

## **1 General**

### **1.1 GENERAL**

- .1 This Section of the specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 The Contractor shall furnish all labour, materials and necessary tools and equipment to provide complete and operating electrical systems, as set forth on the plans and in these specifications and as called for elsewhere in the Contract Documents. Any work which is obviously necessary or reasonably implied to complete the work, even if not shown or specified, shall be carried out as if it were both shown and specified.

### **1.2 REFERENCES**

- .1 Reference: CEC C22.1-09, under C22.2 Appendix A - Safety Standards for Electrical Equipment, Canadian Electrical Code, Part II, Pages 346 to 360.
- .2 Reference: CEC-2012.

### **1.3 INTENT**

- .1 The electrical drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of the work. The Drawings are not to be scaled to determine accurate measurements. Take field measurements when material and equipment dimensions are dependent upon building features, process and mechanical installations.
- .2 The Drawings do not show all conduits, cables, fastenings and supports. Provide conduit, cables, cable trays, fastenings and supports as required to implement the drawings, process and instrumentation diagrams, schematics, riser diagrams, single line diagrams and all electrical documents.
- .3 The electrical drawings do not show every circuit that is to be installed under this Contract. Specific circuiting requirements for power circuits at the 208 V level are generally shown on the Drawings. Cables not shown on the cable schedules to be sized based on the equipment circuit breaker and in accordance with the Canadian Electrical Code (CEC). Circuits are to be installed per the specific information included here. The plan drawings provide the general locations for the equipment to be circuited.

### **1.4 SCOPE OF WORK**

- .1 The intent is to have backup emergency power for the Bowden Sewage Lift Station. Existing is a direct power feed from a utility pole transformer nearby rated for 25 kV stepping down to 120 V/208 V/3 Ø/ 4 wire. The scope of work is as follows:

- .1 Before removing existing panel "LS" rated for 120/208 V/3Ø/4 wire, 42 CCT 225 amp, located in sewage lift station, temporarily disconnect all existing wiring for all loads on Panel "LS". See Drawing E-001.
  - .2 Install new Panel "LS" type, POW-R-Line 1 225 A c/w distribution panelboard 42 CCTS, 120/208 VAC, 60 Hz into same location, then reconnect all existing loads as before. See new Drawing E-002.
  - .3 Run 2x2C#12 AWG, in 21 mm conduit from new wall mounted 100 W HPS, Class 1, Div. 2, Grp A, B,C D in wetwell to existing Type 2 incandescent lighting fixture in parallel, as per Drawing E-002.
  - .4 Run 2C#8AWG Teck 90 underground from generator battery charger to Panel "LS"CCT#26.
  - .5 Run 2C#8AWG Teck 90 underground from generator block heater to Panel "LS"CCT#28.
  - .6 Run 2C#8AWG Teck 90 underground from generator oil heater to Panel "LS"CCT#30.
  - .7 Remove existing manual transfer switch rating for 150 A, 3 P, 120 V/208 V, 3 phase, in sewage lift station as per Drawing E-001.
  - .8 Install new floor-mounted automatic transfer switch with manual bypass rated for 200 A, 120/208 V/3 Ø 4 W in place of existing manual transfer switch. Make sure of 1 meter clearance in front of new transfer switch to allow the racking of switch. Install transfer switch against wall.
  - .9 Remove existing 100 A 3Ø 4 W female receptacle, including conduit and wiring. Remove existing 100 A breaker, including conduit and wiring. See Drawing E-001.
  - .10 Install new pad-mounted diesel engine driven generator rated for 50 kW, 120/208 V3Ø, with a 3R (weatherproof) enclosure outside near the sewage lift station, as per Drawing E-002.
  - .11 Run 3C#4/0 in 53 mm conduit from 200 A breaker at pad-mounted diesel engine driven generator rated for 50 kW to auto transfer switch located inside lift station building. See new Drawing E-002.
  - .12 Remove existing 150 A breaker upstream of utility meter and replace with 200 A rated breaker as shown on Drawing E-001 and E-002.
  - .13 Remove all abandoned circuitry and conduit.
- .2 Operating facility; interruptions to normal operation to be limited to:
    - .1 No longer than 8 hours per shutdown.
    - .2 No more than 2 shutdowns.
    - .3 Pre-approval by Departmental Representative.
  - .3 Shutdown work plans (detailed) with contingency plan, pre-approved by Departmental Representative.

## **1.5 EXAMINATION OF THE SITE**

- .1 The project includes modifications to the existing electrical service in the Bowden Institution Sewage Lift Station. The Drawings for the existing Bowden Institution Sewage Lift Station are to be considered as representative only, they may not necessarily indicate the true as-built conditions.
- .2 Prior to submitting Tender, the Contractor shall visit the site and thoroughly investigate locations, connections and details of all services and systems which in any way affect or tie-in with work of these specifications and drawings.
- .3 No extra payment will be allowed for work resulting from conditions which would have been evident upon a thorough examination of the site.
- .4 Notify Departmental Representative, in writing, seven (7) days prior to Tender closing date of any discrepancies or points of doubt or contention. Failing this, allow in the Tender for the most expensive course of action.

