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 C22.1-2009 except where specified otherwise.

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

1.3 DRAWINGS AND SPECIFICATIONS

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

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

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

.4 If discrepancies or omissions in the Drawings or Specifications are found, or if the intent or meaning is not clear, advise the Contract Administrator for clarification before submitting Bid, in accordance with B4.

1.4 CARE, OPERATION AND START-UP

.1 Instruct City maintenance and operating personnel in the operation, care and maintenance of systems, system equipment and components.

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

1.5 PERMITS, FEES AND INSPECTION

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

.2 Pay associated fees.

.3 Notify Contract Administrator of changes required by Electrical Inspection Department prior to making changes.

.4 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Contract Administrator.

1.6 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with 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

NAMEPLATE SIZES			
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 1-0130L-E0001 Single Line Diagram

.2 1-0130L-P0001 (Sheet 001 and Sheet 002) Process P&ID

.3 1-0130L-P0002 HVAC and Miscellaneous P&ID

1.14 LOCATION OF OUTLETS

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

1.15 MOUNTING HEIGHTS

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

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

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

.1 Panelboards: 1800 to top
.2 Light switches: 1420 to top
.3 Wall receptacles: 900 to top
.4 Control panels: 1800 to top
.5 Emergency lights: 2400 (minimum)
.6 Emergency stop switches: 1500 to top
.7 Motor disconnect switches: 1800 to top

1.16 CONDUIT AND CABLE INSTALLATION

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

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

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

1.17 FIELD QUALITY CONTROL

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

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

1.18 TESTING

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

1.19 SUBMITTALS

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

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

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

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

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

1.20 RECORD DRAWINGS

.1 The Contractor shall keep one (1) complete set of white prints at the Site during work, including all addenda, change orders, Site instructions, clarifications, and revisions for the purpose of Record Drawings. As the Work on-site proceeds, the Contractor shall clearly record in Red Pencil all as-built conditions, which deviate from the original Contract Documents. Record Drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

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

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

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

1.2 PRODUCT DATA

.1 Submit product data in accordance with 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 Connectors:

.1 Watertight, approved for TECK cable.

2.3 VFD CABLE

.1 Cable to:

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

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

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

.2 Conductors:

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

.2 Circuit conductors: copper, size as indicated.

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

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

.5 Armour: aluminum, interlocking or continuous.

.6 Overall covering: polyvinyl chloride material.

.7 Approved for six-pulse VFD use.

.8 Fastenings:

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

.2 Channel type supports for two or more cables.

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

.9 Connectors:

.1 Watertight, approved for the cable.

2.4 ACIC/CIC CONTROL CABLE

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

.2 Conductors, copper, size as indicated.

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

.4 Shielding as indicated on the drawings.

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

Part 3 Execution

3.1 GENERAL

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

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

3.2 INSTALLATION OF BUILDING WIRES

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

3.3 INSTALLATION OF TECK CABLE 0 -1000 V

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

.2 Perform an insulation-resistance test on each conductor, prior to termination, utilizing a megohmmeter with a voltage output of 1000 volts DC. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 50 megaohms, or deviations between parallel conductors. Conductors with insulation resistance values, at one minute, less than 25 megaohms, or that deviate from other similar conductors by more than 50% will be rejected.

3.4 INSTALLATION OF CONTROL CABLES

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

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

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

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

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

3.5 TERMINATIONS AND SPLICES

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

.1 Lighting circuits.

.2 Receptacle circuits.

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

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

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

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

3.6 INSTALLATION IN CONDUIT

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

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

3.7 CABLE INDENTIFICATION

.1 Install cable tags.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

.2 Product Data:

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

Part 2 Products

2.1 MATERIALS

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

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

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

Part 3 Execution

3.1 INSTALLATION

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

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

.3 Protect exposed grounding conductors during and after construction.

3.2 ELECTRODE INSTALLATION

.1 Install ground rod electrodes.

.1 Ground rods to be in a triangle configuration.

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

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

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

.1 Connect each electrode to all others.

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

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

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

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

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

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

.4 Minimum depth of burial: 450mm

.3 Make required grounding connections.

.1 Utilize thermo-weld connections to the ground rods.

.2 Utilize thermo-weld connections or approved compression type connectors for underground wire to wire connections.

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

END OF SECTION

Part 1 General

1.1 REFERENCES

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

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

.2 Canadian Standards Association, (CSA International)

Part 2 Products

2.1 EQUIPMENT

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

.2 Insulated grounding conductors: green, type RW90.

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

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

Part 3 Execution

3.1 INSTALLATION GENERAL

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

.2 Protect exposed grounding conductors from mechanical injury.

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

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

.5 Soldered joints not permitted.

3.2 EQUIPMENT GROUNDING AND BONDING

.1 Install grounding connections to transformers.

.2 Install bonding connections to all electrical equipment.

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

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

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

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

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

3.3 FIELD QUALITY CONTROL

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

.2 Perform tests before energizing electrical system.

END OF SECTION

Part 1 General

1.1 NONE

.1 None.

Part 2 Products

2.1 FRAMING AND SUPPORT SYSTEM

.1 Materials:

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

.2 Finishes:

.1 Wet locations: Aluminum.

.2 Indoors, dry locations: Aluminum.

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

2.2 CONCRETE AND MASONRY ANCHORS

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

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

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

Part 3 Execution

3.1 INSTALLATION

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

.2 Secure equipment to poured concrete with expandable inserts.

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

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

.5 Maximum spacing between conduit supports:

.1	16mm conduit:	1.0 m
.2	21mm conduit:	1.5 m
.3	27mm conduit	1.5 m

.4	35mm conduit	2.0 m
.5	41mm conduit and larger	2.5 m

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

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

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

.7 Suspended support systems.

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

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

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

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

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

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

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

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

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

Part 2 Products

2.1 JUNCTION AND PULL BOXES

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

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

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

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

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

3.2 IDENTIFICATION

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

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

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

.1 Example: L73-2 (Panelboard PNL-L73, circuit 2)

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

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

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SURFACE MOUNTED OUTLET BOXES FOR METAL CONDUIT

.1 General Requirements:

.1 Acceptable materials:

.1 Cast Aluminum

.2 Cast ferrous alloy with corrosion resistant epoxy coating.

.2 Suitable for threaded rigid conduit

.3 Mounting lugs as required.

.2 Specific Requirements:

.1 Ceiling Outlets:

.1 Crouse Hinds VXF/VFT series or approved equal in accordance with B7.

.2 Device Boxes:

.1 Crouse Hinds FS/FD series or approved equal in accordance with B7.

.2 Wet location covers for all locations below grade.

2.3 MASONRY BOXES

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

2.4 CONCRETE BOXES

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

2.5 CONDUIT BOXES

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

2.6 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

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

2.7 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.

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

Part 3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

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

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

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

.1 Example: L73-2 (Panelboard PNL-L73, circuit 2)

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

- .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
- .2 CSA C22.2 No. 45, Rigid Metal Conduit.
- .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 211.2, Rigid PVC (Un-plasticized) Conduit.
- .5 CAN/CSA C22.2 No. 227.3, Flexible Non-metallic Tubing.

Part 2 Products

2.1 GENERAL

.1 Material Requirements:

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

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

2.2 RIGID METAL CONDUIT

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

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

2.3 RIGID PVC CONDUIT

.1 Meets CSA C22.2 No. 211.2.

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

2.4 FLEXIBLE METAL CONDUIT

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

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

2.5 CONDUIT FASTENINGS

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

.2 Strap material to match conduit material.

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

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

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

2.6 CONDUIT FITTINGS

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

.2 All fittings to be liquid and dust tight.

.3 Enclosure Connections

.1 Connections in dry locations (bottom or side)

.1 Locknuts inside and outside enclosures.

.2 Insulated bushings Thomas & Betts Series 222 or approved equal in accordance with B7.

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

.1 Liquid-tight threaded hubs

.2 Insulated bushings Thomas & Betts Series 222 or approved equal in accordance with B7.

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

.4 Elbows:

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

.5 Threaded Hubs for Metal Conduit

.1 liquid and dust tight with insulated throat

.2 Approved products

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

.2 Or approved equal in accordance with B7

.6 Fittings for Metal Conduit

.1 Cast metal

.2 Gasketted covers.

.3 Approved products

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

.2 Or approved equal in accordance with B7

.7 Explosion proof conduit sealing fittings:

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

.2 Material: Cast aluminum.

.8 Sealing Compound. As recommended by manufacturer.

2.7 CONDUIT SPACERS

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

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

2.8 FISH CORD

.1 Polypropylene

Part 3 Execution

3.1 ROUTING

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

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

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

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

3.2 INSTALLATION - GENERAL

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

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

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

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

.5 Ensure electrical continuity in all metallic conduit systems.

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

.7 Seal conduits with duct seal where conduits are run between heated and unheated areas. Where conduits, cables, or cable trays pierce fire separations, seal openings with Dow

Corning 3-6548 sealant. Seal all conduits entering or leaving hazardous classified areas with approved seals.

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

.9 Install fish cord in empty conduits.

.10 Dry conduits out before installing wire.

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

.12 Underground Conduits

.1 Slope conduits to provide drainage.

.13 Surface Conduits

.1 Run parallel or perpendicular to building lines.

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

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

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

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

.6 Install spacers as required to provide a space between the conduits and the supporting surface, with a minimum space as follows:

.1 Above grade spaces not classified as CEC Category 1 or 2:

.1 Drywall / Wood surfaces: no space required

.2 Masonry / concrete surfaces: 6 mm

.2 Below grade spaces: 12 mm

.14 Colour Coding

.1 Apply plastic tape or paint colour coded bands to conduits at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.

.2 Bands: 38 mm wide prime colour and 19 mm wide auxiliary colours

.3 Band colours as per the following table.

