATION

.1 Coordinate the size/compartment locations on the reviewed shop drawings prior to installing oil containment system, concrete pad, conduits, and cabling.

.2 Ensure concrete pad is fully cured before transformer is installed.

.3 Install oil containment system complete with water drainage piping to the river. Provide tertiary oil containment (in-line filter) in water drainage pipe.

.4 Set and secure transformer unit in place, rigid, plumb and square.

.5 Make connections.

.6 Connect transformer unit ground bus to system ground.

.7 Wire one set of contacts on low oil level switch to the station PLC (RTU). Refer to the drawings.

.8 Wire one set of contacts on the high temperature switch to the station PLC (RTU). Refer to the drawings.

.9 Ensure care is taken to prevent contamination of liquid and components when field filling transformer.

.10 Use only metal hose when field-filling transformer with oil: do not use rubber hose.

.11 Set taps to produce 585V secondary voltage at no-load due to 550V motor loads within the station.

3.4 FIELD QUALITY CONTROL

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

.2 Carry out following insulation tests using megger with 20,000 megohm scale and resulting insulation resistance corrected to base of 20 degrees C.

.1 High voltage to ground with secondary grounded for duration of test.

.2 Low voltage to ground with primary grounded for duration of test.

.3 High to low voltage.

.3 Inspect primary and secondary connections for tightness and for signs of overheating.

.4 Inspect and clean bushings and insulators.

.5 Check oil level and temperature indicators.

.6 Set transformer taps in accordance with supply voltage.

.7 Inspect for oil leaks and excessive rusting.

.8 Inspect oil level.

.9 Check fuses for correctness of type and size.

.10 Check for grounding and neutral continuity between primary and secondary circuits of transformer.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Service equipment and installation.

1.2 RELATED SECTIONS

.1 Section 01 74 11 - Cleaning

.2 Section 26 05 27 - Grounding - Primary.

.3 Section 26 05 28 - Grounding - Secondary.

.4 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

.5 Section 26 28 21 - Moulded Case Circuit Breakers.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, and cleaning procedures.

.3 Submit shop drawings and indicate:

- .1 Outline dimensions.
- .2 Configuration of identified compartments.
- .3 anchoring method and dimensioned foundation template.
- .4 Cable entry and exit locations.
- .5 Dimensioned position and size of busbars and details of provision for future extension.
- .6 Schematic and wiring diagrams.
- .7 Enclosure finish.

.4 Closeout Submittals: provide as-built drawings and supplemental information for motor control centre as specified in Section 01 78 00 - Closeout Submittals.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials where possible.

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

.3 Collect and separate for disposal packaging material for recycling.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility.

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

Part 2 Products

2.1 5 kV FUSIBLE DISCONNECT SWITCH c/w UTILITY METERING COMPARTMENT (FDS-A70):

.1 Requirements:

.1 Rating: 5 kV, 200A, 3ph, 3 wire.

.2 Interrupting Rating: 3 kA minimum.

.3 Fuses: Type and ampere rating as shown on the drawings.

.1 Provide three (3) spare fuses of equal type and rating.

.4 Manually operated switch.

.5 Integrated 5kV metering compartment.

.1 Metering components (meter, CTs, and PTs) supplied by Manitoba Hydro.

.6 Dead front construction.

.7 All compartments and sections to be barriered from adjoining sections.

.8 Copper bus.

.9 Cabling: 5/8 kV rated, EPR or EPDM, copper conductors, with 133% insulation when applied to a 5 kV system.

.10 Switch Kirk-Key Interlock: Interlocked with XFMR-A70 door.

.11 Enclosure Rating: NEMA Type 3R.

.2 Manufacturer:

.1 Strong Electric,

.2 Littelfuse/JRS,

.3 S&C Electric,

.4 Schneider Electric,

.5 Eaton,

.6 ABB,

.7 Or approved equal in accordance with B7.

2.2 5 kV MEDIUM VOLTAGE SERVICE TRANSFORMER (XFMR-A70)

.1 Requirements:

.1 4160:600V, 750 kVA, in accordance with Section 26 12 19 – Pad Mounted, Liquid Filled, Medium Voltage Transformers.