## **1.6 CODES AND STANDARDS**

- .1 Do complete installation in accordance with the Canadian Electrical Code, latest edition, except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No. 1, except where specified otherwise.
- .3 Abbreviations for electrical terms to CSA Z85.

## **1.7 VOLTAGE RATINGS**

- .1 Operating voltages: to CAN3-C235.
- .2 Distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

## **1.8 PERMITS, FEES AND INSPECTION**

- .1 The Contractor shall submit to Electrical Inspection Department and utility, the necessary number of drawings and specifications for examination and approval prior to commencement of Work.
- .2 Notify Departmental Representative of changes required by Electrical Inspection Department prior to making any changes.
- .3 The Contractor shall obtain all permits, pay all fees levied and furnish Certificates of Acceptance from Electrical Inspection Department and other authorities having jurisdiction on completion of work to Departmental Representative.

## **1.9 MATERIAL AND EQUIPMENT**

- .1 Equipment and material shall be new and CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department. This approval to be arranged with knowledge of this by the Departmental Representative.
- .2 Factory assemble control panels and component assemblies.

## **1.10 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.
- .2 Paint outdoor electrical equipment ASA 70 grey finish.
- .3 Paint indoor enclosures to ASA 61 light grey.
- .4 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint. Equipment with scratches, dents or other damage that cannot be completely restored by painting shall be replaced.
- .5 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.
- .6 Where unistrut has been cut, treat the exposed cut area with rust inhibitor.

## **1.11 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates and labels as follows:
  - .1 Nameplates to be 20 mm high, 75 mm long, 1.5 mm thick, laminated acrylic reverse engraved, back painted Romark "Ultra Mattes", Helvetica font (0.040 cutter) reverse engraved letters. Colour: Black 3/4-401 with reverse engraved white letters.
  - .2 Lamicoids to be attached to the equipment with double sided tape or screws. If this cannot be achieved, lamicoids to be suspended from the equipment with #6 stainless steel bead chain. At no time should an attached lamicoid cover a nameplate or cause an indicator/display to become unreadable.
  - .3 Labels to be embossed plastic labels with 6 mm high letter, unless specified otherwise.
- .2 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .3 Allow for average of twenty-five (25) letters per nameplate and label.
- .4 Identification to be English.

- .5 Nameplate for splitter to indicate equipment being controlled, its power source and a circuit number.
- .6 Disconnects: indicate equipment being controlled and voltage.
- .7 Include as-built wiring diagrams in all electrical equipment.

#### **1.12 WIRING IDENTIFICATION**

- .1 Identify wiring with machine-printed markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders, and branch circuit and control wiring.
- .2 WRITE-ON LABELS ARE NOT ACCEPTABLE.
- .3 Maintain phase sequence and colour coding throughout.
- .4 Colour code: to CSA C22.1.
- .5 Use colour coded wires in communication cables, matched throughout system.

#### **1.13 CONDUIT AND CABLE IDENTIFICATION**

- .1 Tag conduits, boxes and armoured cables with identification as indicated on the drawings and in these specifications. Use engraved tags as specified in this section.
- .2 Tag where conduit or cable enters a panel or equipment.
- .3 Tags to be lamicoid, reverse engraved white letters and two (2) holes on each end. Strap to cable using black tie-wraps.

#### **1.14 WIRING TERMINATIONS**

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

#### **1.15 MANUFACTURER'S AND CSA LABELS**

- .1 Visible and legible, after equipment is installed.

#### **1.16 WARNING SIGNS**

- .1 Supply and install red warning nameplate on the front of all equipment fed from two (2) separate voltage sources "More than one live power source."

#### **1.17 CONDUIT AND CABLE INSTALLATION**

- .1 Where located in concrete, install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel or PVC pipe, sized for free passage of conduit, and protruding 50 mm.

- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation. Alternatively, if sleeve must be left in place, trim the pipe so it is flush with the wall or floor material.
- .3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .4 Clean all conduits and Teck cables from dust and debris at the end of construction before the facility is turned over to the Departmental Representative.

## **1.18 FIELD QUALITY CONTROL**

- .1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentice 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 Electrician contractor license as issued by the province that the Work is being constructed.

## **2 Products**

- .1 Not Used.

## **3 Execution**

- .1 Not Used.

**END OF SECTION**

## **1 General**

### **1.1 WORK OUTLINE**

- .1 This Section relates to wire and cable, 0 to 1000 V for this installation.

### **1.2 REFERENCES**

- .1 Reference: CEC C22.1-09, under C22.2 Appendix A - Safety Standards for Electrical Equipment, Canadian Electrical Code, Part II, Pages 346 to 360.
- .2 Reference: CEC-2012.