System	**Prime Band**	**Aux. Band**
Medium Voltage (>750 V)	Orange	
347/600 V	Yellow	
120/208/240 V Power	Black	
UPS 120/208/240 V Power	Black	Green
Control Wiring (120 V)	Black	Orange
Fire Alarm	Red	
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring (<50 V)	Blue	Orange
Intrinsically Safe	Blue	White

3.3 PVC CONDUIT

.1 Concrete Penetrations:

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

.2 Maximum spacing between supports for rigid PVC conduit:

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

3.4 METAL CONDUIT

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

.2 Mechanically bend conduits over 19 mm in diameter.

.3 Concrete Penetrations:

.1 Sleeves for Aluminum Conduit

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

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

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

.4 Maximum spacing between supports for rigid metallic conduit:

.1	16mm conduit:	1.0 m
.2	21mm conduit:	1.5 m
.3	27mm conduit	1.5 m
.4	35mm conduit	2.0 m
.5	41mm conduit and larger	2.5 m

3.5 LIQUID-TIGHT FLEXIBLE CONDUIT

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

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

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

3.6 INSTALLATIONS IN CATEGORY 1 LOCATIONS

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

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

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

.4 Install every joint to be water-tight.

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

3.7 INSTALLATIONS IN CATEGORY 2 LOCATIONS

.1 Comply with all requirements of Category 1 locations.

3.8 INSTALLATIONS IN CATEGORY 2 WET LOCATIONS

.1 Comply with all requirements of Category 1 locations.

3.9 INSTALLATIONS IN HAZARDOUS ZONE 1 LOCATIONS

.1 Explosion proof conduit sealing fittings:

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

.2 Add sealing compound following manufacturer’s instructions.

3.10 INSTALLATIONS IN HAZARDOUS ZONE 2 LOCATIONS

.1 Explosion proof conduit sealing fittings:

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

.2 Add sealing compound following manufacturer’s instructions.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association, (CSA International)

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

Part 2 Products

2.1 CABLE PROTECTION

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

Part 3 Execution

3.1 DIRECT BURIAL OF CABLES

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

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

.3 Underground cable splices not acceptable.

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

.5 Cable separation:

.1 As shown on drawings.

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

END OF SECTION

Part 1 General

1.1 REFERENCES

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

1.2 TESTING REPORT

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

.2 The Contractor shall furnish 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 CSTE

.2 SGR-L71, including:

.1 Surge Protector

.2 Power Meter

.3 CTs

.4 PTs (if present)

.3 MCC-L72E

.4 ATS-L72

.5 GEN-L72

.6 VFD-L01

.7 VFD-L02

.8 VFD-L03

.9 Perform a harmonics measurement, at the following locations with one wastewater lift pump running:

.1 SGR-L71 incoming feed.

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 °C)

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

Table 260805-2

Insulation Resistance Correction Factors (40 °C)

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

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

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

.2 Where, RC = Resistance at corrected temperature.

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

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

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

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

.2 Torque all accessible bolted electrical connections.

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

.4 Inspect grounding and cable/conduit support.

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

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

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

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

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

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

3.5 SURGE ARRESTORS, LOW VOLTAGE

.1 Inspection and testing shall 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.

3.6 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

3.7 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.

3.8 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.

3.9 MOTORS, INDUCTION, AC, 600 V

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

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

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

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

.5 Clean the unit.

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

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

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

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

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

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

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

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

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

.5 Correct test results to 40 °C.

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

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

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

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

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

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

3.10 MOTOR STARTERS, 600 V

.1 Inspection and testing shall 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.

3.11 VARIABLE FREQUENCY DRIVE, 600V

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

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, and grounding.

.3 Inspect for evidence of corrosion.

.4 Clean the unit.

.5 Check the air filters.

.6 Ensure vent path openings are free from debris and that heat transfer surfaces are not contaminated by oil, dust, or dirt.

.7 Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.

.8 Visually inspect VFD grounding to ensure continuity.

.9 Inspect condition of line reactors, if present.

.10 Inspect condition of DC Link Reactors, if present.

.11 Inspect condition of isolation transformers, if present.

.12 Inspect DC bus capacitors for bulging and leakage.

.13 Cooling fans and heat sinks:

.1 Visually inspect and listen for any abnormal noises or vibration.

.2 Verify that fans rotate freely.

.3 Verify correct direction of airflow.

.4 Clean and verify integrity of heat sinks.

.5 Verify the operation of the grounding switch, if present.

.2 Record the following VFD Parameters:

.1 Motor voltage, current, frequency, nominal speed, nominal power.

.2 Control mode / method.

.3 Minimum and maximum control frequency.

.4 Acceleration and deceleration time.

.5 Compare drive overcurrent set points with motor full-load current rating to verify correct settings.

.3 Power fuses:

.1 Record fuse data. Confirm that the fuses are of the correct type and rating. Utilize manufacturer's published data where available.

.2 Measure fuse resistance.

.4 Bolted connections:

.1 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.

.2 Torque all bolted connections.

.5 Inverter / Supply Module Power Connections:

.1 Remove each power module and visually inspect the contacts.

.2 Torque all cable connections.

.3 Clean all contact surfaces and apply suitable joint compound as recommended by manufacturer.

.6 Operator Interface:

.1 Check the display and keypad for proper operation and communication.

.2 Retrieve fault history log and note any faults.

.7 Grounding/Bonding measurements:

.1 Measure the resistance of the ground bonding connection between the VFD and the main grounding bus in the corresponding electrical room.

.8 Control Wiring:

.1 Check for tightness of all accessible control wiring and torque any loose connections.

.9 Perform operational tests by initiating control devices.

.1 Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual noise or vibration.

.2 Verify operation of drive from local start/stop and speed control signals.

.3 Verify operation of all local pilot lights.

.4 Verify the operation of any emergency stop switches.

.10 Voltage and Current Testing:

.1 With the VFD under load, measure and record the following:

.1 Measure and record incoming AC voltage and currents.

.2 Measure and record DC and AC bus voltages.

.2 Utilize a recording oscilloscope to capture the input voltage waveform and verify correct operation.

.3 Utilize a recording oscilloscope to capture the output voltage waveform and verify correct operation.

.4 Include input and output waveforms with the report.

.11 With the VFD output in START/RUN mode, and at zero speed:

.1 Measure and record the AC output voltage. Voltages above 40 VAC should be investigated.

.12 Affix an inspection sticker or inspection tag to each VFD 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.

3.12 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.

3.13 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.

3.14 PANELBOARDS, LOW VOLTAGE

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

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

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Clean the unit.

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

.1 Record breaker data on the inspection form.

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

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

.4 Restore breaker position to original position.

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

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

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

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

.10 Open all load breakers.

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

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

3.15 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.

3.16 HARMONICS MEASUREMENTS

.1 Testing shall be comprised of the following:

.1 Connect to existing CTs and PTs, if provided. If not provided, supply appropriate CTs and PTs as required.

.2 Test duration at each location is to be one hour.

.3 Coordinate with operations personnel to ensure the loads run during the test are representative of normal and maximum plant operation.

.4 Monitor the following for all three phases:

.1 Voltage, current, and power factor

.2 Harmonic voltage level for 1st (base) through 15th harmonics.

.3 Harmonic current level for 1st (base) through 15th harmonics, expressed in % of current.

.4 Total harmonic distortion (THD)

.5 Record samples as one (1) minute intervals.

.6 Provide Microsoft Excel files of the test results.

.7 Provide a summary page in the report indicating the THD, and maximum, average, and minimum for each voltage and current harmonic.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

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

.2 CSA C9, Dry-Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

1.3 PRODUCT DATA

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

Part 2 Products

2.1 TRANSFORMERS

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

.2 Requirements:

.1 Type: ANN.

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

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

.4 Windings: copper.

.5 Insulation: Class H, 220ºC.

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

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

.8 Hipot: 4kV.

.9 Average sound level: To meet the local municipal & building codes and meet at minimum the following criteria:
45 dB max. up to 45 kVA
50 dB max. up to 150 kVA

.10 Impedance at 170 degrees C: standard

.11 Enclosure: as indicated in Schedule 261217-1.

.12 Mounting: as indicated on the drawings.

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

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

2.2 EQUIPMENT IDENTIFICATION

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

.2 Label size: 7.

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

Part 3 Execution

3.1 INSTALLATION

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

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

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

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

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

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

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

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

.10 Energize transformers after installation is complete.

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

3.2 TESTING

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

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

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

Schedule 261217-1 : Transformers

Identifier	Location	Size	Voltage	Enclosure Type
Community Row Wastewater Pumping Station				
XFMR-L73	Main Floor – Generator Building	30 kVA	600:120/208V, 3Ø	CSA 1

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for low voltage switchgear for controlling relatively large loads - 2000 A or larger.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 26 05 01 - Common Work Results - Electrical.

.4 Section 26 28 21 – Moulded Case Circuit Breakers.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

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

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

.1 EEMAC G8-3.3, Metal-Enclosed Interrupter Switchgear Assemblies.

1.4 SHOP DRAWINGS PRODUCT DATA

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

.2 Indicate on shop drawings:

.1 Floor anchoring method and foundation template.
.2 Dimensioned cable entry and exit locations.
.3 Dimensioned position and size of bus.
.4 Overall length, height and depth of complete switchgear.
.5 Dimensioned layout of internal and front panel mounted components.

.3 Indicate on product data:

.1 Time-current characteristic curves for air circuit breakers.

1.5 QUALITY ASSURANCE

.1 Submit copies of certified factory test results.

1.6 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for secondary switchgear for incorporation into manual in accordance with Section 01 78 00 - Closeout Submittals.

.2 Copies of maintenance data for complete switchgear assembly including components.

1.7 STORAGE AND PROTECTION

.1 Store switchgear on site in protected, dry location. Cover with plastic to keep off dust.