2.3 600V CUSTOMER SERVICE TERMINATION ENCLOSURE (CSTE-A70)

.1 Requirements:

.1 Rating: 600V, 1200A, 3 phase, 4 wire.

.2 Interrupting Rating: 25 kA minimum

.3 Service Entrance Rated.

.4 Main breaker:

.1 In accordance with 26 28 21 – Moulded Case Circuit Breakers, Clause 2.2.

.5 Meter socket: 7-jaw with insulated neutral.

.6 Provision for utility metering CTs (current transformers).

.1 Metering CTs not included in contract.

.7 Compartments and sections:

.1 Main Breaker Section

.2 Metering Section

.3 Distribution Section

.8 All compartments and sections to be barriered from adjoining sections.

.9 Copper bus.

.10 Insulated neutral.

.11 Factory-installed neutral-ground link.

.12 Enclosure Rating: NEMA Type 3R.

.13 Doors: stays to hold compartment doors in 110 degrees open position.

.2 Manufacturer:

.1 Strong Electric,

.2 Littelfuse/JRS,

.3 Or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

.1 Install conduit sleeves, conduits, cable sleeves, ground cabling, and transformer pad.

.2 Install service equipment.

.3 Connect to incoming service.

.4 Connect to outgoing load circuits.

.5 Install ground fault equipment.

.6 Make primary grounding connections in accordance with Section 26 05 27 - Grounding - Primary.

.7 Make secondary grounding connections in accordance with Section 26 05 28 - Grounding - Secondary.

.8 Make provision for power supply authority's metering.

.9 Set transformer taps.

.10 Ensure care is taken to prevent contamination of liquid and components when field filling transformer.

.11 Use only metal hose when field filling transformer with oil: do not use rubber hose.

.12 Provide spare components as indicated in the specifications and drawings.

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 Section 01 33 00 - Submittal Procedures.

1.4 O&M Manual

.1 Include product data in 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 Bus and breakers rated for 10 kA (symmetrical) interrupting capacity, or as indicated.

.3 Each breaker identified by permanent number identification as to circuit number and phase.

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

.5 Main Breaker:

.1 Main Breaker to be top mounted.

.2 Backfed 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 and models:

.1 Schneider Electric Square D

.2 Or approved equal in accordance with B7.

2.2 BREAKERS

.1 Connection: bolt-on.

.2 Type and rating as indicated on the drawings.

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

.2 GFCI breakers as indicated on the drawings (for below-grade receptacles, excluding sump pumps).

2.3 EQUIPMENT IDENTIFICATION

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

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

.1 Line 1 is to be the panel identifier as indicated on the drawings, for example “PNL-A73”.

.2 Line 2 is to be the voltage, for example “120/208V, 3Ø”.

.3 Complete circuit directory with typewritten legend.

Part 3 Execution

3.1 INSTALLATION

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

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

.3 Mount panelboards to height of two (2) metres to top of cover, as required by Code, or as indicated.

.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 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit product data sheets for sills, busbars and compartments. Include product characteristics, physical size and finish.

.3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, and cleaning procedures.

.4 Submit shop drawings and indicate:

- .1 Outline dimensions.
- .2 Configuration of identified compartments.
- .3 Floor anchoring method and dimensioned foundation template.
- .4 Cable entry and exit locations.
- .5 Dimensioned position and size of busbars and details of provision for future extension.
- .6 Schematic and wiring diagrams.
- .7 Layout of all customer starter assemblies.

.5 Closeout Submittals: provide as-built drawings and supplemental information for motor control centre as specified in Section 01 78 00 - Closeout Submittals.

- .1 Include data for each type and style of starter.

Part 2 Products

2.1 SUPPLY CHARACTERISTICS

.1 600 V, 60Hz, wye connected, 3 phase, 3 wire.

2.2 GENERAL DESCRIPTION

.1 Compartmentalized vertical sections with common power busbars.

.2 Floor mounting, free standing, enclosed dead front.