## **2 Products**

### **2.1 WIRES AND CABLES 0 TO 1000 V**

- .1 Refer to cable schedules on the drawings for cable tag, size and type of cables. Also, refer to Section 26 05 00 - Common Work Results for Electrical for information on conduit and cable schedule requirements.
- .2 Teck Cable
  - .1 Teck cable to CSA C22.2 No. 131-M and constituted of:
    - .1 Grounding conductor copper.
    - .2 Circuit conductors copper sized as indicated.
  - .2 Insulation:
    - .1 Chemically cross-linked thermosetting polyethylene type RW90 rated to 1000 V.
    - .2 Inner jacket: thermoplastic polyvinyl chloride material.
  - .3 Armour: aluminum.
  - .4 Overall covering: polyvinyl chloride material, fire retardant marked as FT4.
- .3 Fastenings
  - .1 One (1) hole malleable iron straps to secure surface cables 50 mm and smaller. Two (2) hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two (2) or more cables at 1000 mm centres.
- .4 Teck Connectors
  - .1 Choose connectors to suit cable diameters as recommended by manufacturer.
  - .2 Connectors are to be copper free aircraft-grade aluminum for multi and single conductor cables, liquid and dust tight, Thomas & Betts "Star Teck" ST Series.

.3 Install Thomas & Betts sealing rings for all exterior connections to motors, control stations, terminal cabinets, etc.

.4 Teck connectors shall be sized and installed in accordance with the recommendations of the cable manufacturer.

### **3 Execution**

#### **3.1 INSTALLATION OF WIRES AND CABLES 0 TO 1000 V**

- .1 Install wires and cables in conduits where indicated and in accordance with manufacturer's instructions.
- .2 Conduits and cables to be tagged in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .3 Where cables pass through poured concrete or masonry, install sleeves for the cables and provide seals where cables continue through walls or floors.
- .4 In-line splices are not permitted.
- .5 Provide mechanical protection for cables which are turned up above the floor through sleeves or slots. Provide channels, angle sills or rigid conduit sleeves.
- .6 Where cables cannot be run in tray, support on Unistrut channels at 1 m intervals. Run cables parallel to the lines of the building. Bends to be concentric. Group cables wherever possible in a neat fashion.
- .7 Fasteners for all cables on Unistrut channels shall be cable clamp type. Use non-ferrous channels and fasteners in wet locations and on single conductor cables.
- .8 Care shall be taken to ensure that cable jacket is not damaged by application of the clamps.
- .9 Cinch anchors shall be used to fasten the Unistrut brackets to walls. Concrete beams shall not be drilled without prior authorization by the Departmental Representative. Care shall be taken in drilling concrete blocks or masonry work to ensure the surface will not be cracked.
- .10 Power actuated fastening tools, e.g., Hilti, shall not be used without written approval from the Departmental Representative.
- .11 Where vertical runs are required and walls, columns or equipment supports are not adjacent, Unistrut channels complete with beam clamps and floor anchor plates shall be provided. Unistrut sections for this purpose shall be sized as required.
- .12 Any damage to the jacket of armoured cable shall be immediately repaired in accordance with the manufacturer's recommendation.



### **3.2 GROUND CONDUCTORS IN CONDUITS**

- .1 Ensure that every conduit is provided with a ground conductor with ampacity to meet Code.

**END OF SECTION**



## **1 General**

### **1.1 WORK OUTLINE**

- .1 Provide connection lugs at all 120/208 V.

### **1.2 REFERENCES**

- .1 Reference: CEC C22.1-09, under C22.2 Appendix A - Safety Standards for Electrical Equipment, Canadian Electrical Code, Part II, Pages 346 to 360.
- .2 Reference: CEC-2012.

## **2 Products**

### **2.1 CONNECTORS AND TERMINATIONS**

- .1 Copper long barrel or short barrel compression connectors as required sized for conductors for 120/208 V connections.

## **3 Execution**

### **3.1 INSTALLATION**

- .1 Install terminations and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required.

**END OF SECTION**



## **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 datasheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

### **1.2 REFERENCES**

- .1 Reference: CEC C22.1-09, under C22.2 Appendix A - Safety Standards for Electrical Equipment, Canadian Electrical Code, Part II, Pages 346 to 360.
- .2 Reference: CEC-2012.

### **1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 All waste shall be managed and disposed of in accordance with Section 01 74 21.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

## **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.
- .3 Supply NEMA 3R.

### **2.2 CABINETS**

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle and catch, for surface mounting.
- .2 Type T, sheet steel cabinet with hinged door, latch, lock 2 keys, containing 19 mm G1S plywood backboard, for surface mounting.

- .3 Supply NEMA 3R.

### **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.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. 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 00 - Common Work Results for Electrical.
- .2 Install nameplates indicating equipment being controlled, its power source and a circuit number as specified in Section 26 05 00 - Common Work Results for Electrical.

**END OF SECTION**

## **1 General**

### **1.1 RELATED SECTIONS**

- .1 This Section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### **1.2 REFERENCES**

- .1 Reference: CEC C22.1-09, under C22.2 Appendix A - Safety Standards for Electrical Equipment, Canadian Electrical Code, Part II, Pages 346 to 360.
- .2 Reference: CEC-2012.

### **1.3 SUBMITTALS**

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

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Material Delivery Schedule: Provide Departmental Representative with schedule within two (2) weeks after award of Contract.

### **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 All waste shall be managed and disposed of in accordance with Section 01 74 21 - Construction Waste Management.