.2 Provide energized strip heater in each cell to maintain dry condition during storage.

1.8 EXTRA MATERIALS

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

.2 Include:

.1 3 fuses for each type and rating of fuse.

Part 2 Products

2.1 MATERIALS

.1 Switchgear assembly: to EEMAC G8-3.3 / CAN/CSA-C22.2No.31.

2.2 RATING

.1 Secondary switchgear: indoor, 600 V, 800 A, 3 phase, 4 wire, 60 Hz, minimum short circuit capacity 25 kA (rms symmetrical).

.2 Service entrance rated.

2.3 ENCLOSURE

.1 Main incoming section to contain:

.1 Moulded case circuit breaker sized as indicated.
.2 Power meter, associated metering transformers, and CT shorting block.
.3 Transient voltage surge suppressor, 240 kA.
.4 Cable entry: bottom.

.2 Distribution sections to contain:

.1 Moulded case circuit breakers, sized as indicated.
.2 Copper bus, from main section to distribution sections including vertical bussing.

.3 Blanked off spaces for future units.

.4 Metal enclosed, free standing, floor mounted, dead front, indoor.

.5 Access from front.

2.4 BUSBARS

.1 Three phase and full capacity neutral, bare or insulated busbars, continuous current rating 800A self-cooled, extending full width of multi-cubicle switchgear, suitably supported on insulators.

.2 Main connections between bus and major switching components to have continuous current rating to match major switching components.

.3 Busbars and main connections: 99.30% conductivity copper.

.4 Provision for extension of bus on both sides of unit without need for further drilling or preparation in field.

.5 Tin plated joints, secured with non-corrosive bolts and Belleville washers.

.6 Identify phases of busbars by suitable marking.

.7 Busbar connectors, when switchboard shipped in more than one section.

2.5 GROUNDING

.1 Copper ground bus not smaller than 50 x 6 mm extending full width of multi-cubicle switchgear and situated at bottom.

.2 Lugs at each end for size 2/0 AWG grounding cable.

2.6 MOULDED CASE CIRCUIT BREAKERS

.1 Refer to Section 26 28 21 – Moulded Case Circuit Breakers.

2.7 TRANSIENT VOLTAGE SURGE SUPPRESSOR

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

.2 Requirements:

.1 TVSS units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

.2 Voltage: Refer to drawings.

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

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

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

.1 3Ø, 3W System: L-L, and L-G

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

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

.6 Nominal Discharge Current (In) – All TVSSs applied to the distribution system shall have a 20kA In rating regardless of their TVSS Type (includes Types 1 and 2) or operating voltage. TVSSs having an In less than 20kA shall be rejected.

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

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

.1	120/208 V:	700V
.2	347/600 V:	1500V

.2 L-L:

.1	120/208 V:	1200V
.2	347/600 V:	3000V

.3 TVSS Design

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

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

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

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

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

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

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

.4 Overcurrent Protection

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

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

.1	600V Equipment – Service Entrance:	240 kA
.2	600V Equipment – Not Service Entrance:	120 kA

.6 Installation Requirements:

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

.2 The switchgear 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 switchgear. The TVSS shall be located directly adjacent to the circuit breaker.

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

.7 The complete switchgear including the TVSS shall be CSA/cUL listed.

2.8 POWER METER

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

.2 Requirements:

.1 Multifunction electrical measurement on 3 phase power systems.

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

.3 Integrated display.

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

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

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

.7 Maximum burden of 0.0625 VA at 10 Amps.

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

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

.10 Function Requirements:

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

.2 Frequency, kWh, kVAh, kVARh

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

.11 Operating Temperature:

.1 -20 to +60 °C ambient.

.3 Communications ports:

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

.4 Acceptable Products:

.1 Schneider Electric PM8000 series.

.2 Or approved equal in accordance with B7.

2.9 FINISHES

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

.1 Cubicle exteriors gray.

.2 Cubicle interiors white.

2.10 EQUIPMENT IDENTIFICATION

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

.2 Nameplates:

.1 White plate, black letters, size 7.

.2 Complete switchgear labelled: "SGR-L71, 600 V, 800A, 3 PH, 4 WIRE".

.3 Main cubicle labelled: "MAIN".

.4 Distribution units labelled as per the load description on the single line drawing.

Part 3 Execution

3.1 INSTALLATION

.1 Locate switchgear assembly as indicated and bolt to floor.

.2 Connect main secondary power supply to main breaker.

.3 Connect load side of breakers in distribution cubicles to distribution feeders.

.4 Check factory made connections for mechanical security and electrical continuity.

.5 Run grounding conductor 2/0AWG bare copper in 25 mm conduit from ground bus to ground.

.6 Adjust trip settings as directed by the Contract Administrator. The Contract Administrator will perform the Coordination Study.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Service equipment and installation.

1.2 RELATED SECTIONS

.1 Section 01 74 11 - Cleaning

.2 Section 26 05 27 - Grounding - Primary.

.3 Section 26 05 28 - Grounding - Secondary.

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

1.3 SUBMITTALS

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

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

.3 Submit shop drawings and indicate:

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

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

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials where possible.

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

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

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

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

Part 2 Products

2.1 600V CUSTOMER SERVICE TERMINATION ENCLOSURE, CSTE-L70

.1 Requirements:

.1 Rating: 600V, 800A, 3 phase, 4 wire.

.2 Interrupting Rating: 25 kA minimum

.3 Meter socket: 13-jaw with insulated neutral.

.1 Confirm requirements with Manitoba Hydro metering standards.

.4 Provision for utility metering CTs (current transformers) and PTs (potential transformers).

.1 Metering units are not supplied with the CSTE. Installation Contractor is responsible for coordinating with Manitoba Hydro to procurement and installation as required.

.5 Copper bus.

.6 Insulated neutral.

.7 Enclosure Rating: NEMA Type 3R.

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

.2 Manufacturer:

.1 Strong Electric,

.2 Or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

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

.2 Install service equipment.

.3 Connect to incoming service.

.4 Connect to outgoing load circuits.

.5 Install ground fault equipment.

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

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

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

.9 Set transformer taps.

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

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

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

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

1.3 SHOP DRAWINGS

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

1.4 O&M Manual

.1 Include 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 manufacturers and models:

.1 Square D NQOD series.

.2 Or approved equal in accordance with B7.

2.2 BREAKERS

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

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

.3 The Contractor is responsible for coordinating with the generator (GEN-L72) equipment supplier to provide the required breakers for the engine block heater, alternator heater, battery charger, and any other circuits required for the overall generating unit. Some generators may power all of these sub-systems from one circuit, and others may require multiple circuits.

2.3 EQUIPMENT IDENTIFICATION

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

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

.1 Line 1 is to be the panel identifier as indicated on the drawings, for example “PNL-L73”.

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

.3 Complete circuit directory with typewritten legend.

Part 3 Execution

3.1 INSTALLATION

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

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

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

.4 Connect loads to circuits.

3.2 TESTING

.1 Test in accordance with Section 26 08 05.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

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

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

.4 Submit shop drawings and indicate:

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

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

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

Part 2 Products

2.1 SUPPLY CHARACTERISTICS

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

2.2 GENERAL DESCRIPTION

.1 Compartmentalized vertical sections with common power busbars.

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

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

.4 Suitability for Service Entrance: Not Required.

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

.6 Nameplates: white with black letters.

.7 SCCR: 25 kA minimum.

.8 Acceptable manufacturer:

.1 Schneider Electric Model 6.

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

.9 Purchase or Quotation:

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

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

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

2.3 VERTICAL SECTION CONSTRUCTION

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

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

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

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

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

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

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

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

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

.10 Stab opening protection: Removable protective caps.

.11 Isolation barriers between units and wireways.

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

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

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

.15 Removable lifting means.

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

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

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

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

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

2.4 SILLS

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

2.5 BUSBARS

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

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

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

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

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

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

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

.6 Location: Top

2.6 GROUND BUS

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

.1 Size: 6 x 25 mm (1/4” x 1”)

.2 Plating: Tin

.3 Location: Bottom

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

.1 Material: tin plated copper.

2.7 VOLTAGE MONITORING RELAY

.1 Requirements,

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

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

.3 Undervoltage trip point:

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

.4 Voltage unbalance:

.1 Adjustable from 2% to 10%.

.5 Phase loss detection:

.1 Triggered upon ≥ 15% unbalance.

.2 Response time ≤ 200 msec.

.6 Trip delay:

.1 Adjustable from 0.25 to 30 sec.

.7 Automatic reset (restart) delay:

.1 Adjustable from 0.25 to 64 sec.

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

.8 Faults stored in non-volatile memory.

.1 Storage of the last 10 faults.

.9 Status and faults displayed on LED readout.

.10 Remote reset input.

.11 CSA approved.

.2 Relay output:

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

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

.2 Actuate relay on any of the following:

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

.2 Voltage unbalance greater than 10%.

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

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

.3 Acceptable products:

.1 SSAC WVM011AL.

.2 Or approved equal in accordance with B7.

2.8 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.

2.9 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.

2.10 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.

2.11 EQUIPMENT IDENTIFICATION

.1 Identify Motor Control Centre with nameplates as follows:

.2 Nameplates:

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

NAMEPLATE SIZES

Motor control centre main nameplate	70 x 120 mm	1 line	40 mm high letters
Individual compartment nameplates	30 x 90 mm	3 lines	5 mm high letters

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

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

.5 Identification to be English.

2.12 FINISHES

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

.1 Paint indoor switchgear and distribution enclosures light grey to ANSI 61 grey enamel, unless otherwise specified.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during construction.

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

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

2.13 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.

2.14 SPARE PARTS

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

Part 3 Execution

3.1 INSTALLATION

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

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

.3 Make field power and control connections as indicated.

