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 C22.1-2012 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 1-0630M-E0022 Electrical Single Line Diagram - Overview

1.14 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

1.15 CONDUIT AND CABLE INSTALLATION

.1 Sleeves through concrete: not required for TECK style cables and rigid galvanized conduit.

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

1.16 CUTTING AND PATCHING

.1 Provide all cutting and 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.

1.17 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.

1.18 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.

1.19 TESTING

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

1.20 SUBMITTALS

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

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

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

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

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

1.21 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 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. 230, Tray Cable

.5 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.

.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.

2.3 TRAY CABLE

.1 Cable: to CAN/CSA-C22.2 No. 230.

.2 Conductors:

.1 Grounding conductor: copper, sized per CEC.

.2 Circuit conductors: copper, size as indicated.

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

.4 Jacket: polyvinyl chloride material.

.5 Cable Fittings:

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

2.4 ACIC/CIC CONTROL CABLE

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

.2 Conductors, copper, size as indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90, 600V.

.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, except where a junction box is shown on the drawings.

.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 TRAY CABLE 0 -1000 V

.1 Install with care to avoid installation damage. Minor damage to cable jacket will require repair and significant damage will require replacement of the entire cable, to the satisfaction of the Contract Administrator.

.2 Locate in cable trays and conduit.

.3 Verify that the cable size is suitable for installation within the size of conduit provided.

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

.5 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.

3.5 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 There is a barrier separating power and control cables within the tray, or
- .2 The cable tray does not contain power cables, unless specifically authorized by the Contract Administrator in writing, and
- .3 The ACIC cable voltage rating is equal or greater than the highest voltage contained in the cable tray.

3.6 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 B6.

3.7 RE-USE OF EXISTING WIRING

.1 Except where specifically identified or approved, reuse of existing wiring is not permitted.

.2 Ensure all existing wiring is tagged prior to disconnection of equipment.

.3 Tag spare wires as “Spare”

3.8 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.

3.9 CABLE INDENTIFICATION

.1 Install cable tags on both ends of each cable.

.2 Cable tags to be located external to equipment and panels and within 203 mm of point of entry of cable.

.3 Construction and installation: white plate and black text, four through holes to facilitate fastening to cable by means of cable ties (tie-wraps).

3.10 TESTING

.1 Test all power conductors 12 AWG and larger in accordance with 26 08 05.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for connectors and terminations.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.41-07, Grounding and Bonding Equipment.

1.3 PRODUCT DATA

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

1.4 CERTIFICATES

.1 Obtain inspection certificate of compliance covering high voltage stress coning from inspection authority and include it with maintenance manuals.

Part 2 Products

2.1 5 kV CONNECTORS AND TERMINATIONS

.1 For existing equipment:

.1 Copper, long barrel, one-hole compression connections to CSA C22.2, sized for conductors.

.2 For new equipment:

.1 Copper, long barrel, two-hole compression connectors to CSA C22.2, sized for conductors.

.3 Silicon rubber termination kits, suitable for indoor installation on tape or wire shielded, 3 conductor , suitable for 5 kV TECK cable or cable supplied. Termination kit sized for cable.

Part 3 Execution

3.1 INSTALLATION

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

.2 Bond and ground as required to CSA C22.2 No.41.

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 None.

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 B6 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.

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 a galvanized steel strut framing system together with the manufacturer's connecting components and fasteners for a complete system.

.2 Finishes:

.1 Wet locations: Galvanized.

.2 Indoors, dry locations: Galvanized.

.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 B6.

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 straps to secure surface conduits and cables 50 mm and smaller.

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

.7 Suspended support systems.

.1 Support individual cable or conduit runs with 10 mm dia threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 10 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 junction boxes not detailed in the drawings in accordance with Section 01 33 00 – Submittal Procedures.

1.4 DESIGN REQUIREMENTS

.1 Design junction boxes not detailed in the drawings.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

.1 Requirements:

.1 Utilize steel NEMA 12 junction and pull boxes.

.2 Junction boxes 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: L10-2 (Panel L10, circuit 2)

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

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

.2 CSA C22.2 No. 45, Rigid Metal Conduit.

.3 CSA C22.2 No. 83, Electrical Metallic Tubing.

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

1.2 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures for the following:

.1 Metal conduit fittings.

Part 2 Products

2.1 GENERAL

.1 Material Requirements:

.1 Rigid Metal Conduit and Electrical Metal Tubing as per the drawings.

2.2 RIGID METAL CONDUIT

.1 Meets CSA C22.2 No. 45, Rigid Galvanized Steel, threaded.

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

2.3 ELECTRICAL METALLIC TUBING

.1 Meets CSA C22.2 No. 83, with couplings.

.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, 10 mm dia., to support suspended channels.

2.6 CONDUIT SPACERS

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

.2 Galvanized channel may be utilized where conduits are grouped.

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 Utilize insulated grounding bushings at all enclosure entries for metallic conduit.

.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" 370 Series.

.6 Fittings for Metal Conduit

.1 Cast metal

.2 Gasketted covers.

.3 Approved products

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

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 trade marks.

.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 Wet locations: 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 auxillary 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 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 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

.4 Maximum spacing for Electrical Metallic Tubing same as above.

3.4 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.

3.5 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.

3.6 INSTALLATIONS IN CATEGORY 2 LOCATIONS

.1 Comply with all requirements of Category 1 locations.

3.7 INSTALLATIONS IN CATEGORY 2 WET LOCATIONS

.1 Comply with all requirements of Category 1 locations.

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 NETA Acceptance Testing Specifications, 2003 (ATS-2003)

1.2 SUBMITTALS

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

.2 Submit:

.1 Test equipment to be utilized with last calibration date.

.2 Qualifications of lead on site inspector.

1.3 QUALIFICATION

.1 Provide competent lead electrical inspection technician thoroughly familiar with all aspects of electrical testing. It is expected that the technician will have a CET or equivalent designation. The designated technician is to be on-site and lead all electrical testing.

.1 The Contract Administrator reserves right to approve the lead electrical inspection technician, and request an alternate technician if deemed to be unqualified.

1.4 TESTING EQUIPMENT

.1 All test equipment shall be in good mechanical and electrical condition.

.2 Accuracy of metering in test equipment shall be appropriate for the test being performed.

.3 Wave shape and frequency of test equipment output waveforms shall be appropriate for the test and the tested equipment.

.4 The test equipment shall be calibrated as specified below:

.1 The testing organization shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy for each test instrument calibrated.

.2 The firm providing calibration service shall maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.

.3 Instruments shall be calibrated in accordance with the following frequency schedule:

.1 Field instruments: Analog, 6 months maximum. Digital, 12 months maximum.

.2 Laboratory instruments: 12 months maximum.

.3 Leased specialty equipment: 12 months maximum.

.4 Dated calibration labels shall be visible on all test equipment.

.5 Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.

.6 Calibrating standard shall be of higher accuracy than that of the instrument tested.

.5 Specific requirements of insulation resistance meters.

.1 Must be digital units. Crank-type analog insulation resistance meters will not be acceptable.

.6 Specific requirements of low-resistance meters:

.1 Measure resistance range from 1 μΩ to 1000 Ω.

.2 Standard electrician multimeters will not be accepted.

1.5 TESTING REPORT

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

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

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

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

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

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

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

.6 The report shall include the following:

.1 Summary of project.

.2 Testing Equipment.

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

.4 Description of equipment tested.

.5 Description of all tests.

.6 Typed inspection forms including:

.1 Identification of the testing organization.

.2 Equipment identification.

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

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

.5 Identification of the testing technician.

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

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

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

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

.1 Detailed description of the deficiency.

.2 The cost associated with the deficiency repair.

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

.1 Detailed description of the deficiency.