## **2 Products**

### **2.1 CAST OUTLET BOXES**

- .1 Size boxes in accordance with CSA C22.1-09.
- .2 Blank cover plates for boxes without wiring devices.
- .3 102 mm<sup>2</sup> or larger outlet boxes as required.
- .4 Gang boxes where wiring devices are grouped.
- .5 Combination boxes with barriers where outlets for more than one (1) system are grouped.
- .6 One-piece electro-galvanized cast construction.

- .7 Utility boxes for outlets connected to surface mounted electrical metallic tubing (EMT) conduit, minimum size 102 mm x 54 mm x 48 mm.
- .8 102 mm square or octagonal outlet boxes for lighting fixture outlets.

## **2.2 CONCRETE BOXES**

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

## **2.3 CONDUIT BOXES**

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

## **2.4 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.

## **2.5 AREA CLASSIFICATION**

- .1 Indoors: NEMA 12.
- .2 Outdoors: NEMA 3R

# **3 Execution**

## **3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar authorized material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit and armoured cable connections. Do not install reducing washers.



- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

**END OF SECTION**



## **1 General**

- .1 Reference: CEC C22.1-09, Canadian Standards Association (CSA International).
  - .1 CAN/CSA C22.2 No. 18-(98(R..), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware - a National Standard of Canada.
  - .2 CSA C22.2 No. 45-(M1981(R..)), Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56-(04), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No.83-(M1985(R..)), Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2-(M1984(R...)), Rigid PVC (unplasticized) Conduit.
  - .6 CAN/CSA C22.2 No. 227.3(05), Non-metallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).
- .2 Reference CEC-2012.

## **2 Products**

### **2.1 SUPPORT CHANNELS**

- .1 U shape, size 41 mm by 41 mm, 2.5 mm thick, surface mounted or suspended as required.

## **3 Execution**

### **3.1 INSTALLATION**

- .1 Secure equipment to poured concrete with expandable inserts.
- .2 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole malleable iron steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .3 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips or as required.
  - .2 Support two (2) or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical or as required.

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- .4 For surface mounting of two (2) or more conduits use channels at 1.5 m on centre spacing.
  - .5 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support cable conduit and cabletray.
  - .6 Ensure adequate support for raceways and cabletray dropped vertically to equipment where there is no wall support.
  - .7 Do not use wire lashing or perforated strap to support or secure raceways or cabletray.
  - .8 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
  - .9 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
  - .10 Install fastenings and supports as required for each size and type of cabletray in accordance with manufacturer's installation recommendations.
  - .11 All supports, brackets, suspended columns, fittings and support accessories for cabletray supports shall be assembled from factory formed materials.
  - .12 Acceptable manufacturers: Cantruss, Unistrut and C-Channel.

**END OF SECTION**

## **1 General**

- .1 Reference: CEC C22.1-09, under C22.2 Appendix A - Safety Standards for Electrical Equipment, Canadian Electrical Code, Part II, Pages 346 to 360.
- .2 Reference: CEC-2012.

## **2 Products**

- .1 Not Used.

## **3 Execution**

### **3.1 CABLE INSTALLATION IN CONDUIT**

- .1 Install cables in ducts or conduit sleeves where indicated.
- .2 Do not pull spliced cables inside conduit sleeves.
- .3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .4 Before pulling cable into conduit and until cables properly terminated, seal ends of cables with moisture seal tape.
- .5 Install in each conduit a 6 mm stranded polypropylene pull rope continuous throughout each conduit run with 3 m spare rope at each end. Pull rope to remain inside the conduits after cables have been pulled through.
- .6 After installation of cables, seal conduit ends with duct sealing compound and seal all wall and/or roof penetrations to form a completely leak proof system.
- .7 CAP off all spare conduits.

### **3.2 TESTING**

- .1 Perform tests using qualified testing firm and in the presence of the authorized representative for the Departmental Representative.
- .2 Acceptance tests:
  - .1 Ensure that terminations and accessory equipment are disconnected.
  - .2 Ground shields, ground wires, metallic armour and conductors not under test.
  - .3 Megger testing:

- .1 Conduct megger testing in accordance with Manufacturer's or IPCEA recommendations.
- .2 Resistance to ground of circuits shall be 50 megohms or greater.
- .3 Remove and replace entire length of cable, if cable fails to meet any of the test criteria recommended by the applicable cable standard, Manufacturer or Departmental Representative.
- .4 Check phase rotation and identify each phase conductor of each feeder.

**END OF SECTION**

## **1 General**

### **1.1 RELATED SECTIONS**

- .1 This Section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.2 No. 29, Panelboards and enclosed Panelboards.
- .2 Reference: CEC C22.1-09, under C22.2 Appendix A - Safety Standards for Electrical Equipment, Canadian Electrical Code, Part II, Pages 346 to 360.
- .3 Reference: CEC-2012.

### **1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 All waste shall be managed and disposed of in accordance with Section 01 74 21 - Construction Waste Management.