.4 Ensure correct overload settings are applied.

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

3.2 FIELD QUALITY CONTROL

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

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

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

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

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

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

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

1.3 SHOP DRAWINGS AND PRODUCT DATA

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

Part 2 Products

2.1 SWITCHES – TWO POSITION, SINGLE POLE

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

.2 Manually operated heavy duty ac switches with following features:

.1 Heavy duty mounting strap.

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

.3 Silver alloy contacts.

.4 One piece lexan toggle, lever, and cam.

.5 Suitable for back and side wiring.

.6 Green hex head grounding terminal.

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

.4 Switches of one manufacturer throughout project.

.5 Acceptable manufacturer:

.1 Hubbell or approved equal in accordance with B7.

2.2 SWITCHES – TWO POSITION, DOUBLE POLE (HS-L600)

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

.2 Manually operated heavy duty ac switches with following features:

.1 Heavy duty mounting strap.
.2 Terminal holes approved for No. 10 AWG wire.
.3 Silver alloy contacts.
.4 One piece lexan toggle, lever, and cam.
.5 Suitable for back and side wiring.

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

.4 Switches of one manufacturer throughout project.

.5 Acceptable manufacturer:

.1 Hubbell or approved equal in accordance with B7.

2.3 RECEPTACLES

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

.1 Heavy duty nylon face with steel reinforcing plate in centre.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Break-off links for use as split receptacles.
.4 Receptacle contacts to utilize spring steel clips to reduce contact fatigue.

.2 Receptacles of one manufacturer throughout project.

.3 Acceptable manufacturer:

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

2.4 COVER PLATES

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

.2 Cover plates from one manufacturer throughout project.

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

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

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

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

Part 3 Execution

3.1 INSTALLATION

.1 Switches:

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

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

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

.2 Receptacles:

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

.2 Mount duplex receptacles vertically.

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

.3 Cover plates:

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

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

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

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

.1 Example: L73-2 (Panelboard PNL-L73, circuit 2)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

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

1.4 SUBMITTALS

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

Part 2 Products

2.1 BREAKERS GENERAL

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

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

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

.4 Circuit breakers to have minimum 10kA 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 SGR-L71.MCB

.1 Requirements:

.1	Frame Size:	600A
.2	Trip Rating:	600 A

.3	Interrupting Rating:	25 kA @ 600 VAC (minimum)
.4	Type:	Electronic LSI
.5	Model:	Schneider Electric PowerPact L Frame with Micrologic 5.3A trip unit.

2.3 CB-L72-A, CB-L72-B

.1 Requirements:

.1	Frame Size:	600A
.2	Trip Rating:	600A
.3	Interrupting Rating:	25 kA @ 600 VAC (minimum)
.4	Type:	Electronic LI
.5	Model:	Schneider Electric PowerPact L Frame with Micrologic 3.3 trip unit.

2.4 CB-L01, CB-L02, CB-L03

.1 Requirements:

.1	Frame Size:	400 A
.2	Trip Rating:	250 A
.3	Interrupting Rating:	25 kA @ 600 VAC (minimum)
.4	Type:	Electronic LI
.5	Model:	Schneider Electric PowerPact L Frame with Micrologic 3.3 trip unit.

2.5 SGR-L71 AND MCC-L72E BREAKERS (OTHER THAN THOSE LISTED IN SECTIONS 2.2, 2.3, AND 2.4 ABOVE)

.1 Requirements:

.1	Frame Size:	As Rqd
.2	Trip Rating:	As indicated on the drawings
.3	Interrupting Rating:	25 kA @ 600 VAC (minimum)
.4	Type:	Thermal Magnetic
.5	Model:	Schneider Electric PowerPact series.

2.6 ACCESSORIES

.1 All main and branch breakers in SGR-L71 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: 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: "VFD-L01, WASTEWATER LIFT PUMP P-L01".

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.

.3 Extra Materials:

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

.1 All control fuses.

.2 1 indicating lamp bulb.

Part 2 Products

2.1 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.

.3 Accessories:

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

.2 Indicating lights: heavy-duty oil tight type and color as indicated.

.3 1-N/O spare auxiliary contact.

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 Pushbutton: heavy duty, oil tight as required.

.2 Selector switches: heavy duty, oil tight as required.

.3 Indicating lights: heavy duty, oil tight, type and colour as indicated.

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 of each rating.

Part 3 Execution

3.1 INSTALLATION

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

.2 Install and wire starters and controls as indicated.

.3 Ensure correct fuses installed.

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

3.2 FIELD QUALITY CONTROL

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

.2 Operate switches and contactors to verify correct functioning.

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

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Technical requirements related to the design and supply of Variable Frequency Drives (VFD), including all equipment, manufacture, assembly, factor, wiring, inspection, testing and delivery.

1.2 REFERENCES

.1 CSA, Canadian Standards Association

.2 NEMA, National Electrical Manufacturer Association

.3 IEEE, The Institute of Electrical and Electronics Engineers

.4 Other, Local Power Utility and Telephone Utility Guidelines for Harmonic Distortion.

1.3 DESIGN REQUIREMENTS

.1 Provide equipment layout drawing detailing

- .1 The dimensions, physical arrangement of major components, and the degree of compartmentalization and physical segregation provided between components
- .2 Front layout of the panel
- .3 When air-cooled systems are provided, the following shall also be shown:
  - .1 air inlet and outlet passages
  - .2 cooling fans
  - .3 filters.

1.4 SUBMITTALS

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

.2 Submit shop drawings including:

- .1 Panel layout.
- .2 Wiring diagrams:
  - .1 AutoCAD versions of the VFD schematic drawings will be provided upon request.

1.5 PARTS AVAILABILITY

.1 Guarantee that parts for the drive units be available for a minimum of ten years from time of delivery.

1.6 DESIGN REQUIREMENTS

.1 Ventilation system designed for ambient temperature range of 10°C to 35°C. Enclosure temperature not to exceed 45°C.

Part 2 Products

2.1 VARIABLE FREQUENCY DRIVES

.1 Variable speed controller shall be electronic adjustable frequency and voltage output unit.

.2 Designed to operate standard squirrel cage induction motor with a 1.15 S.F. or definite purpose motors meeting NEMA MG1 Part 31.

.3 Harmonic loading will not exceed a motor service factor of 1.0.

.4 Products shall comply with IEEE standard 519.

.5 CSA certified.

.6 To employ a minimum 6-pulse pulse width modulated (PWM) inverter system utilizing Insulated Gate Bipolar Transistors (IGBT) power switching devices and come complete with line and load reactors.

.7 Be capable of re-accelerating the driven equipment, following voltage dips greater than 20% of the rated input power supply, of up to 5 seconds duration, without the need to come to a complete stop. Vendor shall indicate the maximum time delay before re-acceleration begins following restoration of the supply voltage.

.8 Be capable to continue operation without coming to a standstill or resulting in a process shutdown, following any momentary voltage dips in the input power supply, auxiliary power supply, or both, of less than 20% rated voltage, which last for less than 0.5 second.

.9 Designed to provide output requirements dictated by the speed/torque characteristics of motor and driven equipment over the entire speed range. The motors may be supplied by others.

.10 VFD shall convert the line input power to adjustable AC voltage and frequency output power. The output power shall be controlled such that permissible volts/Hertz ratio is not exceeded throughout the specified operating speed range, over a voltage range of ±10% and frequency variation of ± 5%.

.11 The VFD output frequency shall not deviate more than ± 1% of any given set point within the operating frequency range.

.12 The VFD shall be provided with radio interference suppression and limit radio interference values to within the limits of local code requirements.

.13 The telephone influence factor shall be in accordance with maximum values specified by local authorities.

.14 Input Run Command signal will be a 24Vdc discrete signal. Provide a 24Vdc relay in the VFD control compartment.

.15 Input frequency setting signal will be 0-10 VDC and 4-20 mA. Output speed and current monitoring signals will be 4-20 mA.

.16 Enclosure

.1 VFD shall be installed in individual drip proof, Type 12 free-standing enclosure. Filters to be provided for any forced air-cooled enclosures as required by the supplier. VFD(s) shall be suitable for the location installed and shall be able to operate under these conditions with no special cleaning requirements.

.17 Operational features

.1 Integral flush mounted keypad on enclosure door for programming, monitoring, and operating the drive, accessible through password or other acceptable security measure only.

.2 Integral selector switches and pushbuttons, where shown on the drawings: heavy duty, oil-tight, 30mm.

.18 Diagnostic features

.1 Integral long life LED indicating lights on enclosure door.

.2 Indicating lights as follows:

.1 Ready (Blue)

.2 Running (Red)

.3 VFD Fault (Yellow)

.19 Environmental capabilities: Drive to operate without mechanical or electrical damage under any combination of conditions as follows:

.1 Room ambient temperature 0°C to 35°C

.2 Humidity 0 to 90 percent (non condensing)

.3 Vibration up to 0.5 g

.4 Altitude 0 to 1250 m

.20 Protective functions to be incorporated are:

.1 VFD failure

.2 Ground fault in VFD

.3 Ground fault on converter output

.4 VFD overcurrent

.5 Supply system over or under voltage

.6 Supply system phase voltage unbalance

.7 DC link fault

.8 Voltage/frequency ratio incorrect

.9 5% frequency deviation from the set point

.10 Loss of control signal

.11 Control electronics fault

.12 Electronic motor overload protection adjustable up to 150 percent of motor rating for 60 seconds.

.13 Motor stalled

.14 Inverter over temperature.

.21 As supplied by one of the following acceptable manufacturers:

.1 Schneider Electric

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

2.2 INPUT HARMONIC FILTER

.1 Harmonic filter (active or passive) designed such that the VFD can operate the load (pump) at full speed while meeting IEEE 519 requirements.