.3 Indoor NEMA Type 1A (gasketed) enclosure, front mounting.

.4 Suitability for Service Entrance: Not Required.

.5 Wiring class: Class 1, Type B-D or B-T as shown on the drawings.

.6 Nameplates: white with black letters.

.7 SCCR: 25 kA minimum.

.8 Acceptable manufacturer:

.1 Schneider Electric Model 6.

.2 This product was standardized by the City via RFP 756-2013. No alternates or substitutes will be accepted.

.9 Purchase or Quotation:

.1 All requests for purchase or quotation shall reference RFP 756-2013 to receive discount pricing that the City has negotiated with the Vendor.

.2 Contact: Schneider Electric Canada, 21 Omands Creek Blvd, Winnipeg, MB, R2R 2V2

.3 The Bidder's bid price shall reflect the discounted equipment price. The City will review the purchase price for standardized equipment to ensure the applicable discount factor has been applied.

2.3 VERTICAL SECTION CONSTRUCTION

.1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.

.2 Dimensions: 2324 mm (91.5") high, 381 mm (15") deep and 508 mm (20") wide, except as noted on the Drawings.

.3 Assembled sections into a group having a common power bus and forming an enclosure to which additional sections may be readily added.

.4 Design for all power and control connections to be made from the front. All bus and feeder bolted connections shall be accessible from the front.

.5 Sections with horizontal wiring spaces top and bottom and with 102 mm full height vertical wiring spaces with cable tie supports. Insulate wireways from horizontal and vertical bus.

.6 Each vertical section divided into compartment units, minimum 152 mm high, as indicated.

.7 Each unit to have complete top and bottom steel plate for isolation between units.

.8 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.

.9 Vertical wireways c/w doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

.10 Stab opening protection: Removable protective caps.

.11 Isolation barriers between units and wireways.

.12 Openings, with removable cover plates, in side of vertical sections for horizontal wiring between sections.

.13 Incoming cables to enter at top and/or bottom.

.14 Provision for outgoing cables to exit via top and/or bottom.

.15 Removable lifting means.

.16 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.

.17 Divide assembly for shipment to site, complete with hardware and instructions for re-assembly.

.18 Provide all spaces complete with bussing hardware and other accessories required so that additional combination starter units can be readily installed. Provide barriers to isolate the space from all buswork.

.19 Provide barriers to isolate all buswork to prevent accidental contact when starter units are removed or spaced are provided. Barriers shall also provide phase-to-phase isolation of the vertical bus.

.20 Master nameplate lamacoid: text as shown on the drawings.

2.4 SILLS

.1 Continuous channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

2.5 BUSBARS

.1 Main horizontal and branch vertical, three phase high conductivity, tin plated copper busbars in separate compartment bare self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:

.1 Main horizontal busbars: As indicated on the drawings.

.2 Branch vertical busbars: 300 A or 600 A as required.

.2 Branch vertical busbars for distribution of power to units in vertical sections.

.3 No other cables, wires, equipment in main and branch busbar compartments.

.4 Brace buswork to withstand effects of short-circuit current of 42 kA rms symmetrical.

.5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

.6 Location: Top

2.6 GROUND BUS

.1 Copper ground bus extending entire width of motor control centre.

.1 Size: 6 x 25 mm (1/4” x 1”)

.2 Plating: Tin

.3 Location: Bottom

.2 Vertical ground bus, full height of section, tied to horizontal ground bus, engaged by plug-in unit ground stab.

.1 Material: tin plated copper.

2.7 TRANSIENT VOLTAGE SURGE SUPPRESSOR

.1 Supply and install a Transient Voltage Surge Suppressor (TVSS) where shown on the drawings.

.2 Requirements:

.1 TVSS 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 TVSS 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 TVSSs applied to the distribution system shall have a 20kA In rating regardless of their TVSS Type (includes Types 1 and 2) or operating voltage. TVSSs having an In less than 20kA 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 TVSS Design

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

intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

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

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

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

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

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

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

.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:	240 kA
.2	600V Equipment – Not Service Entrance:	120 kA

.6 Installation Requirements:

.1 The TVSS shall be installed immediately following the load side of the main breaker or main switch.