## **2 Products**

### **2.1 PANELBOARDS**

- .1 Panelboards: to CSA C22.2 No. 29 and product of one (1) manufacturer:
  - .1 Install circuit breakers in panelboards before shipment.
  - .2 In addition to CSA requirements manufacturers' nameplate must show fault current that panel including breakers has been built to withstand.
- .2 208/120 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 Two keys for each panelboard and key panelboards alike.
- .6 Copper bus with neutral of same ampere rating as mains.
- .7 Mains: suitable for bolt on breakers.
- .8 Trim with concealed front bolts and hinges.
- .9 Trim and door finish: ASA 70 grey.
- .10 Isolated ground bus for the 208/120 V panel.
- .11 NEMA 12 in electrical room, NEMA 4X in sprinkler assembly room.
- .12 Authorized manufacturer: Eaton - Cutler hammer, POW-R-Line1 or approved equal.

## **2.2 BREAKERS**

- .1 Breaker to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock on devices for fire alarm, and emergency lighting circuits.
- .5 Panel fill as per drawings and schedules.
- .6 Provide spare breakers as per panel schedules.

## **2.3 EQUIPMENT IDENTIFICATION**

- .1 Complete circuit directory with typewritten legend showing location and load of each circuit.

## **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.



- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

### **3.2 CLEANING**

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

**END OF SECTION**



## **1 General**

### **1.1 REFERENCES**

- .1 Reference: CEC C22.1-09, under C22.2 Appendix A - Safety Standards for Electrical Equipment, Canadian Electrical Code, Part II, Pages 346 to 360.
- .2 Reference: CEC-2012.

## **2 Products**

### **2.1 BREAKERS GENERAL**

- .1 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .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. Trip settings on breakers with adjustable trips to range from 3 to 8 times current rating.
- .4 Circuit breakers with interchangeable trips as indicated.
- .5 Minimum interrupting capacity:
  - .1 120/208 V breakers: 10,000 A symmetrical.

### **2.2 THERMAL MAGNETIC BREAKERS [DESIGN A]**

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

### **2.3 OPTIONAL FEATURES**

- .1 The following features are to be provided where indicated.
  - .1 On-off locking device.
  - .2 Handle mechanism.

### **2.4 ENCLOSURE**

- .1 All indoor enclosures to be EEMAC 1.

**3 Execution**

**3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

**END OF SECTION**

## **1 General**

### **1.1 GENERAL**

- .1 Provide for the Departmental Representative, automatic, unattended, emergency power supply system consisting of:
  - .1 Liquid cooled high voltage diesel electric generating unit with control panel.
  - .2 Accessories and equipment specified in this specification.
- .2 Provide design, fabrication, testing, transportation, demonstration and guarantee of the equipment.

### **1.2 REFERENCES**

- .1 Reference: CEC C22.1-09, under C22.2 Appendix A - Safety Standards for Electrical Equipment, Canadian Electrical Code, Part II, Pages 346 to 360.
- .2 Reference: CEC-2012.

### **1.3 DESIGN CRITERIA**

- .1 Design equipment suitable to meet the following criteria:
  - .1 Total load: 31 kW.
  - .2 Motor load: 14.92 kW.
  - .3 Largest motor: 7.46 kW.
  - .4 Voltage: 120/280 V.
  - .5 Frequency: 60 Hz.
  - .6 Phase/Wire: 3/4.
  - .7 Power factor: 0.8.
  - .8 Load harmonic content: 20% THD.
  - .9 Maximum rotational speed: 1900 rpm.
  - .10 Interrupting capacity: 10 kA.
  - .11 Duty rating: full load continuous plus 10% overload for 1h in every 12h period.
  - .12 Performance: automatic.
  - .13 Elevation above sea level: 998 m.
  - .14 Ambient temperature: 40°C.
  - .15 Relative humidity: 60%.

- .2 Unit must be capable of starting, attaining settled voltage and frequency limits and accepting full rated load with voltage and frequency settling to the specified steady state bands, all within 15 seconds for any temperature between 0°C to 40°C.
- .3 Use engine manufacturer's standard, published continuous horsepower rating in assessing engine capacity and de-rate this rating for the specified conditions and engine driven accessories in accordance with latest revisions of ISO3046/1.
- .4 Description of generating set operation:
  - .1 Automatic starting on abnormal or loss of normal voltage: voltage sensing relays shall sense all three phases of the utility supply. If the voltage on any one phase should drop below preset limits (adjustable) for an adjustable period of time, the engine start contact shall close and cause the engine to start.
  - .2 When the emergency supply has reached settled voltage and frequency preset limits (adjustable) the transfer switch will transfer the load to the emergency supply.
  - .3 The set will continue to supply the load until utility supply returns or the set is shut down manually or under failure conditions.
  - .4 On utility restoration, confirmed by three phase sensing of voltage above an adjustable preset, for a time period in excess of three minutes (adjustable), the transfer switch will transfer the load to the utility supply. Provide a dead bus timer to allow motor starters to drop out and motors to stop prior to connecting to utility.
  - .5 An adjustable time delay relay shall allow the engine to run unloaded to cool down and subsequently to shut down, ready for the next cycle.
  - .6 The engine shall be equipped with a key switch with the following positions: auto-off-crank-start, key removable in auto position only.
  - .7 Automatic shut down on
    - .1 Overcranking
    - .2 Overspeed
    - .3 High Engine Temperature
    - .4 Low lubricating oil pressure
    - .5 Over and under frequency
    - .6 Emergency breaker failure
    - .7 Electrical fault lock-out on short circuit and generator over and under voltage.