2.3 LOAD REACTOR

.1 Provide load reactor due to long motor feeder cable length.

.2 Reactors shall not exceed their temperature limit under all operation conditions.

.3 Size reactors for the given load.

2.4 TERMINALS

.1 Terminals as follows:

.1 Feed-through: Phoenix Contact 3046184 or approved equal in accordance with B7,

.2 Potential earth: Phoenix Contact 3046207 or approved equal in accordance with B7,

.3 Fused: Phoenix Contact 3046142 with 3036806 or approved equal in accordance with B7,

.4 End plate: Phoenix Contact 3047141 or approved equal in accordance with B7.

2.5 COOLING SYSTEM

.1 Perform heat load analysis to determine air-cooling requirements.

.2 Air-cooled converters shall meet the following:

.1 Redundant cooling fans

.2 Cooling fan operates when pump is started from VFD or bypass system or when enclosure reaches hi temperature.

.3 Provide adjustable hi temperature switch, with minimum range 10°C to 30°C.

2.6 WIRING

.1 Utilize the following wire colours for the types of voltage/signals indicated:

.1	120VAC Line:	Black
.2	120VAC Control:	Red
.3	120VAC Neutral:	White
.4	24VDC Supply:	Blue
.5	24VDC Control:	Blue
.6	24VDC Common:	Brown
.7	24VAC Supply:	Black

.8	24VAC Control:	Red
.9	24VAC Neutral:	White
.10	10VDC Supply:	Blue
.11	0-10VDC Signal:	Blue
.12	10VDC Common:	Brown
.13	Intrinsically Safe:	Light Blue
.14	4-20mA Signal:	White (+), Black (-)

.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 VFD panels shall be identified on both ends with non-erasable markers from.

.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.

.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 VFD 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 in accordance with B7. 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. 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 in accordance with B7

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

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

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

2.7 SPARE PARTS

.1 Provide, at minimum, the following spare parts:

.1 One cooling fan

.2 All control fuses

.3 One N.O. and N.C. contact block for control switches

.4 One form “C” relay

.2 Spare parts to be provided in a sealed plastic bag taped to side of enclosure interior.

Part 3 Execution

3.1 INSTALLATION

.1 VFD cabinets shall be mounted in such a way that there is adequate room for ventilation and no build up of heat. The minimum clearance in front of VFDs is 1 m.

3.2 CONFIGURATION

.1 Submit settings sheet for review.

.2 Configure VFD parameters as specified on settings sheet.

.3 Include settings sheets in the O&M manuals.

3.3 TESTS

.1 VFD units are to be factory tested prior to shipment. Provide confirmation from factory of actual tests completed and results.

.2 Confirm VFD capability to continue operation without coming to a standstill, following any momentary voltage dips in the input power supply, auxiliary power supply or both of less than 20% rated voltage, which last for less than 0.5 seconds.

.3 Confirm VFD capability to automatically re-accelerate following loss of voltage for up to five seconds.

.4 Field testing

.1 Provide on-site startup, fine-tuning, commissioning, operator training, and instruction.

.2 Full-load functional test of the VFD shall be performed. The test shall prove the correct operation of all control functions, auxiliaries, protective systems, alarms and metering.

.3 Ensure shaft to ground voltages do not exceed 1.5 V at any speed or load requirement.

END OF SECTION

PART 1 General

1.1 INTRODUCTION

This specification defines the technical requirements related to the design, fabrication, factory testing, supply, delivery to the specified location, for a skid mounted 3ϕ, 600VAC standby natural gas fueled generator c/w Automatic Transfer Switch and all ancillary equipment specified herein and as indicated on the drawings and datasheets.

This Specification shall be read in conjunction with the drawings and other documents forming part of the Tender/Purchase Order documents.

The generator shall be completely fabricated, assembled, factory tested and bear CSA/cUL certification at the manufacture's facilities and shipped to site ready for field installation.

1.2 CODES AND STANDARDS

The most recent adopted version of the following standards:

A. Cenelec EN 61000-6-4:2007 (BS EN 61000-6-4:2007+A1:2011) – Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments.

B. Cenelec EN 61000-6-2:2005 (BS EN 61000-6-2:2005) – Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments.

C. CSA C282-15 – Emergency Electrical Power Supply for Buildings.

D. CAN/CSA-E61131-2-06 (R2011) – Programmable Controllers - Part 2: Equipment Requirements and Tests (Adopted IEC 61131-2:2003, second edition, 2003-02, including Corrigendum 1:2004, with Canadian deviations)

E. EEC 89/336/EEC, 91/368/EEC, 3/44/EEC, 93/68/EEC – Electromagnetic compatibility,

F. Manitoba Building Code (MBC)

G. NFPA 37 – Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, 2015 Edition.

H. UL 508 – Standard for Industrial Control Panels
23 (Note that as of Jan. 27, 2017, UL 508 will be replaced by the UL 60947 series and **UL-508 series approvals will be withdrawn**),

1.3 SUBMITTALS

A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 26 05 01 – Common Work Result – Electrical.

B. Submit shop drawings:

1. Complete set of dimensioned equipment drawings showing plan and elevations of the proposed generator set and drive system including anchoring requirements
2. Interconnecting wiring diagrams.
3. Field wiring cable list, conduit list.
4. Weight of all equipment.
5. Engine mechanical data at varying loads up to full load, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, noise data, fuel consumption, etc.
6. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
7. Material List.
8. Generator resistances, reactances (including transient and sub-transient), and time constants.
9. Generator current decrement curves.
10. Generator motor starting capability.
11. Generator thermal damage curve.
12. Jacket water heater connection diagram, heater wattage and voltage.
13. Alternator space heater connection diagram, heater wattage and voltage.
14. Control panel schematics.
15. Generator set synchronization details and wiring diagrams
16. Generator set controller details and wiring diagrams
17. Control interconnection diagrams / interface with the ATS
18. Manufacturer's written warranty.
19. Emissions data (sound and environmental).
20. Breaker specifications, including trip unit curves.
21. Complete list of accessories provided.

C. Product Data:

1. Submit manufacturer’s printed product literature, specifications and datasheets and include product characteristics, performance criteria, and limitations. Specific model shall be indicated.

D. Owner’s Manual:

1. Paper and digital copies of owner’s manual specific to the product supplied must be provided in accordance with the requirements of CSA C282. General operating instructions, preventative maintenance, wiring diagrams, schematics and parts exploded views specific to the supplied model must be included.

1.4 OPERATIONS & MAINTENANCE (O&M) MANUAL

A. Provide submittals in accordance to Section 01 78 00 – Closeout Submittals and Section 26 05 01 – Common Work Results – Electrical.

B. Prepare installation, operating and maintenance (O&M) manuals in the formats and quantities required by Section 01 78 00.

C. Each of the O&M Manuals shall include, at a minimum, the following:
1. All Shop drawing information.
2. Signed and sealed equipment "As Manufactured" drawings,.
3. Certified product test reports.
4. Certificates of compliance.
5. Certified Arc-flash type test data.
6. CSA certificates of inspection for the provided equipment, or Manitoba Office of the Fire Commissioner, Inspection and Technical Services Manitoba "Special Inspection" certificate for the provided equipment.
7. Handling and installation instructions, including equipment anchorage information and provisions.
8. Operating and maintenance instructions.
9. Complete component list.
10. Recommended maintenance practices and procedures.
11. Recommended spare parts list.
12. CT curves and data sheets.
13. Equipment and component Manufacturer's detailed instructions, installation and maintenance manuals.
14. Standard cut sheets for OEM devices.
15. Component manuals for all devices/equipment/relays incorporated into the equipment.
16. Metering equipment settings and programming information.
17. Site Testing & Commissioning Procedures, and recommendations and precautions for setting into operation.
18. Test plan and inspection records.
19. Certified copies of all test reports.
20. Nameplate rubbings.
21. Such additional information, instructions, data, recommendations, and procedures that the Manufacturer considers to be pertinent.

D. Relay programming settings (copy of software as well as printed hardcopy). Include a copy of the software needed to view / read / modify the files.

1.5 QUALITY ISSURANCE

A. Prior to shipment, the manufacturer shall factory test the generator and associated control and protection equipment and switchgear in accordance with the requirements of clauses 2.11 – FACTORY TESTING,

B. A certified test and compliance report shall be submitted within 7 days of the successful completion of the tests.

C. Accept equipment on site and inspect for shipping damage.

D. When long term storage (> 1 week) is required, the equipment shall be stored indoors in a heated environment, or shall be covered with a weather-proof heated hording. For short term storage (≤ 1 week) and during installation protect equipment from weather and moisture by covering with heavy plastic or canvas and by maintaining heat within the enclosure in accordance with manufacturer's instructions.

PART 2 Products

2.1 GENERAL

A. Maximum unit overall dimensions including frame rails and lifting eyes:
1. Width: 1355 mm
2. Height: 1920 mm
3. Length: 3580 mm

B. Quality and Experience

All materials and parts of the generator set shall be new and unused. Each component shall be of current manufacture from a firm regularly engaged in the production of such equipment. Units and components offered under these specifications shall be covered by the manufacturer's standard warranty on new machines, a copy of which shall be included in the submittal.

C. Torsional Vibration

The system shall be free of injurious torsional and bending vibrations within a speed range from 10% below to 10% above synchronous speed.

D. Guards

The system shall be adequately guarded both physically and electrically for protection of operating personnel.

E. Layout

The layout of the Generator Room is based on the generator from the first named manufacturer listed herein and as shown on the Contract Drawings. The Contractor is responsible for coordinating layout changes and interface connections to other work and equipment which is different than that shown on the Drawings if alternative manufacturers are proposed. The Contractor will be responsible for coordinating this work and the changes will be at sole expense of the Contractor.