Part 2 Products

2.1 NOT USED

.1 Not Used

Part 3 Execution

3.1 SCOPE OF TESTING

.1 MCC-M1, including:

.1 Surge Protector
.2 Power Meter
.3 Voltage Monitor
.4 CTs
.5 PTs (if present)
.6 Branch Circuit Breakers
.7 Motor Starters

.2 DP-M2, including:

.1 Surge Protector
.2 Power Meter
.3 Voltage Monitor
.4 CTs
.5 PTs (if present)
.6 Branch Circuit Breakers

.3 MCC-M3E, including:

.1 Surge Protector
.2 Power Meter
.3 Voltage Monitor

.4 CTs
.5 PTs (if present)
.6 Branch Circuit Breakers
.7 Motor Starters

.4 ATS-M1 (existing)

.5 ATS-M3E

.6 PFC-M1

.1 Metering
.2 Capacitors
.3 Branch Circuit Breakers
.4 Contactors

.7 HCC-M601

.8 HCC-M602

.9 XFMR-M1

.10 XFMR-M2

.11 PNL-A (existing)

.12 PNL-B (with replaced interior)

.13 PNL-M10

.14 XFMR-M10

.15 XFMR-M20 (existing)

.16 XFMR-M30E

.17 Cables:

.1 All power cables or wire 12 AWG or larger
.2 Existing 600V motor feeder cables after re-termination.
.3 Existing 4160V motor feeder cables after re-termination.
.4 All field-installed network cabling.

.18 Grounding system

3.2 INPECTION, 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 ℃)

Measured Temperature (℃)	Oil Immersed Insulation	S olid 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 ℃)		
Measured Temperature (℃)	**Oil Immersed Insulation**	**S olid 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 AUTOMATIC TRANSFER SWITCH

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

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

.2 Record all adjustable settings, setpoints, delays, 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 unit for evidence of overheating or stress.

.8 Visually inspect and exercise transfer switch.

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

.3 Perform an insulation resistance test.

.1 Units rated < 600V, test voltage is to be 500 VDC.

.2 Units rated >= 600V, test voltage is to be 1000 VDC.

.4 Perform a contact/pole-resistance test.

.5 Perform comprehensive functional testing to verify operation of unit.

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

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

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

.2 Torque all accessible bolted electrical connections.

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

.4 Inspect grounding and cable/conduit support.

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

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

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

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

3.5 CABLES, 4160V

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

.1 Inspect exposed sections of cables for physical damage and evidence of overheating and corona.

.2 Inspect terminations and splices for physical damage and evidence of overheating and corona.

.3 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.

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

.5 Inspect shield grounding and cable support.

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

.7 Measure and record the length of cable.

.8 If cables 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.

.9 Perform a shield-continuity test on each power cable by ohmmeter method. The shielding must exhibit continuity. Investigate resistance values in excess of 10 ohms per 1000 feet of cable.

.10 Perform an insulation-resistance test on each conductor utilizing a megaohm-meter with a voltage output of at least 2500 V. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 1000 megaohms.

.11 Perform a Very Low Frequency (VLF) ac high-potential test on all cables. Adhere to all precautions and limits as specified in the applicable NEMA / ICEA Standard for the specific cable. Perform tests in accordance with IEEE Standard 400.2. Test procedure shall be as follows, and the results for each cable test shall be recorded as specified herein. The test voltage shall be sinusoidal with a frequency of 0.1 Hz, and shall not exceed cable manufacturer's maintenance test value or 7 kV RMS (10 kV peak) phase-to-ground. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the over-potential test, the test specimen is considered to have passed the test.

.1 Ensure that the input voltage to the test set is regulated.

.2 Current-sensing circuits in test equipment shall measure only the leakage current associated with the cable under test and shall not include internal leakage of the test equipment.

.3 Record wet and dry-bulb temperatures or relative humidity and temperature.

.4 Test each section of cable individually.

.5 Individually test each conductor with all other conductors grounded. Ground all shields.

.6 Terminations shall be adequately corona-suppressed by guard ring, field reduction sphere, or other suitable methods as necessary.

.7 Ensure that the maximum test voltage does not exceed the limits for terminators specified in IEEE Standard 48 or manufacturer's specifications.

.8 Raise the conductor test voltage to the specified maximum test voltage and hold for five minutes. Record leakage current.

.9 Apply grounds for a time period adequate to drain all insulation-stored charge.

.12 Perform a Dissipation Factor (Tangent Delta) test on all cables.

.1 Perform tests in accordance with IEEE Standard 400.2.

.2 The test voltage applied shall be a 0.1 Hz sinusoidal waveform.

.3 The dissipation factor shall be calculated for an applied voltage of 2400 V (uo) RMS.

.4 Provided that the dissipation factor does not rise significantly while raising the voltage, the dissipation factor shall also be calculated for an applied voltage of 4800 V (2uo) RMS.

.13 In the event of a cable failure discovered during testing, assist as required in the repair or replacement of the cable. All services for cable repair or replacement are to be considered as Additional Services.

.14 Affix an inspection sticker or inspection tag in an appropriate place so that it will be conspicuous to all authorized personnel. This inspection notice must include, but is not limited to, identifier of cable, testing company name, date of inspection and the inspector's name. The sticker shall not obscure any equipment nameplates, readouts, or indicators.

3.6 CAPACITOR BANKS

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

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

.2 Record all adjustable settings.

.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 unit for evidence of overheating or stress.

.8 Visually inspect and exercise transfer switch.

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

.3 Perform an insulation resistance test.

.1 Units rated < 600V, test voltage is to be 500 VDC.

.2 Units rated >= 600V, test voltage is to be 1000 VDC.

.4 Perform a contact/pole-resistance test.

.5 Measure and record capacitance of each capacitor.

.6 Measure and record resistance of discharge resistors, if present.

.7 Perform functional testing to verify operation of unit.

3.7 CIRCUIT BREAKERS, INSULATED-CASE/MOLDED CASE, 600 V

.1 Inspection and testing shall include the following:

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

.2 Record all adjustable settings.

.3 Inspect physical and mechanical condition.

.4 Inspect anchorage and alignment.

.5 Clean the unit.

.6 Torque all accessible bolted power connections.

.7 Operate the circuit breaker to insure smooth operation.

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

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

.10 Restore breaker position to original position.

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

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

.1 Perform an insulation resistance test.

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

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

.4 Perform a contact/pole-resistance test.

3.8 CONTACTOR PANELS

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

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

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Verify the unit is clean.

.5 Torque all accessible bolted power connections.

.6 Inspect unit for evidence of overheating or stress.

.7 Visually inspect and exercise transfer switch.

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

.3 Perform an insulation resistance tests.

.1 Units rated < 600V, test voltage is to be 500 VDC.

.2 Units rated >= 600V, test voltage is to be 1000 VDC.

.4 Perform a contact/pole-resistance tests.

.5 Perform functional testing to verify operation of unit.

3.9 CONTROL POWER TRANSFORMERS, < 1000 V

.1 Inspection and testing shall be comprised 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

3.10 CURRENT INSTRUMENT TRANSFORMERS

.1 Inspection and testing shall be comprised 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.

3.11 GROUNDING SYSTEM

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

.1 Perform resistance tests between the main grounding electrode and grounded points in the electrical distribution system located in the switchgear, transformers, and MCCs. Investigate connections with a resistance greater than 0.5 milliohms.

3.12 METERING DEVICES, DIGITAL

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

.1 Inspect physical and mechanical condition.

.2 Torque all bolted connections.

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

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

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

3.13 MOTOR CONTROL CENTRE AND DISTRIBUTION SWITCHBOARDS, 600 V

.1 Inspection and testing shall be comprised 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 Verify the correct operation of the network cabling, network switch, and associated components within Smart MCCs.

.1 Verify I/O and metering data from each Intelligent Overload.

.33 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.

3.14 MOTOR STARTERS, 600 V

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

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

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

.3 Inspect physical and mechanical condition.

.4 Inspect anchorage, alignment, and grounding.

.5 Verify the unit is clean.

.6 Torque all accessible bolted power connections.

.7 Inspect contactors for evidence of overheating or stress.

.8 Visually inspect and exercise circuit breaker.

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

3.15 PANELBOARDS, LOW VOLTAGES

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

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

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Clean the unit.

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

.1 Record breaker data on the inspection form.

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

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

.4 Restore breaker position to original position.

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

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

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

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

.2 Open all load breakers.