#### **1.4 QUALITY ASSURANCE**

- .1 All work shall meet requirements of Quality Standard CSAZ299.3.

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## **1.5 LOCATION OF PROJECT**

- .1 Project to be located at site.

## **1.6 TENDER REQUIREMENTS**

- .1 Include the following in tender: 1) Detailed description and specification of diesel engine, generator and auxiliary equipment; 2) Calculations of unit power output.
  - .1 Sample of technical literature and specifications in English.
  - .2 List of tools to be supplied with unit.
  - .3 List of spare parts to be supplied with unit.
  - .4 Detailed description of test facilities available at this factory to test unit; identify load bank capacity type (resistive, reactive, non-linear).
  - .5 Description of service facilities in Canada.
  - .6 Description of special features.
  - .7 List of optional accessories, other than those specified, which may be available for engine, with current unit price.
  - .8 Evaluation of Canadian content.
- .2 Manufacturer Qualification: a minimum of five years' experience in the design, manufacture, assembly and testing of diesel generator systems is required. Provide details of the experience, in the tender.
- .3 Departmental Representative reserves the right to reject any bid in the event that the above information, or any part thereof, is not furnished with the bidder's proposal.

## **1.7 SHOP DRAWINGS**

- .1 Submit within 2 weeks of contract award 6copies of shop drawing for review to Departmental Representative.
- .2 One copy of each drawing will be returned to the contractor within 2 weeks of receipt as reviewed, reviewed as noted, or rejected. Contractor shall incorporate changes identified on the drawings and resubmit the drawings for further review within two weeks.
- .3 Do not proceed with fabrication of equipment until review process is completed.
- .4 Maximum sheet size 86cm x 112cm.
- .5 Quality of all drawings to be suitable for microfilming purposes.
- .6 Shop drawings and specifications shall include, but not be limited to, the following:

- .1 Engine: make, model, rating and performance curves.
  - .2 Starter motor, make model.
  - .3 Generator: make, model and rating complete with generator saturation curves, heat damage curves, reactive capability and special data.
  - .4 Voltage regulator: make, model, type.
  - .5 Governor: type, model.
  - .6 Battery: make, type, voltage, capacity.
  - .7 Charger: make, model, input and output rating.
  - .8 Submit a general outline drawing of the complete assembly showing engine, radiator and generator mounting, exhaust, recirculating and intake air louvre arrangement, exhaust gas silencer and pipe arrangement, locations of fuel and lubricating oil filters, fuel supply and return line connections, lubricating oil drain valve, radiator and coolant drain valves, air cleaner, engine instrument panel, starting motor, power and control junction boxes, engine and generator mounting feet. Indicate on drawings horizontal and vertical dimensions, minimum door opening required for moving the unit, head room required for removal of piston and connecting rod, and weight of engine, generator, baseplate, radiator and exhaust silencer.
  - .9 Identify exact locations and details where necessary of interconnecting services to permit final Departmental Representativeing by the Departmental Representative.
  - .10 Baseplate construction details and materials.
  - .11 Outline and layout of all panels.
  - .12 Schematic and wiring diagrams of engine, generator, control panel, automatic transfer isolation complete with interconnecting wiring diagrams.
  - .13 Single line diagram showing all breakers, switches, metering and protective relays.
  - .14 Field wiring diagrams.
  - .15 Complete bill of materials, including manufacturer's name, catalogue numbers and capacity.
- .7 Express all dimensions and data in metric units and symbols followed by in bracket imperial units and symbols wherever applicable, CSAZ234.1, Metric Practice Guide.
  - .8 Device Numbering System shall be in accordance with IEEE200 Reference Designations for Electrical and Electronics Parts and Equipment.
  - .9 Responsibility for errors and omissions in the drawings submittal is not relieved by review of submittals by the Departmental Representative.
  - .10 Responsibility for deviations in drawings submittal from contract requirements is not relieved by the Departmental Representative review of submittals unless the Departmental Representative gives in writing acceptance of specified deviations.



## **1.8 MAINTENANCE DATA AND INSTRUCTION MANUALS**

- .1 Provide, but not be limited to, the following in English for incorporation into instruction manuals:
  - .1 Complete set of reviewed shop drawings.
  - .2 Factory test data of engine, generator, exciter, control logic, metering and all other pertinent test data.
  - .3 Maintenance and operation bulletins for:
    - .1 Engine and Accessories
    - .2 Generator
    - .3 Voltage Regulator and Accessories
    - .4 Exciter
    - .5 Permanent magnet generator if installed
    - .6 Battery charger
    - .7 Speed Governor
    - .8 Starting Motor
    - .9 Batteries
    - .10 Ventilating Equipment
    - .11 Timers, Relays, Meters
    - .12 Power Circuit Breakers
    - .13 Controller, Contactors
    - .14 Other Accessories
  - .4 If brochures are submitted, these shall be originals; photocopies are not acceptable. Brochures shall contain all technically relevant data.
  - .5 Complete sequence of system operation.
  - .6 Complete bill of materials including nameplate data of equipment and accessories.
- .2 Forward, two weeks prior to the factory tests, one copy of instruction manual for each unit of different ratings to Departmental Representative.
- .3 Forward, within two weeks after the factory tests, three copies of instruction manuals, with updated drawings, for each unit of different ratings, to Departmental Representative. Submit one set of sepias along with the manuals. Where more than one unit of identical ratings is supplied on the same purchase order, provide three copies for the first unit, two copies per unit for each succeeding unit, up to a total of six units, one copy per unit for each additional unit above this amount.