2.2 ENGINE

A. The engine shall be a stationary, liquid cooled, 1800 rpm, four-cycle design, vertical inline or V-type, with Dry exhaust manifolds. It shall have cylinders with minimum displacement of 11 liters and be manufactured in the United States or Canada.

B. The engine shall be water cooled with a unit mounted radiator, fan (with guard), water pump, and closed coolant recovery system providing low coolant level alarm. The radiator shall be designed for operation in ±40 °C ambient temperatures.

C. Radiator duct flange shall be shipped loose by generator set manufacturer, and shall be installed with flexible boot vibration isolator by Contractor.

D. Intake air filter(s) with replaceable element(s) c/w service indication shall be mounted on the unit.

E. The integral engine mounted natural gas fuel system shall consist of gas pressure regulator and carburetors. The carburetor shall be a diaphragm type which includes a load screw for fuel ratio adjustment and throttle body to control the air-fuel mixture to the engine.

F. Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have full flow oil filter(s) with internal bypass and replaceable element(s).

G. The engine shall be equipped with a battery charging DC alternator with an integral “solid state” voltage regulator.

H. The engine shall be equipped with a unit mounted, thermostatically controlled jacket water heater to aid in quick starting. Power supply for the jacket water heater shall be from a 120 Vac, 1-phase, or 208 Vac 3-phase supply. The Genset manufacturer shall provide all required thermostatic controls, contactors, control transformers, inside an enclosure. The wattage shall be as recommended by the manufacturer. The jacket water heater shall be sized to allow the genset to start at -40ºC ambient temperature (even though the genset room will normally be heated). The contractor shall provide proper branch circuit from normal utility power source.

I. Sensing elements shall be located on the engine for:
1. Low oil pressure alarm/shutdown.
2. High coolant temperature alarm/shutdown.
3. Low coolant level shutdown.
4. Overspeed shutdown.
5. Overcrank shutdown.
6. Emergency stop shutdown.
7. Low coolant temperature alarm.
8. Low battery voltage alarm.
9. High battery voltage alarm.
10. Unit control selector switch not in auto alarm.

11. AC battery charger failure alarm.
12. Fuel alarms (programmable).

J. Sensors shall be connected to the control panel using a prefabricated wiring harness(es), each connectors shall be sealed to prevent corrosion and all wiring shall be run in flexible conduit(s) for protection from the environment and moving parts.

K. The following equipment is to be provided by the engine-generator set manufacturer and shipped loose with the generator set for installation by the Contractor:
1. Approved fuel lines to connect the engine to the external natural gas supply and return lines.
2. Approved isolation valves, pressure gauge for natural gas fuel supply line as indicated on the Contract Drawings.
3. AC Battery Charger.
4. Vibration isolators.

L. The engine speed shall be controlled by an isochronous governor. Speed regulation during steady state operation shall be ±0.2 Hz.

M. The Generator set shall be capable of accepting a block load of 100% of the block load nameplate rating.

N. Generator set performance shall meet the requirements of the latest version of CSA C282-15.

O. Approved manufacturers:
1. Kohler,
2. Caterpillar,
3. Olympian,
4. Generac,
5. Or approved equal in accordance with B7.

2.3 FUEL SYSTEM

A. The engine shall be natural gas powered, with an electronic pressure regulator.

B. Operating fuel pressure shall be between 7in. H_20 to 11in. H_20, or as specified in supplier data sheet.

2.4 GENERATOR ALTERNATOR

A. The alternator shall be of the 4 poles revolving field type, wired for 600 VAC, 3Ø, 60 Hz, rated at 200 kW, 0.8 pf , stationary armature, synchronous machine. The excitation system shall utilize a brushless exciter with a three phase full wave rectifier assembly protected against abnormal transient conditions by a surge protector. Photo-sensitive components will not be permitted in the rotating exciter. The alternator shall be suitable for use with grounded neutral connection system.

B. The alternator rotor shall be connected to the engine by means of a gear type coupling to ensure permanent alignment.

C. The alternator shall meet temperature rise standards for Class "H" insulation; operate within Class "F" temperature rise standards for extended life. All leads shall be extended into an AC connection panel.

D. The alternator and regulator shall sustain at least 300% short circuit current for 10 seconds during 3 phase fault conditions.

E. The alternator shall be equipped with an internally mounted space heater. Heater supply shall be 120 Vac 1 Ø or 208 Vac 3Ø. The Genset manufacturer shall provide the appropriate fusing, disconnects, breakers, contactors, controls, control transformer, etc.. The alternator heater(s) shall be automatically disconnected when the engine is running and shall have an independent means of being disconnected or switched off for maintenance.

F. The alternator terminal box shall be arranged for top connection of the outgoing load cable(s) and the neutral cable(s). The terminal box shall be oversized and shall include adequate space for the installation of cable terminations, neutral current transformers (if mounted in the terminal box), cable gland connectors, and for bending and training of the load and neutral cables.

2.5 AUTOMATIC TRANSFER SWITCH

A. Rating: 600V, 600A, 3 phase, 3 wire, 60 Hz.

B. Provide contactors or switches mounted on common frame, in double throw center-off arrangement, mechanically and electrically interlocked, solenoid operated, with CSA 12 enclosure.

C. Ensure that ATS and relay contacts, coils, springs and control elements are accessible for inspection and maintenance from front of ATS panel without removal or disconnection of power conductors.

D. Provide silver plated auxiliary contacts to initiate emergency generator start-up on failure of normal power. Provide high pressure silver alloy main contacts, protected by arc disruption means.

E. Operational sequence of the ATS shall be as described in Section 2.6 of this Specification.

F. Provide all conductors/cabling between the Generator load breaker terminals and the ATS as well as all wiring/cabling required for the proper functioning of the ATS.

G. Provide space for a minimum 2 x 3C 350 MCM type TECK90 1kV cables on both the “normal” and “load” side of the ATS, connections for these cables shall accommodate

long barrel standard NEMA two (2) hole lugs provided by Others. 600V cabling between the Generator load breaker terminals and the "Generator connections of the ATS shall employ type Teck-90 1KV cables and long barrel standard NEMA two (2) hole lugs.

H. Dry-Contact status outputs:
1. Indication of "On Utility Power" – Qty 4 Form A or Form C dry-contacts
2. Indication of "On Generator Power" – Qty 4 Form A or Form C dry-contacts

2.6 CONTROLS

A. The generator unit control system shall be a fully integrated control system enabling remote diagnostics and building management integration of all generator functions. The generator controller shall provide integrated and digital control over all generator functions including: engine protection, alternator protection, speed governing, voltage regulation and critical generator operations. The generator controller shall also provide seamless digital integration with the engine's electronic management system. Generator controller shall utilize separate voltage regulators and speed governors to integrate with the engine management system.

B. The generator control system shall meet all requirements of CSA C282 for standby engine generators.

C. Communications shall be supported with building automation via the Modbus protocol over Ethernet.

D. The control system shall be environmentally sealed including encapsulated circuit boards and sealed automotive style plugs for all sensors and circuit board connections. The generator set control shall be tested and certified to the following environmental conditions:
1. -40°C to 70°C Operating Range.
2. 95% humidity non-condensing, 30°C to 60°C.
3. IP22 protection.
4. 5% salt spray: 48 hours, 38°C, 36.8 V system voltage.
5. Sinusoidal vibration: 4.3G RMS, 24-1000 Hz.
6. Electromagnetic Capability:
    a. 89/336/EEC, 91/368/EEC, 3/44/EEC, 93/68/EEC,
    b. BS EN 61000-6-4:2007+A1:2011,
    c. BS EN 61000-6-2:2005.
7. Shock withstand: 15G.

E. Diagnostic capabilities shall include time-stamped event and alarm logs, ability to capture operational parameters during events, and simultaneous monitoring of all input and output parameters.

F. The Controller shall include the ability to accept six programmable digital inputs, two dedicated digital inputs, six programmable form "A" dry contacts, two programmable

form "C" dry contacts, and two digital outputs. The signals shall be programmable for either high or low activation using programmable Normally Open (NO) or Normally Closed (NC) contacts.

G. The control panel shall display all user pertinent generator set parameters including, but not limited to, the following:

1. Alarm Conditions:
   a. Low oil pressure alarm,
   b. High coolant temperature alarm,
   c. High intake manifold temperature alarm,
   d. High exhaust manifold temperature alarm,
   e. High crankcase pressure alarm,
   f. Low coolant temperature alarm,
   g. CCV filter,
   h. Low battery voltage,
   i. High battery voltage,
   j. Unit control switch not in "automatic" position alarm.
   k. AC Battery charger failure,
   l. Voltage Regulator,
   m. Loss of excitation,
   n. Instantaneous over-excitation,
   o. Time over-excitation,

2. Shutdown Conditions:
   a. Low oil pressure,
   b. High coolant temperature,
   c. Loss of coolant,
   d. Overspeed,
   e. Overcrank,
   f. High intake manifold temperature,
   g. High exhaust manifold temperature,
   h. High crankcase pressure,
   i. Emergency stop activated,
   j. Generator shutdown.
   k. Generator over voltage.
   l. Generator under voltage.
   m. Generator over frequency.
   n. Generator under frequency.
   o. Generator reverse power.
   p. Generator overcurrent.
   q. Voltage Regulator,
   r. Loss of excitation,
   s. Instantaneous over-excitation,
   t. Time over-excitation,
   u. Rotating diode failure.
   v. Loss of sensing.