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

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

3.16 SURGE ARRESTORS, LOW VOLTAGE

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

.1 Inspect physical and mechanical condition.

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

.3 Clean the unit.

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

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

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

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

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

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

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

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

3.17 TRANSFORMERS, LOW VOLTAGE, DRY-TYPE

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

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

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Clean the unit.

.5 Torque all accessible bolted power connections.

.6 Record the tap setting.

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

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

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

3.18 TRANSFORMERS, MEDIUM VOLTAGE, DRY-TYPE

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

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

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Clean the unit.

.5 Verify that alarm settings on temperature indicators are as specified and operate within manufacturer’s recommendations for specified settings.

.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 Record tap setting. Confirm the tap setting appears reasonable by measuring the voltage during normal facility operation.

.8 Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Calculate polarization index. Minimum insulation-resistance values of transformer insulation should be 1000 megaohms for the 4160 V windings and 100 megaohms for the 600 V windings. Values of insulation resistance less than the values stated should be investigated. The polarization index should not be less than 1.0.

.1 The test duration shall be 10 minutes for each winding.

.2 4160 V windings shall be tested at 2500 Vdc.

.3 600 V windings shall be tested at 1000 Vdc.

.9 Perform turns-ratio tests at the designated tap position. Turns-ratio test results should not deviate more than one-half percent from either the adjacent coils or the calculated ratio.

.10 Measure the resistance of each winding at the designated tap position.

.11 Measure core insulation resistance at 500 Vdc if the core is insulated and if the core ground strap is removable.

.12 Verify correct secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading. Phase-to-phase and phase-to-neutral secondary voltages should be in agreement with nameplate data.

3.19 THERMOGRAPHIC INSPECTION

.1 Camera

.1 Minimum IR resolution: 320 x 240 pixels.

.2 Minimum visible resolution: 640 x 480 pixels.

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

.1 Remove all necessary covers prior to thermographic inspection.

.2 Equipment to be inspected shall include all current-carrying devices.

.3 Test Parameters

.1 Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1 °C at 30 °C.

.2 Equipment shall detect emitted radiation and convert detected radiation to a visual signal.

.3 Thermographic surveys should be performed during periods of maximum possible loading but not less than 40% of rated load of the electrical equipment being inspected. Coordinate with City as required.

.4 Note all temperature differences larger than 1°C. Investigate all temperature differences larger than 4 °C.

.5 Re-inspect deficient areas with the thermographic camera following repairs and corrections, for deficient areas identified.

.3 Provide a report which shall include the following:

.1 Description of the equipment tested.

.2 Discrepancies found.

.3 Temperature difference between the area of concern and the reference area.

.4 Probable cause of temperature difference.

.5 Identify any repairs made during the thermographic inspection. If no repairs were made, provide recommended action for repair.

.6 Areas inspected. Identify inaccessible and / or unobservable areas and / or equipment.

.7 Identify load conditions at time of inspection.

.8 Provide photographs and thermograms of all areas investigated, with deficient areas identified.

.9 Provide thermograms of all deficient areas corrected, and identify the load conditions at the time of re-inspection.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials, components, cabinets, instruments and installation for metering and switchboard Instruments.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI C39.1-1981, Requirements, Electrical Analog Indicating Instruments.

.2 Canadian Standards Association, (CSA International)

.1 CAN3-C17-M84(R1999), Alternating - Current Electricity Metering.

1.3 PRODUCT DATA

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

.2 Indicate meter outline dimensions, panel drilling dimensions and include cutout template.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for metering and switchboard instruments for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

.2 Operation and maintenance instructions to include:

.1 Operation and configuration of unit,
.2 Wiring diagrams,
.3 Recommended environmental conditions, and
.4 Recommended periodic inspection and maintenance.

Part 2 Products

2.1 METER (SGR-M1.PM)

.1 Polyphase, 3-element kilowatt-hour energy meter: to CAN3-C17.

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

.3 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.

.4 Accept a current input of up to 5 Amps nominal, 20 Amps full scale

.5 Fault Current Withstand:

.1 500 Amps for 1 second, non-recurring.

.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 0.05 VA per phase, at the nominal 5 Amperes continuous input.

.8 The meter shall have an accuracy of +/- 0.1% or better for volts and amps, and 0.2% for power and energy functions. The meter shall meet the accuracy requirements of IEC687 (class 0.2%) and ANSI C12.20 (Class 0.2%).

.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 Min / Max recording capability
.4 Minimum 17 µs transient detection
.5 Sampling rate of 1024 samples/cycle
.6 Harmonics measurement, individual, even, and odd, up to 63rd.

.11 Rectangular, flush mounted, indoor.

.12 Communications port:

.1 Ethernet supporting Modbus-TCP.
.2 RS-485 supporting Modbus-RTU.

.13 Register: self contained and pulse contacts for transmitting signal.

.14 Acceptable products:

.1 Schneider Electric ION7650 or approved equal in accordance with B6.

Part 3 Execution

3.1 METERING INSTALLATION

.1 Install meter in location free from vibration and shock.

.2 Make connections in accordance with diagrams.

.3 Connect meter and instrument transformers to ground.

3.2 FIELD QUALITY CONTROL

.1 Conduct tests in accordance with Section 26 05 01 - Common Work Results - Electrical and in accordance with manufacturer's recommendations.

.2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.

.3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.

.4 Perform tests to obtain correct calibration.

.5 Do not dismantle meters and instruments.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C9-M2002(R2007), Dry-Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

1.2 SHOP DRAWINGS

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

.2 Include:

.1 Dimensioned drawing showing enclosure, mounting devices, terminals, taps, internal and external component layout.

.2 Technical data:

.1 kVA rating.

.2 Primary and secondary voltages.

.3 Frequency.

.4 Polarity or angular displacement.

.5 Full load efficiency.

.6 Regulation at unity pf.

.7 BIL.

.8 Insulation type.

.9 Sound rating.

.10 Physical dimensions.

.11 Connection diagram.

1.3 CONTROL SUBMITTALS

.1 Submit to Contract Administrator one copy of standard factory test certificates of each transformer and type test of each transformer in accordance with CSA C9. Electronic submissions are accepted.

1.4 CLOSEOUT SUBMITTALS

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

.2 Operation and maintenance instructions to include:

.1 Tap changing.

.2 Recommended environmental conditions.

.3 Recommended periodic inspection and maintenance.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Store transformers indoors in dry location.

Part 2 Products

2.1 MATERIALS

.1 Dry-type transformers: to CSA C9.

.2 Bushings: to EEMAC GL1-3.

2.2 TRANSFORMER CHARACTERISTICS

.1 Type: ANN

.2 Rating: 300 kVA, 3 phase, 60 Hz.

.3 220 degrees C insulation system class, 115 degrees C temperature rise.

.4 Impedance: 3 to 5.5 %.

.5 Primary winding: 4160 V, delta, BIL 30 kV.

.6 Secondary winding: 600 V, star, BIL 10 kV, four wire with neutral brought out and grounded.

.7 Meets all current Canadian energy efficiency regulations (OEE).

.8 Sound rating: 58 dBA or less.

.9 CSA Certified.

2.3 ENCLOSURE

.1 NEMA Type 1, drip proof or NEMA Type 3R. Fabricated from sheet steel.

.2 Bolted removable panels for access to tap connections, enclosed terminals.

.3 Conductor entry:

- .1 Knockouts.
- .2 Potheads.
- .3 Junction boxes.
- .4 Bushings.
- .5 Clamping rings.
- .6 Entry for cable.

.4 Designed for floor mounting.

.5 Indoor, ventilated, self cooled type. Temperature of exposed metal parts not to exceed 65 degrees C rise.

2.4 VOLTAGE TAPS

.1 - 5%, -2.5%, 0%, +2.5%, +5%.

2.5 NAMEPLATE

.1 Include all transformer data including actual impedance.

2.6 WINDINGS

.1 Primary and secondary coils:

.1 Copper.

.2 Coil and core assembly:

.1 Taps located at front of coils for accessibility.

2.7 TERMINATIONS

.1 Suitable for NEMA standard dual-hole lugs.

.2 Size:

.1 Primary side: suitable for lugs sized for 4 AWG cable.