.2 The MCC shall be capable of re-energizing upon removal of the TVSS.

.3 Utilize a breaker, appropriately rated as directed by the TVSS manufacturer, to connect the TVSS to the MCC. The TVSS shall be located directly adjacent to the circuit breaker.

.4 The TVSS shall be included and mounted within the MCC by the manufacturer of the MCC where shown on the drawings.

.1 The complete MCC including the TVSS shall be CSA/cUL listed.

2.8 POWER METER

.1 Where indicated on the drawings, provide a microprocessor based multifunction power meter.

.2 Requirements:

.1 Multifunction electrical measurement on 3 phase power systems.

.2 User programmable for voltage range to any PT ratio.

.3 Integrated display.

.4 Accept a direct voltage input range of up to 347 Volts Line to Neutral, and a range of up to 600 Volts Line to Line.

.5 Accept a current input of up to 5 Amps nominal, 10 Amps full scale.

.6 Programmable for current to any CT ratio. The use of DIP switches for selecting fixed ratios shall not be acceptable.

.7 Maximum burden of 0.0625 VA at 10 Amps.

.8 The meter shall have an accuracy of +/- 0.25% or better for volts and amps, and 1.5% for power and energy functions.

.9 The meter shall provide true RMS measurements of voltage, phase to neutral and phase to phase; current, per phase and neutral.

.10 Function Requirements:

.1 Volts, Amps, kW, kVAR, PF, kVA (per phase)

.2 Frequency, kWh, kVAh, kVARh

.3 Harmonics measurement, individual, even, and odd, up to 15^{th}.

.11 Operating Temperature:

.1 -20 to +60 °C ambient.

.3 Communications ports:

.1 10 Mbps or 10/100 Mbps Ethernet supporting Modbus-TCP.

.4 Acceptable Products:

.1 Schneider Electric PM8000 series.

.2 Or approved equal in accordance with B7.

2.9 VOLTAGE MONITORING RELAY

.1 Requirements,

.1 Suitable for direct connection to MCC bus having nominal operating voltage of 600 V line-to-line.

.2 Adjustable nominal input voltage via potentiometer from 500 V to 600 V.

.3 Undervoltage trip point:

.1 Adjustable from 88% to 92% of nominal voltage.

.4 Voltage unbalance:

.1 Adjustable from 2% to 10%.

.5 Phase loss detection:

.1 Triggered upon ≥ 15% unbalance.

.2 Response time ≤ 200 msec.

.6 Trip delay:

.1 Adjustable from 0.25 to 30 sec.

.7 Automatic reset (restart) delay:

.1 Adjustable from 0.25 to 64 sec.

.2 Adjustable random restart delay from 3 to 15 sec.

.8 Faults stored in non-volatile memory.

.1 Storage of the last 10 faults.

.9 Status and faults displayed on LED readout.

.10 Remote reset input.

.11 CSA approved.

.2 Relay output:

.1 Equipped with, at minimum, one Form C electromechanical dry contact output for monitoring.

.1 Relay contact to be normally open, held-closed during normal operation, and open upon an alarm condition.

.2 Actuate relay on any of the following:

.1 Phase A-B, B-C, or C-A voltage less than 550 V.

.2 Voltage unbalance greater than 10%.

.3 Rated at 10A resistive @ 250 VAC, 6A inductive (0.4 PF) @ 250 VAC.

.4 Mechanical life of $1x10^7$ operations.

.3 Acceptable products:

.1 SSAC WVM011AL.

.2 Or approved equal in accordance with B7.

2.10 MOTOR STARTERS AND DEVICES

.1 Equip the MCC with combination starters as specified and shown on the drawings.

.2 Refer to Section 26 29 10 – Motor Starters to 600 V.

2.11 STARTER UNIT COMPARTMENTS

.1 Units EEMAC size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.

.2 Unit mounting:

.1 Engaged position - unit stabbed into vertical bus.

.2 Withdrawn position - unit isolated from vertical bus but supported by structure.

.3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.