- .4 Crate with each unit, one copy of instruction manual, with updated drawings, plus one extra loose set of drawings all in protective cover.
- .5 Bind in 25cm x 30cm, vinyl hard covered, 3 D ring loose leaf binders.
- .6 Enclose title sheet, project name, date and list of contents.
- .7 Identify binders on the spine with Departmental Representative identification designation and electrical ratings.

## **1.9 DELIVERY AND STORAGE**

- .1 Prepare and crate all equipment to be supplied for protection against shipping and storage damage.
- .2 Provide a minimum 12.5 mm plywood outer covering single vapour barrier inside.
- .3 Provide a minimum 20 mm plywood outer covering with one side finished and double vapour barrier and sufficient desiccant for one year's remote storage.
- .4 Mount unit and panel on shipping skids with plank floor.
- .5 Each package to have shipping weight, address, dimensions and department number and brief description of contents clearly stencilled on at least two sides. Staple on the outside a packing list contained in a waterproof envelope. Place a copy of packing list inside. Mail additional copies to consignee and to Departmental Representative.

## **1.10 GUARANTEE**

- .1 Provide a written guarantee signed and issued in the name of Her Majesty the Queen in right of Canada stating that the complete assembly consisting of the diesel generator unit and all equipment and accessories is guaranteed against defects and malfunction for a period of one year from the date of installation or two years from the date of factory delivery whichever is the lesser.

## **1.11 SPARES**

- .1 For panels provide the following:
  - .1 One spare control circuit breaker per rating.
  - .2 Three spare indicating light bulbs per rating.
  - .3 One spare control relay and socket per rating and contact arrangement.
  - .4 One spare contactor operating coil.
- .2 Provide for the generator unit, a standard set of engine manufacturer's spare parts for one year normal operation. Spares to include as a minimum.

- .1 Six fuel filter elements for each type of fuel filter/water separator.
- .2 Six lubricating oil filter elements.
- .3 three air cleaner elements.
- .3 Where metric size nuts and bolts are used, provide one set of sockets complete with ratchet handle and set of combination wrenches, to fit all sizes used.
- .4 Provide conclusive evidence that a Canadian distributor has been established and will stock in Canada spare parts likely to be required during the normal life of the engine.

## **1.12 ACCEPTANCE TESTS**

- .1 General: before acceptance, assemble and set up the unit, complete with specified equipment, for tests at the supplier's plant. Tests shall be witnessed by an officer of Departmental Representative on a date mutually agreed on. Provide suitable test area with adjustable loading facilities. Supplier shall ensure that the engine has run in sufficiently prior to load test, all test forms filled in, system debugged and recorders connected.
- .2 Examination of product: a complete mechanical and electrical examination to determine compliance with specification and drawings with respect to materials, workmanship, dimensions and marking.
- .3 Non-operational tests and checks: perform following test and checks before starting the unit:
  - .1 Shaft alignment, end float, angular and parallel.
  - .2 Cold resistance of generator windings.
  - .3 Belt tensioning.
  - .4 Equipment grounds.
  - .5 Electrical wiring.
  - .6 All grease lubricating points.
  - .7 Personnel safety guards.
  - .8 Air cleaner.
  - .9 Coolant.
  - .10 Lubricating oil type and level.
  - .11 Type of fuel.
  - .12 Vibration isolator adjustment.
  - .13 Temperature and pressure sensors.
  - .14 Engine exhaust system.

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- .15 Tools.
  - .16 Spares.
  - .4 Operation test and check: on completion of paragraph 1.12.3, start the unit cold. Provide multi-channel recorder and record the following:
    - .1 Time for unit to start and reach settled voltage and frequency.
    - .2 Time from initiation of start to full load application, with voltage and frequency settled.
    - .3 Voltage and frequency transient and steady state limits for full load to no load,  $\frac{3}{4}$  load to no load,  $\frac{1}{2}$  load to no load,  $\frac{1}{4}$  load to no load and vice versa. Measure machine vibration levels under the same load conditions.
    - .4 Record battery voltage drop during cranking.
  - .5 Protection and control demonstration: on completion of paragraph 1.12.4, demonstrate the following:
    - .1 Overheat protection.
    - .2 Low oil pressure protection.
    - .3 Cranking cut out.
    - .4 Overcrank protection (3tries).
    - .5 Overspeed protection.
    - .6 Under and over frequency.
    - .7 Under and over voltage.
    - .8 Electrical fault protection:
      - .1 Failure to close breaker.
      - .2 Failure to build up voltage.
      - .3 Generator short circuit and overcurrent.
    - .9 All control functions.
  - .6 Load tests: load test the unit for 24 h at full rated load and a further 1 h at 110% rated load in ambient room temperature of 40°C. Take following data at the start of load test and every one hour interval thereafter:
    - .1 Frequency.
    - .2 Voltage.
    - .3 Current.
    - .4 Kilowatts.
    - .5 Generator winding temperature.