.2 Secondary side: suitable for lugs sized for 500 MCM cable.

2.8 ACCESSORIES

.1 Winding temperature detector relay and sensing elements with one set of SPDT contacts.

.2 Wiring and terminal box for protective devices.

.3 Grounding terminal: inside of enclosure.

2.9 EQUIPMENT IDENTIFICATION

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

.2 Equipment labels: nameplate text and size as per the lamacoid schedule.

Part 3 Execution

3.1 INSTALLATION

.1 Locate, install and ground transformers in accordance with manufacturer's instructions.

.2 Set and secure transformers in place, rigid plumb and square.

.3 Connect primary terminals to medium voltage circuit.

.4 Connect secondary terminals to low voltage circuit.

.5 Energize transformers and check secondary no-load voltage.

.6 Adjust primary taps as per the drawings.

.7 Wire the normally closed set of contacts on winding temperature detector relay to the Station Programmable Logic Controller per the drawings.

.8 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.

.9 Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.

3.2 FIELD QUALITY CONTROL

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

.2 Energize transformers and apply incremental loads:

.1 At each load change, check ambient, enclosure, and winding temperatures.

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 Design 1 – 600V Input.

.1 Type: ANN.

.2 Single phase, kVA as indicated, 600V input, 120/208 V output, 60 Hz.

.3 Voltage taps: 2.5% and 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.

.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 tests in accordance with Section 26 08 05 – Acceptance Testing.

.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
MacLean Water Pumping Station				
XFMR-M10	Mezzanine Level	30 kVA	600:120/208V, 3Ø	CSA 3R

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. Include:

.1 Panel Schedule

.2 Complete Breaker Model Numbers

.3 Detailed Panel Interior and Exterior Layout Diagram, including all dimensions.

.4 Schematics / Wiring Diagrams for the Power Meter and Voltage Monitor.

.2 For TVSS units:

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

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

1.4 O&M Manual

.1 Include all shop drawings and product submittals.

.2 Include TVSS Operation and maintenance manuals.

.3 Include Voltage Relay Operation and maintenance manuals.

Part 2 Products

2.1 PANELBOARDS, 240 V OR LESS

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

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

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

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

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

.5 Main Breaker:

.1 Main Breaker to be top or bottom mounted, as shown on the drawings.

.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 manufacturer:

.1 Schneider Electric.

2.2 PANELBOARDS, 600 V

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

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

.2 Provide panelboard as follows:

.1 Service type: 3 phase, 4 wire

.2 Bus and breakers rated for 25 kA (symmetrical) interrupting capacity, or as indicated.

.3 Continuous bus rating: 600 A (minimum).

.4 Main breaker:

.1 400 Amp Frame, 350 Amp Trip.

.2 LSI trip unit.

.5 Integrated 120kA TVSS.

.6 Integrated service entrance barrier around main breaker.

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

.8 Mounting space for, at minimum, twenty-eight 3-pole branch circuit breakers.

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

.1 Include three CTs, 400:5A

.10 Trim and door finish: baked grey enamel.

.11 Enclosure:

.1 Two section design.

.2 Section 1 to contain main breaker, tie breaker, power monitor, and voltage monitoring relay.

.3 Section 2 to contain branch circuit breakers.

.4 Dimensions:

.1 Width: 1981 mm (78”).

.2 Height: 2324 mm (91.5”)

.3 Depth: 610 mm (24”)

.3 Acceptable manufacturer:

.1 Schneider Electric.

2.3 BREAKERS

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

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

2.4 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:	250 kA

.2 600V Panelboards – Not Service Entrance: 120 kA

.3 240V or less Panelboards – Service Entrance: 120 kA

.4 240V or less Distribution Panelboards – Not Service Entrance: 40 kA

.6 Panelboard Installation Requirements:

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

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

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

.4 Utilize a breaker, appropriately rated as directed by the TVSS manufacturer, to connect the TVSS to the panelboard. The TVSS shall be located directly adjacent to the 30A circuit breaker.

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

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

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

.1 Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

2.5 POWER METER

.1 Provide a microprocessor based multifunction power meter where shown on the drawings.

.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 Fault Current Withstand:

.1 500 Amps for 1 second, non-recurring.

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

.8 Maximum burden of 0.05 VA per phase, at the nominal 5 Amperes continuous input.

.9 The meter shall have an accuracy of +/- 0.1% or better for volts and amps, and 0.2% for power and energy functions. The meter shall meet the accuracy requirements of IEC687 (class 0.2%) and ANSI C12.20 (Class 0.2%).

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

.11 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}.

.12 Operating Temperature:

.1 -20 to +60 °C ambient.

.3 Communications ports:

.1 10 Mbps Ethernet supporting Modbus-TCP.

.2 RS-485 supporting Modbus-RTU.

.4 Acceptable products:

.1 Schneider Electric ION7300.

2.6 VOLTAGE MONITORING RELAY

.1 Provide a Voltage Monitoring Relay where shown on the drawings.

.2 Requirements,

.1 Suitable for direct connection to panelboard 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.

.3 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.

.4 Acceptable products:

.1 SSAC WVM011AL or approved equal in accordance with B6.

2.7 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 “DP-M2”.

.2 Line 2 is to be the voltage, for example “600V, 3Ø”.

.3 Complete circuit directory with typewritten legend.

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

Part 3 Execution

3.1 INSTALLATION

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

.2 Connect loads to circuits.

3.2 WIRING IDENTIFICATION

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

3.3 POWER METER

.1 Configure the power meter for proper operation for the system installed.

3.4 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.

.5 Closeout Submittals: provide operation and maintenance data for motor control centre for incorporation into manual 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, grounded neutral.

2.2 GENERAL DESCRIPTION

.1 Compartmentalized vertical sections with common power busbars.

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

.3 Indoor CSA 1 enclosure, front mounting.

.4 Class 1, Type B-D and Type B-T as indicated on the drawings.

.5 Nameplates: white with black letters.

.6 The MCC shall be provided with a factory wired and tested intelligent communication system.

.7 Acceptable manufacturer:

.1 Schneider Electric.

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, 508 mm (20”) 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: 600 A.

.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:	250 kA
.2	600V Panelboards – Not Service Entrance:	120 kA
.3	240V or less Panelboards –Service Entrance:	120 kA
.4	240V or less Distribution Panelboards – Not Service Entrance:	40 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 INTELLIGENT MOTOR PROTECTION RELAYS

.1 IMPR’s shall be CSA and UL approved.

.2 IMPR’s shall be fully programmable electronic relays.

.3 The IMPR shall feature a Test/Rest button.

.4 I/O shall consist of six discrete logic inputs, three relay outputs (1 NO) and one relay output for fault signaling (1 NO + 1 NC).

.5 Control voltage shall be 120V AC.

.6 Network, electronic and manual reset functions shall be supported.

.7 The following status and monitoring functions shall be provided based on user configurable parameters:

.1 Metering

.1 Measurement:

.1 Line Currents
.2 Ground current
.3 Average Current
.4 Current Phase Imbalance
.5 Thermal capacity Level
.6 Motor Temperature Sensor

.2 Statistics:

.1 Protection Fault Counts
.2 Protection Warning counts
.3 Diagnostic fault counts
.4 Motor Control Function counts
.5 Fault History

.3 Diagnostics:

.1 Internal watchdog results
.2 Controller Internal Temperature
.3 Temperature Sensor Connections
.4 Current Connections
.5 Control Commands (start, stop, run, check back and stop check back)
.6 Control configuration checksum
.7 Communication loss

.4 Motor States:

.1 Motor control states motor starter/LO1 starts/ LO2 starts
.2 Operating time
.3 Motor starts per hour
.4 Last start max current
.5 Last start time
.6 Time to trip
.7 Time to reset

.2 Fault Monitoring:

.1 Diagnostic:

.1 Run command check
.2 Stop command check
.3 Run check back

.4 Stop check back

.2 Wiring/ Configuration errors:

.1 PTC Connection

.2 CT Reversal

.3 Current Phase Reversal

.4 Phase Configuration

.3 Internal

.1 Stack Overflow

.2 Watchdog

.3 ROM Checksum

.4 EEROM

.5 CPU

.6 Internal Temperature

.4 Motor temp sensor

.1 PTC Binary

.2 PTC Analog

.3 NTC Analog

.5 Thermal overload:

.1 Definite

.2 Inverse Thermal

.6 Current:

.1 Long Start

.2 Jam

.3 Current Phase Imbalance

.4 Current Phase Loss

.5 Overcurrent

.6 Undercurrent

.7 Internal Ground Current

.8 External Ground Current

.7 Communication loss

.1 PLC to IMPR

.3 Protection:

.1 Thermal overload

.2 Current phase imbalance

.3 Current phase loss

.4 Current phase reversal

.5 Long start

.6 Jam (locked rotor during run)

.7 Undercurrent

.8 Overcurrent

.9 Ground current

.10 Motor temperature sensor

.11 Rapid cycle lockout

.4 Control Functions:

.1 Motor control modes

.1 Local terminal strip

.2 Network

.2 Operating mode

.1 Overload

.2 Independent

.3 Reverser

.4 Two-step

.5 Two-speed

.6 Custom Mode

.3 Fault Management

.1 Manual reset

.2 Automatic reset

.3 Remote reset

.8 Metering and Monitoring

.1 The IMPR shall include accurate measurement processing functions to operate the different applications and carry out commissioning and maintenance.

.2 For measurement, the IMPR shall include Current transformers up to 100 A, for all measurements required (current, power, voltage, frequency…). It is not possible to use external special CTs for measurement.

.9 Motor Protection Functions

.1 The IMPR shall integrate all motor protection functions described above.

.2 The thermal overload trip curve shall be selectable between inverse (I^2t) or definite time (Ixt) curve. The Auxiliary Fan Cooling application shall be also selectable.

.3 It shall include Ground Fault Protection internally, and it shall be possible to use an external zero sequence CT to accomplish this, without the need for additional modules or devices.

.10 Programming and configuration software

.1 The IMPR shall use user-friendly settings and operate multi-lingual software in a Windows environment with menus and icons for fast direct access to the data required, guided navigation to go through all the data for the same function on the same screen and with file management.

.2 The PC can be connected in a 1-to-1 configuration to a single controller, or in a 1-to-many configuration to multiple controllers.

.3 The IMPR shall provide a “Custom Mode”, a logic customized by the end user.

.11 Self-Test

.1 The IMPR shall be capable of self-tests. It shall perform internal checks such as a watch-dog check and RAM check, in order to maximize availability and minimize the risk of malfunctioning.

.12 Acceptable products:

.1 Schneider Electric TeSys T.

2.9 COMMUNICATION CABLING

.1 The MCC shall employ a network communication cabling system to interconnect units within the MCC.

.2 Network cabling shall be routed through the lower horizontal wireway to isolate the network from the horizontal bussing routed through the top.

.3 A communication barrier in the full-depth vertical wireway shall serve to separate communications from power cabling and to prevent noise interference on the network cable.

.4 Provisions for appropriate terminators and grounding shall be provided.

.5 Addition, removal, or rearrangement of units shall not interrupt the trunk line and shall not affect the cabling of other units attached to the trunk line.

.6 Cable coupler design shall include a vibration-resistant ratchet to prevent loosening.

.7 The cabling is to be configured in a star configuration.

.8 Cabling shall be Category 6 shielded twisted pair Ethernet cable with RJ45 connector.

.9 Ethernet cable insulation rating shall be 600V minimum.

2.10 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 Fault Current Withstand:

.1 20 Amps continuous.

.2 500 Amps for 1 second, non-recurring.

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

.8 Maximum burden of 0.0625 VA at 10 Amps.

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

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

.11 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}.

.12 Operating Temperature:

.1 -20 to +60 °C ambient.

.3 Communications ports:

.1 10 Mbps Ethernet supporting Modbus-TCP.

.2 RS-485 supporting Modbus-RTU.

.4 Acceptable products:

.1 Schneider Electric ION7300.

2.11 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.

2.12 NETWORK SWITCHES

.1 Type: unmanaged switch, auto-MDIX.

.2 Speed: 100 mbit or gigabit as required.

.3 Port quantity: as indicated on the drawings.

.4 Power supply: 24 VDC.

2.13 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.

2.14 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.

2.15 WIRING IDENTIFICATION

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

2.16 EQUIPMENT IDENTIFICATION

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

.1 Motor control centre main nameplate: size No. 7, engraved as indicated.

.2 Individual compartment nameplates: size No. 5, engraved as indicated.

2.17 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - For Electrical.

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

2.18 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.

2.19 SPARE PARTS

.1 Two (2) spare Intelligent Motor Protection Relays (overloads) of each type and size.

.2 One (1) spare contactor of each size.

.3 One (1) spare circuit breaker of each size.

.4 One (1) spare Motor Circuit Protector (MCP) of each size.

.5 Four (4) spare pilot lights of each type and rating.

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

Part 3 Execution

3.1 SETUP AND TESTING

.1 Upon completion of assembly, all system components shall be factory-wired and tested as a system prior to shipment.

.2 Each device shall be configured and addressed to correspond with software settings.

.3 A read/write test shall be performed prior to shipment on all network devices including, but not limited to, Overloads, Drives, and Soft Starts.

.4 Testing shall be designed to verify system operation and shall include these verifications as a minimum:

.1 I/O addressing
.2 Correct device operation by I/O address
.3 Host Communications
.4 Control Network Interface

3.2 INSTALLATION

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

.2 Make field power and control connections as indicated.

3.3 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.

3.4 TRAINING

.1 Furnish the services of a competent, factory-trained engineer or technician for one session of one hour duration to instruct City electrical maintenance personnel in the operation and maintenance of the equipment, on a date requested by the Contract Administrator.

.1 The contents of the training session to include:

.1 Electrical operation.

.2 Adjustment of overloads

.3 Racking of buckets

.4 Power meter use

.5 Etc.

.2 Furnish the services of a competent, factory-trained engineer or technician for two sessions, each of two hour duration to instruct City technical maintenance personnel in the operation and maintenance of the networked equipment, on a date requested by the Contract Administrator. The contents of the training session to include:

.1 Network communications.

.2 Connection to motor starter web interface.

.3 Viewing and adjustment of parameters.

.4 Replacement of motor overload, including setting of IP address.

.5 Troubleshooting and maintenance, and

.6 Similar contents to the training session identified above.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

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

1.3 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 18kA symmetrical rms interrupting capacity rating, or higher as indicated.

.5 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

.6 Include:

.1 On-off locking device.

.2 Neutral and Ground bus bars, fully rated.

2.2 MCC-M1.MCB

.1 Requirements:

.1	Frame Size:	400 A
.2	Trip Rating:	350 A (400A Plug, 350A Setting)
.3	Interrupting Rating:	18 kA @ 600 VAC (minimum)
.4	Type:	Electronic LSI
.5	Long Time PU:	125 - 400A, Adjustable

.6	Long Time Delay:	2 - 16 sec, Adjustable
.7	Short Time PU:	1.5 - 10 x LTPU, Adjustable
.8	Short Time Delay:	0 - 0.4 sec, Adjustable
.9	Instantaneous:	1.5 - 12 x Plug Rating, Adjustable
.10	Terminals:	Sized for 500 MCM
.11	Interlock:	3oo4 Kirk-Key interlock with MCC-M1-T, DP-M2.MCB, and DP-M2-T
.12	Model:	Schneider Electric LG series with Micrologic 5.3A trip unit or approved equal in accordance with B6.

2.3 DP-M2.MCB

.1 Requirements:

.1	Frame Size:	400 A
.2	Trip Rating:	350 A (400A Plug, 350A Setting)
.3	Interrupting Rating:	18 kA @ 600 VAC (minimum)
.4	Type:	Electronic LSI
.5	Long Time PU:	125 - 400A, Adjustable
.6	Long Time Delay:	2 - 16 sec, Adjustable
.7	Short Time PU:	1.5 - 10 x LTPU, Adjustable
.8	Short Time Delay:	0 - 0.4 sec, Adjustable
.9	Instantaneous:	1.5 - 12 x Plug Rating, Adjustable
.10	Terminals:	Sized for 500 MCM
.11	Interlock:	3oo4 Kirk-Key interlock with MCC-M1-T, DP-M2.MCB, and DP-M2-T
.12	Model:	Schneider Electric LG series with Micrologic 5.3A trip unit or approved equal in accordance with B6.