.4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.

.3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for padlock to lock operating handle in "off" position and lock door closed.

.4 Hinge unit doors on same side.

.5 Overload relays manually reset from front with door closed.

.6 Pushbuttons and indicating lights mounted on door front.

.7 Devices and components by one manufacturer to facilitate maintenance.

.8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

.9 Control wiring shall be extended from each starter module to the control terminal section, including all auxiliary contacts. A multi unit style terminal block having screw type terminal connections shall be installed on standoff supports on back plate.

.10 All terminals shall be number coded or otherwise suitably identified to indicate which section or module of the MCC they are associated with and their function.

.11 Complete control wiring diagrams for each starter with conductor identification clearly shown shall be affixed to the interior cover of the starter section or provide a book of wiring diagrams for all starters in each MCC.

.12 Primary and secondary high rupturing capacity (HRC) fusing shall be installed on the control transformer.

.13 Equip door of each individual unit with a removable plate replaceable with similar plate complete with pushbuttons, pilot lights or selector switches as required. Use pilot lights of push-to-test type and push button of heavy-duty oil tight construction.

2.12 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.

2.13 EQUIPMENT IDENTIFICATION

.1 Identify Motor Control Centre with nameplates as follows:

.2 Nameplates:

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

NAMEPLATE SIZES

Motor control centre main nameplate	70 x 120 mm	1 line	40 mm high letters
Individual compartment nameplates	30 x 90 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.

2.14 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 construction.

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

.4 Paint motor control centre exterior light gray and interiors white.

2.15 SOURCE QUALITY CONTROL

.1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

.2 Contract Administrator to witness standard factory testing of complete motor control centre including operation of switches, circuit breakers, starters and controls.

2.16 SPARE PARTS

.1 One (1) set of fuses of each type and size.

Part 3 Execution

3.1 INSTALLATION

.1 Provide housekeeping pad below the MCC as per the drawings.

.2 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.

.3 Make field power and control connections as indicated.

.4 Ensure correct overload settings are applied.

.5 Coordinate concrete pad with bevelled edges as shown on the Drawings, sized to suit MCC, install and level channel sills and mount MCC.

3.2 FIELD QUALITY CONTROL

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

.2 Ensure moving and working parts are lubricated where required.

.3 Operate starters in sequence to prove satisfactory performance of motor control centre during 8 hour period.

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 CSA-C22.2 No.42-99(R2002), General Use Receptacles, Attachment Plugs and Similar Devices.

.2 CSA-C22.2 No.144.1-06(R2011), Ground Fault Circuit Interrupters.

.3 CSA-C22.2 No.42.1-00, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).

.4 CSA-C22.2 No.55-M1986(July 2001), Special Use Switches.

.5 CSA-C22.2 No.111-00, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 SWITCHES – TWO POSITION, SINGLE POLE

.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:

.6 Hubbell or approved equal in accordance with B7.

2.2 SWITCHES – TWO POSITION, DOUBLE POLE (HS-A600)

.1 15 A, 120 V, double 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.

.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:

.6 Hubbell or approved equal in accordance with B7.

2.3 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.
- .5 Green hex head grounding terminal.

.2 Receptacles of one manufacturer throughout project.

.3 Acceptable manufacturer:

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

2.4 GFI RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, heavy duty specification grade to: CSA-C22.2 No. 144.1-06 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 Trip Level: 4 – 6 mA
- .4 Trip Time: 0.025 sec
- .5 Frequency: 60 Hz
- .6 Nominal Voltage: 120V AC
- .7 Interrupting Capacity: 2,000 Amps (minimum)
- .8 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.

2.5 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 as indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Switches:

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

.2 Mount 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: A73-2 (Panel A73, circuit 2)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers and circuit breakers operating on 600V, 3-phase systems.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

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

1.4 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

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 25 kA symmetrical rms interrupting capacity rating, or higher as indicated.