H. Access to and manipulation of the internal operating set points and alarm limits shall be by password protected.

I. Control Wiring and Connections

1. Current Transformer Wiring and Connections
   a. Current transformer wiring shall be Type SIS, minimum # 10 AWG, 600 V, 90 °C (minimum).
   b. All current transformer wiring shall utilize stud or screw connections and "ring" type crimp lugs. The use of self retaining compression type spade lugs or "push-on" blade terminals and lugs are NOT acceptable for CT wiring.
   c. Current transformers shall be rated as shown on the Drawings.
   d. Current transformers shall be ANSI standard relay class and have their accuracy established in accordance with the connected burden and ANSI C57.13 but shall be at least:
      i. 10C200, Thermal factor 130% for all phase CTs.
      ii. 10C50, for all zero sequence CTs.
   e. Zero sequence CTs shall be manufacturer's standard design, and shall be properly rated and tested for use in medium voltage switchgear installations.
   f. Zero sequence CTs windows shall be dimensioned to allow passage of the specified cables complete with NEMA standard 2-hole pattern long barrel double crimp type lugs and high voltage cable terminations.
   g. Zero sequence CTs shall be mounted in such a manner as to permit its easy removal for installation of cables complete with high voltage terminators and cable gland connectors.

2. Wiring Rules (other than engine mounted wiring except as noted)
   a. Wiring shall in general be type SIS, # 14 AWG, 600 V, 90 °C, except where larger size wire is required by CSA standard, or specified on the Drawings.
   b. Provide terminal blocks for incoming and outgoing control connections.
   c. All wiring (including engine mounted wiring) shall be tagged and identified on both ends of every wire using printed heat shrink sleeve type wire markers. Hand written numbering is NOT acceptable. The wire numbering scheme shall be such that the wire numbers change only when going through a device (coil, contact, etc.); wire numbers at both ends of the same wire shall be identical. All wires on a given terminal block or connector position shall bear the same number.
   d. Wires shall be run in continuous lengths, without splices between connection points, be installed in channels, ducts, or neatly tied and clamped to the supporting structure or panel. Self-stick/adhesive type wire/cable clamps are acceptable ONLY if additionally secured by means of screws.
   e. All wiring originating from a compartment must be first routed to terminal blocks.

f. Connections to external circuits shall be brought to modular, asymmetrical DIN rail mounted snap-on construction, pressure type terminal blocks, with marking strips.

g. The terminal blocks for external connections shall grouped together and easily accessible, visible and positioned near the compartment's field control cable and inter-cell wiring entry/exit points.

h. All wiring not terminated on devices shall be terminated on terminal blocks. Not more than two (2) wires shall be connected to any device terminal or at any one terminal side. Interconnecting jumpers between terminal block positions shall be counted in the above 2 wire per side limitation. General and control wiring shall utilize self retaining compression type spade lugs where wiring is terminated on hardware (relays, meters, switches, etc).

i. Where wiring between cells crosses shipping splits the manufacturer shall supply keyed separable plug and socket type in-line insulated connector(s) to permit separating the cells at the shipping splits without having to un-terminate wiring. The connector shall be sized to accommodate the wire gauge and current carrying capacity of the inter-cell conductors, shall be of a locking design to prevent separation in service due to vibration or other causes and shall be securely screwed or clamped to the structure(s).

j. Where wiring crosses between structure sections (i.e. inter-cell connections), or where wiring (control cables) exits the equipment to connect to other equipment it shall be landed on terminal blocks at both ends. Devices external to the cell (contacts, coils, etc.) shall not be "loop" connected but shall be wired back to the terminal blocks in the cell or panel on an individual device basis.

k. Soldered connections and splices in wiring are not permitted.

2.7 OPERATIONAL CHARACTERISTICS

A. Provide equipment of a standard product line, which have been proven to give reliable service under similar conditions. Ensure they are reliable and fast starting, with rapid loading capabilities and capability of continuous supply to the essential loads, under the ambient and environmental conditions that will prevail at the site.

B. The Generator shall be capable of operating in an automatic mode under the supervision of the Generator Control Panel and the Automatic Transfer Switch (ATS).

C. Generator shall be used to supply power to critical process equipment. In the event of a normal power interruption, the Automatic Transfer Switch (ATS) shall:

- Monitor the "normal" supply for loss of voltage, phase failure, and frequency,

- Detect failure of the "normal" supply and after an adjustable time delay, to confirm that the loss of normal power is not a transient event or "brownout" condition, order the Genset to start,

- Isolate the “Emergency MCC” from the “Normal” supply,
- Detect that the Genset has successfully started and that the output of the Generator is within the required voltage and frequency tolerance limits, and the Generator is ready to accept load,
- Transfer the “Emergency MCC” to the “Generator” supply,
- Continue to monitor the “Normal” supply for its restoration,

D. On restoration of the “Normal” supply the ATS shall:

- Monitor the “normal” supply for an adjustable time delay, to confirm stability of the restored “Normal” power supply system, then
- Isolate the “Emergency MCC” from the “Generator” supply,
- Pause for an adjustable time delay to allow connected motor residual voltages to decay, and,
- Transfer the “Emergency MCC” to the “Normal” supply,
- After an adjustable time delay to permit the Generator and Engine to cool, order the Genset to shut down.

E. Additionally the ATS shall include provisions to allow the exercising of the Genset as follows:

1. Either with or without load transfer, manually selectable at the ATS,
2. By manual operator initiation at the ATS, or
3. Automatically on a time or calendar based user selectable program.

F. Generator System Load Management Control

1. The generator system load management controls shall generate an alarm if the measured generator load exceeds a preset percentage of the on-line generation capacity for an established period of time. The alarm shall be displayed on the generation system HMI and shall also be issued as a fail-safe contact output. The load level alarm set point shall be user adjustable and shall be password protected.
2. If the connected load exceeds the capacity of generation system, resulting in a decrease in generator system frequency to a specified, adjustable setpoint or less, the generation system load management controls shall signal the plant PLC / operator to initiate load shedding to reduce the plant load to within the generation system capacity. The generator set point shall be in accordance with

codes and standards, nominally the maximum frequency reduction shall not exceed 10 percent for greater than 3 seconds.

G. HMI – Human/Machine Interface

1. HMI system interface shall be via a LCD character display with pushbuttons, or a touch screen display.

2. Provide a local emergency-stop pushbutton.

2.8 EXHAUST SYSTEM

A. Heavy duty critical type horizontally mounted stainless steel, insulated exhaust, stainless steel residential silencer with condensate drain, plug and flanged couplings, and insulation blanket exhausting through wall using insulated wall thimble.

B. Heavy duty flexible exhaust pipe with flanged couplings; minimum 450 mm.

C. Fittings and accessories as required.

D. Insulation: 50 mm mineral wool rated to 550 ^{0}C.

E. Jacket: 0.5 mm aluminum, longitudinal and circumferential slip joints with 50 mm laps, 19 mm wide stainless steel banding at minimum 300 mm spacing.

2.9 STARTING SYSTEM

A. Provide a 24VDC electric starting system with positive engagement.

B. Unit mounted thermal circulation type water heater(s) (jacket water heater) shall be installed on the engine. The heater power rating shall be sized by the manufacturer to maintain jacket water temperature at 40 °C with a minimum ambient temperature of -40ºC. Heater supply voltage shall be 208 VAC, 3Ø, 60 Hz. Control voltage can be derived from a common 208 VAC, 1Ø supply.

C. The engine heater(s) shall be automatically disconnected when the engine is running and shall have an independent means of being disconnected or switched off for maintenance.

2.10 ENCLOSURE.

A. Generator set shall be suitable for indoor application and no external weather enclosure is required. The genset shall be designed to start and run at an ambient temperature of -40ºC to allow for the possibility of heating system malfunctions. Generator combustion and cooling air is at outdoor ambient temperatures and will not be tempered.

2.11 FACTORY TESTING

A. All testing indicated in this section is supplemental to the requirements of Specification 26 08 05 – Acceptance Testing.

B. QA REQUIREMENTS

1. Submit an Inspection and Test Plan in accordance with this specification, applicable Standards and NETA Acceptance Testing Standards.

C. SHOP INSPECTION AND TESTING

1. Equipment will be subject to inspection at the following stages of manufacture:
   a. Prior to shop testing,
   b. Prior to packaging for shipment.
2. Test equipment to ensure satisfactory operation prior to shipping. Provide Certification of Satisfactory performance.
3. Test and inspect all equipment, materials, works in accordance with scope of work, specifications, all applicable codes, standards, regulations, laws and provide Certification and Records.
4. Provide the Contract Administrator, or designate, with proper access to work, equipment, tools and facilities for carrying out such inspection, test, witness inspection or test points, surveillance or audit, whether it is in preparation or progress.
5. Provide upon request, the following information:
   a. Non-destructive test records/results,
   b. Welding procedures and welder qualifications,

D. ROUTINE FACTORY TESTS

1. Test the equipment per applicable standards and provide test data.
2. The Contract Administrator, or designate, reserves the right to witness any or all tests.
3. Prior to proceeding with the tests, provide in writing, a list of the tests to be performed at least four weeks before the tests are scheduled to begin, and an approximate schedule, with dates anticipated for the tests.
4. The equipment shall be tested at the manufacturing plant prior to shipment and in accordance with the latest applicable standards.

E. DESIGN TESTS (TYPE TESTS)

1. For the design tests, include the following:
   a. Dielectric tests,
   b. Power frequency voltage withstand on auxiliary equipment and control circuits,

c. Partial discharge,
d. Radio interference,
e. Temperature rise,

2. The tests classified by the standards as optional may be carried out or waived at Contract Administrator's discretion, e.g., tests for radio interference, tests with simulated internal arcing fault, operational tests in extreme atmospheric conditions, etc.

3. Perform the design tests in the manufacturer's plant or elsewhere by an internationally recognized laboratory.

4. Where design type test results have been previously obtained and have been certified by an internationally recognized testing laboratory, they may be acceptable in lieu of the above specified type tests at the discretion of the Contract Administrator.