2.4 CB-MCC-M1-T, CB-DP-M2-T (TIE BREAKERS)

.1 Requirements:

.1	Frame Size:	400 A
.2	Trip Rating:	400 A
.3	Interrupting Rating:	18 kA @ 600 VAC (minimum)
.4	Long Time PU:	125 - 400A, Adjustable
.5	Long Time Delay:	2 - 16 sec, Adjustable
.6	Instantaneous:	1.5 - 12 x Plug Rating, Adjustable
.7	Terminals:	Sized for 500 MCM
.8	Interlock:	3oo4 Kirk-Key interlock with each other, MCC-M1.MCB, and DP-M2.MCB.
.9	Model:	Schneider Electric LG series with Micrologic 3.3 trip unit or approved equal in accordance with B6.

2.5 CB-ATS-M3E

.1 Requirements:

.1	Frame Size:	250 A
.2	Trip Rating:	225 A (250 A Plug, 225A Setting)
.3	Interrupting Rating:	18 kA @ 600 VAC (minimum)
.4	Type:	Electronic LSI
.5	Long Time PU:	70 - 250A, Adjustable
.6	Long Time Delay:	0.5 - 16 sec, Adjustable
.7	Short Time PU:	1.5 - 10 x LTPU, Adjustable
.8	Short Time Delay:	0 - 0.4 sec, Adjustable
.9	Instantaneous:	1.5 - 12 x Plug Rating, Adjustable
.10	Terminals:	Sized for 250 MCM
.11	Model:	Schneider Electric JG series with Micrologic 5.3A trip unit or approved equal in accordance with B6.

2.6 CB-XFMR-M20

.1 Requirements:

.1	Frame Size:	150 A
.2	Trip Rating:	60 A
.3	Interrupting Rating:	18 kA @ 600 VAC (minimum)
.4	Type:	Electronic LSI
.5	Long Time PU:	15 - 60A, Adjustable
.6	Long Time Delay:	0.5 - 16 sec, Adjustable
.7	Short Time PU:	1.5 - 10 x LTPU, Adjustable
.8	Short Time Delay:	0 - 0.4 sec, Adjustable
.9	Instantaneous:	1.5 - 15 x Plug Rating, Adjustable
.10	Terminals:	Sized for 3 AWG
.11	Model:	Schneider Electric HG series with Micrologic 5.3A trip unit or approved equal in accordance with B6.

2.7 MCC-M3E.MCS-A, MCC-M3E.MCS-B

.1 Requirements:

.1	Frame Size:	250 A
.2	Interrupting Rating:	18 kA @ 600 VAC (minimum)
.3	Type:	Automatic Moulded Case Switch
.4	Instantaneous:	3125A (fixed)
.5	Terminals:	Sized for 250 MCM
.6	Interlock:	1oo2 Kirk-Key interlock with each other.
.7	Model:	Schneider Electric JGL series or approved equal in accordance with B6

2.8 MCC-M1.CB-TVSS, DP-M2.CB-TVSS, MCC-M3E.CB-TVSS

.1 As per manufacturer's recommendations.

.2 Requirements:

.1	Frame Size:	As per TVSS Manufacturer's recommendations
.2	Trip Rating:	As per TVSS Manufacturer's recommendations
.3	Interrupting Rating:	18 kA @ 600 VAC (minimum)
.4	Type:	Thermal Magnetic
.5	Model:	As per TVSS Manufacturer's recommendations

.1 Use of a current limiting device to meet interrupting rating will not be accepted.

2.9 ACCESSORIES

.1 All main and branch breakers in DP-M2 are to include a permanently fixed attachment for padlocking the breakers in the OFF position.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

.2 Identification of circuit breakers with DP-M2: In accordance with Section 26 05 01 – Common Work Results – Electrical, provide lamacoid plate on or adjacent to each breaker showing load being fed. Example: "MCC-R1".

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for HVAC electric heating coil contactors for system voltages up to 600 V.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.14-95 (R2001), Industrial Control Equipment.

1.3 PRODUCT DATA

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

Part 2 Products

2.1 CONTACTORS

.1 Contactors: to CSA C22.2 No.14.

.2 NEMA rated.

.3 Electrically held, 120 VAC coil, and rated for type of load controlled. Half size contactors not accepted.

.4 Complete with one (1) normally open auxiliary contact.

.5 Installed in MCC compartments and field-installed contactor panels as indicated.

.6 Standard of acceptance:

.1 Schneider Electric Model S or approved equal in accordance with B6.

2.2 EQUIPMENT IDENTIFICATION

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

Part 3 Execution

3.1 MANUFACTURE

.1 Contactor compartment to be constructed by a CSA approved panel shop.

3.2 INSTALLATION

.1 Install contactors and connect auxiliary control devices.

END OF SECTION

Part 1 General

1.1 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.

.3 Shop Drawings:

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

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

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout and components.

.4 Enclosure type.

1.2 CLOSEOUT SUBMITTALS

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

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

Part 2 Products

2.1 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 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.

2.2 CONTROL TRANSFORMER

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

.2 Size control transformer as indicated.

2.3 ACCESSORIES

.1 Pushbuttons and selector switches:

.1 Heavy duty, oil tight, colour as indicated.

.2 Model:

.1 Schneider Electric Harmony XB4 series, or approved equal in accordance with B6.

.2 Indicating lights:

.1 Heavy duty, oil tight, colour as indicated.

.2 Bulb: LED type

.3 Model:

.1 Schneider Electric Harmony XB4 series, or approved equal in accordance with B6.

2.4 FINISHES

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

2.5 EQUIPMENT IDENTIFICATION

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

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

2.6 SPARE PARTS

.1 Fuses: two (2) of each type and rating.

.2 Indicating lamps: two (2) indicating lamp bulbs of each type.

.3 Relays: two (2) relays of each type (base not required).

Part 3 Execution

3.1 INSTALLATION

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

.2 Install and wire starters and controls as indicated.

.3 Ensure correct fuses installed.

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

3.2 FIELD QUALITY CONTROL

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

.2 Operate switches and contactors to verify correct functioning.

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

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

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

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

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

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

1.2 SUBMITTALS

.1 Prior to construction:

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

.2 Where panel layouts have not been supplied, provide detailed panel layout drawings including a detailed Bill of Materials.

.1 Provide thermal loading calculations.

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

.4 Submit proposed factory test plan for the control panels.

.2 Prior to shipment:

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

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

.2 As-built drawings:

.1 Submit as-built drawings of supplied design.

.1 Minor changes to drawings provided in the design package may be made via red-line mark-ups.

.2 Draft significant changes on AutoCAD drawings.

.2 Submit drafted AutoCAD and PDF versions of shop drawings.

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

1.3 DESIGN REQUIREMENTS

.1 Panel Layouts

.1 Review all panel layouts provided as part of the design package to ensure constructability and compliance with CSA requirements. Advise the Contract Administrator of any issues identified prior to construction.

.2 Where panel layouts are not provided as part of the design package, provide a complete design of the panel enclosure in accordance with CSA requirements and good design package.

.3 Calculate the thermal loading of enclosures and ensure that adequate ventilation is provided to maintain the desired panel interior conditions.

.1 Requirement: Max 40°C panel interior (or as required by components), given 30°C ambient temperature.

1.4 INSPECTION

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

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

Part 2 Products

2.1 GENERAL

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

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

2.2 ENCLOSURES

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

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

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

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

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

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

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

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

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

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

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

.12 All floor-mounted control panels shall be equipped with lifting eyes that are attached to a structural member that is capable of bearing the control panel load.

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

2.3 POWER SOURCE

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

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

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

2.4 COMPONENTS

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

.2 Rails (DIN Rails)

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

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

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

.3 Terminals

.1 Requirements:

.1 TS-35 DIN Rail mounting.