.5 Thermal magnetic moulded case circuit breakers 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 CSTE-A70.MCB

.1 Requirements:

.1	Frame Size:	1200 A
.2	Sensor Rating:	1200 A
.3	Interrupting Rating:	25 kA @ 600 VAC
.4	Trip Unit Type:	Electronic LSI, Factory Sealed
.5	Long Time PU:	0.40 – 1.00 A * Sensor Rating (Adjustable)
.6	Long Time Delay:	0.5 – 24 sec (Adjustable)
.7	Short Time PU:	1.5 – 10 * LTPU (Adjustable)
.8	Short Time Delay:	0.0 to 0.4 sec (Adjustable)
.9	Instantaneous:	2 – 15 * Sensor Rating (Adjustable)
.10	Poles:	3
.11	Model:	Schneider Electric PowerPact M series with Micrologic 5.0A series trip unit, or approved equal in accordance with B7.

2.3 MCC-A71.MCB

.1 Requirements:

.1	Frame Size:	1200 A
.2	Sensor Rating:	1200 A
.3	Interrupting Rating:	25 kA @ 600 VAC
.4	Trip Unit Type:	Electronic LSI, Factory Sealed
.5	Long Time PU:	0.40 – 1.00 A * Sensor Rating (Adjustable)
.6	Long Time Delay:	0.5 – 24 sec (Adjustable)
.7	Short Time PU:	1.5 – 10 * LTPU (Adjustable)
.8	Short Time Delay:	0.0 to 0.4 sec (Adjustable)
.9	Instantaneous:	2 – 15 * Sensor Rating (Adjustable)
.10	Poles:	3
.11	Model:	Schneider Electric PowerPact M series with Micrologic 5.0A series trip unit, or approved equal in accordance with B7.

2.4 CB-A71-T, TIE BREAKER (MCC-A72 FEEDER)

.1 Requirements:

.1	Frame Size:	250 A
.2	Trip Unit Rating:	250 A
.3	Interrupting Rating:	25 kA @ 600 VAC
.4	Trip Unit Type:	Electronic LS, Factory Sealed
.5	Long Time PU:	70 – 250 A (Adjustable)
.6	Long Time Delay:	0.5 – 16 sec (Adjustable)
.7	Instantaneous:	1.5 – 15 x Trip Unit Rating (Adjustable)

.8	Poles:	3
.9	Model:	Schneider Electric PowerPact J Series with Micrologic 5.2A series trip unit, or approved equal in accordance with B7.

2.5 CB-A72, TEMPORARY GENERATOR BREAKER

.1 Requirements:

.1	Frame Size:	250 A
.2	Trip Unit Rating:	250 A
.3	Interrupting Rating:	25 kA @ 600 VAC
.4	Trip Unit Type:	Electronic LS, Factory Sealed
.5	Long Time PU:	70 – 250 A (Adjustable)
.6	Long Time Delay:	0.5 – 16 sec (Adjustable)
.7	Instantaneous:	1.5 – 15 x Trip Unit Rating (Adjustable)
.8	Poles:	3
.9	Model:	Schneider Electric PowerPact J Series with Micrologic 5.2A series trip unit, or approved equal in accordance with B7.

2.6 THERMAL MAGNETIC BREAKERS < 100A

.1 Requirements:

.1	Trip Rating:	As shown on the drawings.
.2	Interrupting Rating:	25 kA @ 600 VAC
.3	Type:	Thermal Magnetic
.4	Poles:	As shown on the drawings.
.5	Model:	Schneider Electric PowerPact H series or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 National Electrical Manufacturer's Association (NEMA)

.1 NEMA Standards Publication ICS 2-2000: Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.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 Head load calculations.

.1 Provide heat load calculations, detailing the total head load within the starter and the required fan C.F.M. (cubic feet per minute) air-flow required to maintain a maximum temperature of 45°C within the enclosure. Utilize a maximum ambient air temperature of 30°C in the calculations.

.4 Shop Drawings:

.1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

.1 Provide shop drawings for each starter, indicating:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout and components or internal units and front panels.

.4 Enclosure types.

.5 Wiring diagram.

.6 Interconnection diagrams, as applicable.

.7 When air-cooled systems are provided, the following shall also be shown:

.1 Air inlet and outlet passages.