F. FACTORY ACCEPTANCE TESTS (FAT)

1. Witness Factory Acceptance Tests (FAT) are required for the Individual Engine Generator Sets and Incorporated Controls as well as for the Integrated Generator System/Controls and Generator Switchgear.

2. The FAT for the Individual Engine Generator Sets and Incorporated Controls shall be carried out at the generator set Manufacturer's factory prior to packing and shipment to Site.

3. The Individual Engine Generator Set and Incorporated Controls FATs shall include, but not be limited to, the following for each engine generator set:
   a. Starting test,
   b. Starting battery capacity test,
   c. Verification of the correct functioning of all engine protection shutdowns and alarms,
   d. Engine speed governor functionality verification,
   e. Alternator excitation functionality verification,
   f. Alternator Voltage regulator functionality (no-load, ¼ load, ½ load, ¾ load, full load) ,
   g. A block load application test of the engine generator set at "block load" nameplate rating, the block load shall be applied in a single step,
   h. A full load run test at the generator set nameplate KVA/KW rating. Test duration shall be a minimum of 6 hours at full capacity after both engine and alternator temperatures have stabilized. For the purposes of this test temperature stability shall be defined as $\Delta t \leq 0.5$ °C/hr for both engine and generator. In accordance with the requirements of CSA C282 this test may be run at 1.0 Pf if the alternator has been previously tested at the factory to full capacity at 0.8 Pf. If the alternator has not been factory load tested at 0.8 Pf, the FAT test shall be conducted at 0.8 Pf.

4. Prior to proceeding with the Individual Engine Generator Sets and Incorporated Controls FAT tests the manufacturer shall provide, in writing, a written

Inspection and Test Plan in accordance with the requirements of Specification Section 26 08 05 – Acceptance Testing. The Inspection and Test Plan shall include a detailed list of the tests to be performed, test procedures, sample data forms, and a testing schedule with anticipated test dates. Provide notice a minimum of two weeks before the tests are scheduled commence.

5. The Integrated Generator System/Controls and Generator Switchgear FAT should preferably be carried out at the generator set Manufacturer's factory. The location for this testing shall be subject to the agreement of the Contract Administrator, or designate.

6. The Integrated Generator System/Controls and Generator Switchgear FAT shall be conducted at 1.0 Pf and may be conducted at a reduced load capacity of 2MW total system loading.

7. The Integrated Generator System/Controls and Generator Switchgear FAT shall include, but not be limited to, the following:
   a. Verification of automatic generator set automatic starting, synchronization, and connection of the engine generator sets to the generator switchgear bus,
   b. Verification of Isynchronous governor functionality (no-load, ¼ load, ½ load),
   c. Verification of demand and load sharing between the two engine generator sets at the above loadings,
   d. Verification of correct operation of generator switchgear protection relay systems,
   e. Verification of automatic shutdown and disconnection of the engine generator sets from the generator switchgear bus.

8. Prior to proceeding with the Integrated Generator System/Controls and Generator Switchgear FAT tests the manufacturer shall provide, in writing, a written Inspection and Test Plan in accordance with the requirements of Specification Section 26 08 05 – Acceptance Testing. The Inspection and Test Plan shall include a detailed list of the tests to be performed, test procedures, sample data forms, and a testing schedule with anticipated test dates. Provide notice a minimum of two weeks before the tests are scheduled commence.

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTION

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

3.2 INSTALLATION

A. The following equipment shall be installed for each engine-generator set:

1. A heavy duty, flooded lead acid 24VDC battery shall be shipped loose by the generator set manufacturer.
2. An automatic means shall be provided for maintaining the storage battery in a charged condition. The battery charger shall be as follows:
   a. Fully automatic, dual-rate type with float and equalize modes,
   b. Float voltage shall be 2.17 volts per cell,
   c. Equalize voltage shall be 2.33 volts per cell,
   d. Shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input,
   e. Input voltage shall be 120 VAC, 1Ø, from a 15A circuit,
   f. Charger shall have LED annunciation for low DC volts, rectifier failure, loss of AC power, high DC volts,
   g. Shall be wall-mounting type,
   h. Shall be capable of recharging a battery discharged by two full cranking cycles to 80% of capacity within 4 hours and to full capacity within 12 hours,
   i. Output rating shall not be less than 10 Amperes.
3. The battery charger shall be shipped loose by the generator set manufacturer and shall be installed and connected by the Contractor.

B. Contractor shall install the complete electrical generating system including all fuel connections in accordance with the manufacturer's recommendations as reviewed by the Contract Administrator.

C. Contractor shall supply and install anchors for the engine/generator base in the pad and connect to isolating devices on base.

D. Batteries shall be filled with electrolyte, charged and connected.

E. Contractor shall supply and install interconnecting wiring between engine/generator, switchgear, load bank, remote annunciator, dampers and other equipment.

F. Contractor shall provide power connections to all accessories. Use a separate suitably sized branch circuit for each separate component.

3.3 FIELD TESTING

A. Provide factory trained technicians to verify the completed installation and to perform an initial startup and testing as per Section 26 08 05 – Acceptance Testing.

B. All testing indicated in this section is supplemental to the requirements of Specification 26 08 05 – Acceptance Testing.

C. Initial site installation performance tests shall be performed in accordance with the requirements of CSA C282, Section 10.

1. The "Operational Test" shall be performed in accordance with the requirements of CSA C282 Clause 10.2.1, the operational test shall be continued for a period of 1 hour, after which normal power shall be restored to the plant and satisfactory re-transfer to normal power and cool-down and shutdown of the emergency generator sets shall be verified.
2. Following the "Operational Test" the "Maximum Site Design Load Test" shall be conducted by connecting the generator sets to the load bank individually and operating each generator set at its rated nameplate unity power factor capacity until stable engine and alternator temperatures have been achieved followed by an additional 6 hours at rated capacity. The generator set load for this test shall be applied immediately upon the engine reaching its rated speed, and the rated nameplate "block load" shall be applied in a single step.
3. All data shall be recorded in accordance with the requirements of CSA C282, and a detailed report shall be submitted in accordance with Section 26 08 05 – Acceptance Testing.
4. The initial site installation performance tests shall be performed under the control and supervision of the Manufacturer's factory trained technicians.

D. Provide Contract Administrator with detailed photos of the generator set, and generator set controls during and after construction.

3.4 DEMONSTRATION AND TRAINING

A. Provide demonstration by factory trained representative in use and maintenance of Generator set Systems.

1. Allocate a minimum of two separate 8-hour for training sessions. The date for each training session will be set by the Contract Administrator. Note that the training sessions will NOT be on 2 successive days.
2. Training shall include, but not be limited to the following items:
   a. Overall system description and theory of operation,
   b. Automatic operation, shall be coordinated with 12.47kV switchgear system instruction sessions,
   c. Manual operation,
   d. Safeties and protective relaying,
   e. Recommended system check lists and log sheets in accordance with the requirements of CSA C282,
   f. Recommended preventive maintenance,
   g. Instruction on the operation of the assembly and major components within the assembly,

3.5 FINAL ACCEPTANCE

A. If required by final field testing/commissioning results make adjustments/or changes such that an efficient and fully operational installation is achieved. Such adjustments or

requirements shall be to the suppliers account. Final acceptance by the Contract Administrator will be conditional upon fulfillment of all requirements.

B. For equipment subject to inspection by a government ministry, department, or agency, submit original copies of the test data reports and all other documentation required for the final field inspection of the equipment by the government ministry, department or agency.

C. Following completion of the work, issue a history docket comprised of the quality certificates, inspection and test records, and all other relevant documents related to manufacture and testing for the Contract Administrator's record files.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

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

.2 ANSI C82.4-02(R2007), Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type.

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

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

.3 ASTM International Inc.

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

.4 Canadian Standards Association (CSA International).

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

.6 Underwriters' Laboratories of Canada (ULC).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

Part 2 Products

2.1 LAMPS

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

.2 LED lamps to be 4100 K to 4300 K colour temperature.

2.2 BALLASTS

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

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

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

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

.4 Current crest factor: 1.7 maximum.

.5 Harmonics: 10 % maximum THD.

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

.7 Total circuit power: 62 Watts.

.8 Ballast factor: greater than 0.90.

.9 Sound rated: Class A.

.10 Mounting: integral with luminaire.

2.3 FINISHES

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

2.4 OPTICAL CONTROL DEVICES

.1 Acceptable manufacturers and models:

.1 As indicated in luminaire schedule.

.2 Or approved equal in accordance with B7.

2.5 LUMINAIRES

.1 Acceptable manufacturers and models:

.1 As indicated in luminaire schedule.

.2 Or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

.1 Locate and install luminaires as indicated.

.2 Provide adequate support to suit ceiling system.

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

.1 Example: L73-2 (Panelboard PNL-L73, circuit 2)

3.2 WIRING

.1 Connect luminaires to lighting circuits:

.1 Install rigid aluminum conduit for luminaires as indicated.

3.3 LUMINAIRE SUPPORTS

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

3.4 LUMINAIRE ALIGNMENT

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

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for emergency lighting systems.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

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

1.3 SUBMITTALS

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

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

Part 2 Products

2.1 EQUIPMENT

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

.2 Supply voltage: 120 V ac.

.3 Output voltage: 12 V dc.

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

.5 Battery: sealed, maintenance free.

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

.7 Solid state transfer circuit.

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

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

.10 Lamp heads: integral on unit and remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: MR16, 12 W.

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

.12 Finish: white.

.13 Auxiliary equipment:

.1 Test switch.

.2 Battery disconnect device.

.14 Acceptable manufacturers and models:

.1 As indicated on the Luminaire Schedule,

.2 Or approved equal in accordance with B7.

2.2 WIRING OF REMOTE HEADS

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

Part 3 Execution

3.1 INSTALLATION

.1 Install unit equipment and remote mounted fixtures.

.2 Direct heads.

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

END OF SECTION