.2 Voltage rating:

.1 600V for general control circuits.

.2 600V for power circuits.

.3 Manufacturer: Phoenix Contact or approved equal in accordance with B6.

.2 Terminal blocks shall be designed for the size of the wires to be connected to them. Terminal blocks used for analog, digital, and power cables shall be identified and physically separated from each other.

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

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

.4 Ground Bus Bar

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

.2 Requirements:

.1 Tapped holes with screws.

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

.3 Maximum one wire termination per screw.

.5 Pushbutton, Switch and Indicator Light

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

.2 Manufacturer to be Allen-Bradley or approved equivalent.

.6 General Purpose Relays

.1	Type:	DPDT or as shown on drawings
.2	Indication:	LED
.3	Coil Voltage:	As per drawings
.4	Contact Rating:	5A (120 VAC), 5A (24 VDC)
.5	Approvals:	CSA
.6	Manufacturer:	Omron or approved equal in accordance with B6

.7 Grounding

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

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

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

.8 Wiring

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

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

.3 No more than two (2) conductors may be terminated under each terminal screw. All internal panel conductors shall be connected to the same side of a terminal block, and external conductors to the other side. The only exception is for fused terminals which require connection to the field side for internal wiring.

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

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

.1 Label both ends of each wire.

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

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

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

.7 The routing of all analog, digital, and power cable wiring inside control panels shall be segregated as much as possible, in distinct wiring ducts, by the type of signal they are carrying. All wires shall be physically protected by wiring ducts with covers. The wiring ducts shall be of sufficient size to be filled to a maximum of 50% when all wires are inside.

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

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

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

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

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

.12 Ethernet Patch Cords

.1 Requirements:

.1 Cat-6.

.2 Jacket colour: Blue.

.13 Wiring Duct

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

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

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

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

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

.14 Wire ties shall be non-metallic.

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

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

.9 Overcurrent Protection

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

.10 Internal Lighting

.1 Difficulties resulting from electrical noise generated by fluorescent lamps shall be corrected.

.11 Cooling and Heating Systems

.1 Control panels shall be designed for the environmental conditions of the installation location. Cooling and heating systems shall be in accordance with the specific NEMA rating required by NEMA ICS 6 and NEMA 250.

Part 3 Execution

3.1 COMPONENT INSTALLATION

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

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

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

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

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

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

.7 Supply and install all required fuses.

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

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

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

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

.12 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be

completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.

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

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

3.2 IDENTIFICATION

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

.2 Label terminals as shown on drawings.

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

3.3 TESTING

.1 Testing of the control panels shall be comprehensive, and shall include at minimum:

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

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

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

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

.5 Tests to include:

.1 Power supply functionality

.2 Point to point tests of all wiring

.3 Power terminal voltage verification

.4 Relays and switches functionality

.5 E-stop system component functionality (as applicable)

.6 Receptacle and lighting functionality (as applicable)

.6 If the panel is modified after tests have been performed, tests shall be repeated.

3.4 SHIPMENT

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

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

3.5 SPARE COMPONENTS

.1 Supply two spares of each fuse type and rating.

.2 Supply one spare LED module with bulb of each type and rating.

.3 Place spare components in a clear plastic bag and attach to the panel door interior

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.190-M1985(R2004), Capacitors for Power Factor Correction.

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.

.2 List of all major components and weights.

.3 Shop Drawings

.1 Outline dimensions, front, side and sectional views.

.2 Foundation and support details.

.3 Enclosure construction, lifting and supporting points.

.4 Conduit / cable entrance locations and requirements.

.5 Electrical single line diagram and equipment electrical ratings including voltage, frame size and trip ratings, withstand ratings, and time current curves of equipment and components.

.6 Compartment layout drawings showing device locations.

.7 Wiring diagram showing terminal blocks and terminal numbers.

.4 Submit certified factory test results to Contract Administrator.

.5 Closeout Submittals

.1 Complete set of shop drawings and submittals.

.2 Operation and maintenance manuals.

.3 Factory test reports.

1.3 SERVICE CONDITIONS

.1 Temperature: 5 - 40 degrees C, maximum ambient.

.2 Altitude: Less than 1000 feet.

Part 2 Products

2.1 AUTOMATIC POWER FACTOR CORRECTION BANK - DETUNED

.1 General:

.1 The automatic power factor correction bank shall be a self-contained, automatically and manually-controlled self-protecting capacitor bank. The equipment shall allow automatic or manual switching of the capacitor bank kVAR's in minimum of 25 kVAR per step for a total of six (6) steps. A moulded case circuit breaker in the MCC shall connect the power factor correction bank to the MCC with cable connection.

.2 Approvals:

.1 CSA Approved

.2 Capacitor assembly for power factor correction: to CSA C22.2 No.190.

.3 Ratings:

.1 System Voltage: 600V, 3-phase, 3-wire, 60 Hz, solidly grounded (wye).

.2 Total nominal kVAR: 150 kVAR

.1 Actual capacitor kVAR will be higher due to reactors.

.3 Nominal Capacitance Stages:

.1 Two (2) 25 kVAR

.2 Two (2) 50 kVAR

.4 Insulation Class: 1 kV

.5 Minimum system short circuit capacity: 18 kA

.4 Capacitor bank characteristics:

.1 Fuse protected.

.2 Contactor controlled.

.3 Included transient suppressors.

.4 Included discharge resistors.

.5 Detuned reactors, series connected with capacitors.

.5 Capacitors:

.1 CSA and UL approved.

.2 Self-healing type utilizing a low-loss metalized polypropylene film dielectric system with a pressure sensitive interrupter in each capacitor cell. Metallized paper is not acceptable.

.3 Electrical losses shall be less than 0.5 W/kVAR

.4 Capacitor casing: seamless aluminum.

.5 Capacitor fluid shall be completely biodegradable (no polychlorinated bi-phenyls).

.6 Voltage Rating: 690V to protect against current and voltage overload due to harmonic distortion

.7 Capacitors shall be suitable for -40°C to +60°C ambient temperature.

.6 Fuses

.1 Individually fused on the line side of the contactor

.2 Use current-limiting Class RK5 fuses having an interrupting capacity of 200,000 symmetrical amperes.

.3 Fuses shall be rated to protect the contactor, capacitor, and interconnecting wiring.

.4 Provide means to automatically detect a blown fuse.

.1 Blown fuse indication shall be indicated on enclosure door via controller display or fuse light.

.2 Blown fuse shall actuate alarm contact.

.7 Contactors:

.1 Contactors shall be three-pole, 600-volt type provided with silver-coated contacts and rated to withstand the in-rush currents imposed by dynamic capacitor switching.

.2 Minimum current rating: 135% of nominal current.

.3 Rated Operations: 10,000,000

.4 Coil rating: 120 VAC, 60hz

.8 Harmonic De-Tuned Reactors

.1 Filter tuning frequency shall be 4.1 x 60 Hz (245 Hz), unless otherwise approved by the Contract Administrator.

.2 Insulation rating: 220°C.

.3 Maximum temperature rise: 115°C.

.4 Provide temperature sensitive device on each reactor to de-energize the contactor and alarm on overheating.

.9 Control Transformer

.1 Provide an integrated control transformer with primary and secondary fuse or breaker protection.

.2 No external power shall be required for operation.

.10 Controller

.1 The controller shall provide a user interface and provide control of the contactors to select the appropriate number of stages of power factor correction.

.2 User selectable target power factor.

.3 The controller shall respond to a current signal from the current transformer on costumer bus and the voltage signal from a potential transformer included in the equipment with a built-in adjustable time delay.

.4 Auto / Manual control. In manual, the user shall have the capability to turn each stage on and off manually.

.5 Display target and actual power factor.

.6 Provide a 120VAC, 5A rated dry contact alarm output, indicating any internal alarm condition.

.11 Enclosure:

.1 NEMA Type 1 dust-tight or Type 12. If Type 1, the enclosure must be positively pressurized with filtered fans.

.2 Provide required fans and louvers to maintain specified temperature in enclosure.

.3 All air intakes to be filtered.