.2 Cooling fans.

.3 Filters.

1.3 CLOSEOUT SUBMITTALS

.1 Submit as-built drawings for each type and style of motor starter in accordance with Section 01 78 00 - Closeout Submittals

Part 2 Products

2.1 GENERAL

.1 Starters: to NEMA ICS 2-2000.

.2 Equipment Identification:

.1 Colour: White nameplate, black letters.

.2 Text Size: 8mm high letters.

.3 Text as shown on the drawings.

.3 Control Wiring:

.1 Copper, 16 AWG, TEW unless otherwise indicated.

.4 Wire Identification:

.1 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram. Markings are to be computer generated.

.5 Device Identification:

.1 Door-mounted indicating lights, push buttons, selector switches, as indicated on the drawings. Identification to be lamacoids.

.2 On the door interior, install identification labels adjacent to each pilot device containing the identifier of the pilot device (i.e. HS-L010-1). The identification is to be provided by a lamacoid or permanent machine-made stick-on label.

.3 Internal components such as contactors and relays must be identified by a lamacoid or permanent machine-made stick-on-label. Relays comprised of a base and removable relay are to be identified on the base or enclosure back-panel rather than on the removable relay component.

.6 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 construction.

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

2.2 SOFT STARTERS

.1 Design requirements:

.1 The Short Circuit Current Rating (SSCR) of the assembly must equal or exceed 25 kA.

.2 Ventilation system designed for ambient temperature range of 5°C to 35°C. Enclosure temperature not to exceed 45°C.

.2 Soft Starter Modules:

.1 Continuous rating: as indicated on the drawings.
.2 Rated operation voltage: 600 Vac, 60 Hz
.3 Control circuit voltage: 120 Vac, 60 Hz
.4 Operating temperature range, without de-rating: -10 to +40°C.
.5 Logic inputs: Qty 4, 24 Vdc, programmable
.6 Logic outputs: Qty 2, 24 Vdc (open collector), programmable
.7 Relay outputs: Qty 3, Form A (Normally Open)
.8 Analog outputs: Qty 1, 0-20 mA / 4-20 mA, programmable
.9 Vibration resistance:
.1 1.5 mm peak from 2 to 13 Hz
.2 1 gn from 13 to 200 Hz
.10 Shock resistance: 16 g, 11 ms
.11 Acceptable products:
.1 Schneider Electric ATS48 Series.
.2 No alternates will be accepted.

.3 Isolation Contactors:

.1 NEMA rated, size as indicated on the drawings.
.2 120 Vac, 60 Hz coil.

.4 Bypass Contactors:

.1 NEMA rated, size as indicated on the drawings.
.2 120 Vac, 60 Hz coil.

.5 Control Transformers:

.1 Single phase, dry-type, with 600V primary and 120V secondary, complete with primary and secondary fusing, installed in enclosure with soft starter, as indicated.
.2 Calculate required size of the control transformer. The size shown on the drawings is the minimum size. Provide size as required for appropriate operation of the starter, plus 20% spare capacity.

.6 Cooling:

.1 Provide cooling system as required to maintain an acceptable enclosure.
.2 Intake fan located at bottom of enclosure.
.3 Exhaust vent located at top of enclosure.

.7 Door-mounted soft starter Human Interface Module (HIM).

.8 Pilot Devices:

.1 Pushbuttons and selector switches: Heavy-duty, oil tight, NEMA rated, 30 mm, labelled as indicated.
.2 Indicating lights: Heavy-duty, oil tight, NEMA rated, 30 mm, LED bulb, type and color as indicated.

.3 Start pushbuttons to utilize a green cap, and stop pushbuttons to utilize a red cap.

.9 Documentation:

.1 Provide door pocket with complete set of drawings for each starter.

2.3 FULL VOLTAGE MAGNETIC STARTERS

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

.1 Smallest size of starter: NEMA size 1, unless otherwise indicated

.2 IEC rated starters are not acceptable.

.2 Short Circuit Current Rating (SCCR):

.1 The Short Circuit Current Rating (SSCR) of the assembly must equal or exceed 25 kA.