.4 Access door: hinged latch handle and provision for locking.

.5 Provide appropriate warning labels indicating dangerous voltages in enclosure.

.6 Provide lifting lugs to allow for transport.

.7 Size: to fit within the proposed location as shown on the drawings.

2.2 CURRENT TRANSFORMER

.1 Current transformer for installation within MCC-M1.

.1 Optionally the current transformer for the power meter may be utilized, provided the CT burdens are verified to be adequate.

.2 Current transformer characteristics:

.1	Type:	Window
.2	Class of Accuracy:	0.5
.3	Rated Burden:	5 VA (minimum)
.4	Ratio:	400:5
.5	Nominal System Voltage:	600 VAC
.6	Frequency:	60 Hz
.7	Supply System:	3 phase, 3 wire

2.3 FINISH

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - for Electrical.

2.4 SPARE PARTS

.1 Power Fuses, 3 phase:

.1 Supply three (3) spare fuses of each type and size.

.2 Control Fuses, single phase:

.1 Supply one (1) spare fuse of each type and size.

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 INSTALLATION

.1 Install and connect capacitors.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 08 05 – Acceptance Testing.

3.4 START-UP ASSISTANCE

.1 Provide factory-trained representative to verify the installation and start-up the equipment.

.2 Set-up and verify all parameters and settings. Verify correct operation with loads in operation.

.3 Provide formatted, typed form indicating all settings as programmed.

.4 Allow a minimum of four hours on site, or as required to complete the required work.

3.5 TRAINING

.1 Furnish the services of a competent, factory-trained engineer or technician for one 2-hour period to instruct City personnel in the operation and maintenance of the equipment, on a date requested by the Contract Administrator.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for automatic load transfer equipment which can monitor voltage on all phases of normal power supply, initiate cranking of standby generator unit, transfer loads and shut down standby unit.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN3-C13-M83(R1998), Instrument Transformers.

.2 CSA C22.2 No.178.1-2007, Automatic Transfer Switches.

.2 American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA)

.1 ANSI/NEMA ICS 2-2000, Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.

1.3 SYSTEM DESCRIPTION

.1 Automatic load transfer equipment to:

.1 Monitor voltage on phases of normal power supply.

.2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.

.3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.

.4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.

.5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

1.4 SHOP DRAWINGS

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

.2 Include:

.1 Make, model and type.

.2 Electrical ratings (including withstand), dimensions, weights, mounting details, conduit entry provisions front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, factory relay settings, and accessories.

.3 Complete nameplate data, including manufacturer's name and catalog number.

.4 Description of equipment operation including:

.1 Automatic starting and transfer to standby unit and back to normal power.

.2 Test control.

.3 Manual control.

.4 Automatic shutdown.

1.5 QUALITY ASSURANCE

.1 A factory authorized service representative shall maintain a service center capable of providing emergency services at the Site within a six hour maximum travel distance by road.

1.6 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Detailed instructions to permit effective operation, maintenance and repair.

.3 Technical data:

.1 Schematic diagram of components, controls and relays.

.2 Illustrated parts lists with parts catalogue numbers.

.3 Certified copy of factory test results.

Part 2 Products

2.1 AUTOMATIC TRANSFER SWITCH

.1 Automatic Transfer Equipment: to CSA C22.2 No. 178.1

.2 Electrically operated, mechanically held open contact type, without integral overcurrent protection.

.1 Automatic transfer switches utilizing internal switching of circuit breakers are not acceptable.

.3 Rated: 600 V, 60Hz, 225 A, 3 phase, 3 wire.

.4 Include internal voltage sensing and source selection controls.

.5 Factory assembled as part of a complete assembly, such that only external power and signal connections are required.

.6 Auxiliary contact to initiate emergency generator start-up on failure of normal power, rated 10A @ 120 VAC.

.7 Two auxiliary dry contacts to indicate switch position to an external monitoring system, rated 5A @ 120VAC.

.8 Fault withstand rating: 18 kA symmetrical.

.9 Lever to operate switch manually when switch is isolated.

.10 Operating Mechanism

.1 Actuated by an electrical operator.

.2 Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in either normal and emergency position.

.3 Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of transfer. Release of the locking mechanism shall be possible only by normal operating action.

.4 Contact transfer time shall not exceed six cycles.

.5 Operating mechanism components and mechanical interlocks shall be insulated or grounded.

.11 Contacts:

.1 Main contacts: Silver alloy, protected by arc disruption means.

.2 Current carrying capacity of arcing contacts shall not be used in the determination of the automatic transfer switch rating, and shall be separate from the main contacts.

.3 Main and arcing contacts shall be visible for inspection with cabinet door open and barrier covers removed.

.4 Switch contacts to be replaceable as a field service item.

.12 Sensing Relays

.1 Undervoltage Sensing for Each Phase of Normal Source

.1 Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100% of nominal, and dropout voltage is adjustable from 75 to 98% of pickup value. Factory set for pickup at 90% and dropout at 85%.

.2 Undervoltage Sensing for Each Phase of Emergency Source

.1 Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100% of nominal, and dropout voltage is adjustable from 75 to 98% of pickup value. Factory set for pickup at 90% and dropout at 85%.

.13 Controls

.1 Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

.2 Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes. Time delay to be cancelled and transfer to occur immediately if the normal power supply has been restored and undervoltage of the emergency source occurs.

.3 Test Switch: Simulate normal-source failure.

.4 Switch-Position Pilot Lights: Indicate source to which load is connected.

.5 Source-Available Indicating Lights:

.1 Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

.2 Emergency Power Supervision: Green light with nameplate engraved "Emergency Source Available."

.6 Transfer Override Switch: Overrides automatic retransfer control so that automatic transfer switch shall remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

.7 Engine Starting Contacts: One isolated and normally closed and one isolated and normally open; rated 10 A at 32-V dc minimum.

.8 Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

.9 Engine-Generator Exerciser: Programmable exerciser starts engine-generator(s) and transfers load to them from normal source for a preset time, then retransfers and shuts down engine-generator(s) after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period.

.10 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.

.14 Control transformers: dry type with 120V secondary to isolate control circuits from:

.1 Normal power supply.

.2 Emergency power supply.

.15 Instrument transformers: to CAN3-C13.

2.2 ACCESSORIES

.1 Pilot lights to indicate power availability normal and standby, switch position, red for normal, amber for standby, mounted in panel.

2.3 EQUIPMENT IDENTIFICATION

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

.2 Control panel:

.1 For selector switch and manual switch: size 2 nameplates.

.2 For meters, indicating lights, minor controls: size 2 nameplates.

2.4 SPARE PARTS

.1 Fuses

.1 Provide six spare fuses of each size and type.

Part 3 Execution

3.1 SOURCE QUALITY CONTROL

.1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested.

.2 Tests:

- .1 Operate equipment both mechanically and electrically to ensure proper performance.
- .2 Check selector switch(es), in modes of operation and record results.
- .3 Check voltage sensing and time delay relay settings.
- .4 Check:
  - .1 Automatic starting and transfer of load on failure of normal power.
  - .2 Retransfer of load when normal power supply resumed.
  - .3 Automatic shutdown.

3.2 INSTALLATION

.1 Locate, install and connect transfer equipment.

.2 Check relays and timers and adjust as required.

.3 Install and connect remote alarms.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 08 05 – Acceptance Testing.

.2 Test all automatic, manual, and maintenance modes of operation

3.4 START-UP ASSISTANCE

.1 Provide factory-trained representative to verify the installation and start-up the equipment.

.2 Set-up and verify all parameters and settings. Verify correct operation with loads in operation.

.3 Provide formatted, typed form indicating all settings as programmed.

.4 Allow a minimum of four hours on site, or as required to complete the required work.

3.5 DEMONSTRATION

.1 Demonstrator to the City and Contract Administrator that the complete auxiliary electrical power system operates properly in every respect. Coordinate this demonstration with the demonstration of the engine-generators..

3.6 TRAINING

.1 Furnish the services of a competent, factory-trained engineer or technician for one 2-hour period to instruct City personnel in the operation and maintenance of the equipment, on a date requested by the Contract Administrator.

END OF SECTION