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

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

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

.6 Transient suppressors shall be supplied for all coils in each individual starter unit.

Part 3 Execution

3.1 GENERAL

.1 Perform detailed review of drawings and make necessary corrections to ensure proper operation, and to ensure the design meets Code requirements. Notify the Contract Administrator of any proposed design modifications.

3.2 MOTOR SOFT STARTER TESTING

.1 Perform complete testing of motor starter operation, including but not limited to simulating a soft starter module fault to ensure the starter can be reset and put back into operation.

.2 Submit test results to the Contract Administrator.

3.3 FIELD QUALITY CONTROL

.1 None.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI C82.1-04, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.

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

.1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

.3 ASTM International Inc.

.1 ASTM F1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

.4 Canadian Standards Association (CSA International).

.5 ICES-005-07, Radio Frequency Lighting Devices.

.6 Underwriters' Laboratories of Canada (ULC).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

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

Part 2 Products

2.1 FLUORESCENT LAMPS

.1 Fluorescent lamps to be - T8, 17 Watt or 32 Watt as indicated on the drawings, medium bi-pin, rapid-start, 4100 K, 30,000 hour lamp life, 2950 initial lumens, CRI 80; or as otherwise indicated.

2.2 FLUORESCENT BALLASTS

.1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic.

.1 Rating: 120 V, 60 Hz for use with 2-32W, lamps.

.2 Totally encased and designed for 40 degrees Celsius ambient temperature.

.3 Power factor: minimum 95% with 95% of rated lamp lumens.

.4 Current crest factor: 1.7 maximum.

.5 Harmonics: 10 % maximum THD.

.6 Operating frequency of electronic ballast: 20 kHz minimum.

.7 Total circuit power: 62 Watts.

.8 Ballast factor: greater than 0.90.

.9 Sound rated: Class A.

.10 Mounting: integral with luminaire.

2.3 FINISHES

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

2.4 OPTICAL CONTROL DEVICES

.1 As indicated in luminaire schedule.

2.5 LUMINAIRES

.1 As indicated in luminaire schedule.

Part 3 Execution

3.1 INSTALLATION

.1 Locate and install luminaires as indicated.

.2 Provide adequate support to suit ceiling system.

.3 Install a permanent label or lamacoid for all luminaires indicating the circuit(s) contained within.

.1 Example: A73-2 (Panel A73, circuit 2)

3.2 WIRING

.1 Connect luminaires to lighting circuits:

.1 Install rigid aluminum conduit for luminaires as indicated.

3.3 LUMINAIRE SUPPORTS

.1 Support luminaires from ceiling in accordance with local inspection requirements.

3.4 LUMINAIRE ALIGNMENT

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

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for emergency lighting systems.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.141-M1985(R1999), Unit Equipment for Emergency Lighting.

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Data to indicate system components, mounting method, source of power and special attachments.

Part 2 Products

2.1 EQUIPMENT

.1 Emergency lighting equipment: to CSA C22.2 No.141.

.2 Supply voltage: 120 V ac.

.3 Output voltage: 12 V dc.

.4 Operating time: as shown in schedule on drawings.

.5 Battery: sealed, maintenance free.

.6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations.

.7 Solid state transfer circuit.

.8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.9 Signal lights: solid state, for ‘Fault”.

.10 Lamp heads: integral on unit and remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, 4 W.

.11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.12 Finish: white.

.13 Auxiliary equipment:

.1 Test switch.

.2 Battery disconnect device.

2.2 WIRING OF REMOTE HEADS

.1 Conductors: RW90 type in accordance with Section 26 05 21 - Wires and Cables 0-1000 V, sized 10 AWG, or larger as required..

Part 3 Execution

3.1 INSTALLATION

.1 Install unit equipment and remote mounted fixtures.

.2 Direct heads.

.1 The Contract Administrator will review the direction of the heads and may instruct the contractor to modify the direction. Redirect heads as requested by the Contract Administrator.

.3 Demonstrate emergency lighting operation and coverage to Contract Administrator.

END OF SECTION