- .6 Generator frame temperature.
  - .7 Engine coolant temperature.
  - .8 Oil temperature and pressure.
  - .9 Manifold pressure.
  - .10 Ambient room temperature.
  - .11 Generator cooling air outlet temperature.
  - .12 Exciter field current and voltage.
  - .13 Vibration displacement.
  - .14 Ambient air temperature inside panel with all doors closed.
- .7 Miscellaneous: provide an accurate means for determining fuel and lubricating oil consumption. Provide strip chart recorders for monitoring frequency, voltage and load. Recorder shall have a selection of speeds to allow accurate measurement of voltage, frequency and time during the tests. The recorder shall have been calibrated by the recorder manufacturer (or designated representative) within three months of the factory testing.
- .8 Interpretation of ambient room temperature: consider ambient room temperature as that temperature, which is the lowest temperature registered out of a group of three thermometers when placed in engine room as follows:
- .1 One thermometer located on each side of the engine block, approximately two-thirds of the length of the block back from front (radiator) end of block, 900 mm out from block and at a height equal to height of block. A third thermometer located over end of exciter on the unit centre line, approximately 150 mm above top of exciter.
  - .2 Take the thermometer showing the lowest temperature to give true ambient air temperature. Adjust temperature to maintain this thermometer at 40°C during heat test.
- .9 Voltage and frequency regulation tests: on completion of load tests take the hot resistance reading of generator windings. Subject the unit to hot voltage and frequency regulation tests for full load to no load,  $\frac{3}{4}$  load to no load,  $\frac{1}{2}$  load to no load,  $\frac{1}{4}$  load to no load and vice versa.
- .10 Panel performance and functions: check sequence of operation under service conditions. Make provision for supplying and connecting required levels of voltage for primary circuits. Test overcurrent relays by impressing current in secondary circuits.
- .11 Hi-pot tests: perform over potential tests on primary and secondary wiring in accordance with appropriate EEMAC Standard.
- .12 Additional tests: perform any tests, consistent with the contract, which the Departmental Representative's representative may require to satisfy himself of the adequacy and satisfactory operation of the unit.

- .13 Supplier shall complete the forms with the requisite information pertaining to make, model and serial numbers prior to the test.
- .14 Supplier shall record all test data on the appendix forms, recording charts and manufacturers' test forms and be complete with diagrams and description of test results, deficiencies and corrective action. Test data sheets shall be signed by the supplier and Departmental Representative's representative.

## **1.13 REFERENCES**

- .1 Canadian Standards Association (CSA).
- .2 Electrical and Electronic Association Manufacturers of Canada (EEMAC).
- .3 National Electrical Manufacturers Association (NEMA).
- .4 American National Standards Institute (ANSI).
- .5 Institute of Electrical and Electronic Departmental Representatives (IEEE).
- .6 American Society of Mechanical Departmental Representatives (ASME).
- .7 American Society for Testing and Materials (ASTM).
- .8 Society of Automotive Departmental Representatives (SAE).
- .9 Canadian Government Specifications Board (CGSB).
- .10 International Standards Organization (ISO).

## **2 Products**

### **2.1 MANUFACTURERS**

- .1 Generac.
- .2 Cummins.
- .3 Kubota.

### **2.2 ASSEMBLY**

- .1 Provide the following items plus such other items as necessary to make the unit complete as implied or intended:
  - .1 Diesel Engine.
  - .2 Diesel Engine Accessories.
  - .3 Baseplate and Drip Pan.

- .4 Vibration isolators.
- .5 Governor.
- .6 Engine Exhaust System.
- .7 Engine Cooling System.
- .8 Engine Ventilating System.
- .9 Starting Motor(s).
- .10 Batteries and Rack.
- .11 Battery Charger.
- .12 Generator and Exciter.
- .13 Voltage Regulator and Accessories.
- .14 Spares and Accessories.

## **2.3 MOUNTING**

- .1 Connect engine flywheel housing rigidly to generator stator housing with SAE adapter. Mount unit on a common, heavy duty fabricated steel baseplate. Design and materials of baseplate must be approved by engine manufacturer and Departmental Representative.
- .2 Baseplate of sufficient rigidity to maintain alignment of engine-generator shafts and frames under all conditions incident to shipping, installation and service.
- .3 Machine engine-generator feet and baseplate sole plates parallel and true. Shimming to be steel type and only permitted underneath the generator feet.
- .4 Support baseplate on spring type isolating fixtures from welded side brackets located in such a manner that bottom of baseplate will be approximately 25 mm above supporting floor. Isolators shall have cast iron housings and be complete with levelling bolts, adjustable oil proof snubbers and minimum 6 mm sound pads. Isolation efficiency to be not less than 95%.
- .5 Determine quantity and location of isolators in such a manner that each isolator will carry equal proportion of weight and that the pressure exerted on the floor by each isolator does not exceed 345 kPa.
- .6 Isolators shall be shipped loose for installation at project site.

## **2.4 DIESEL ENGINE**

- .1 Full diesel, heavy duty, cold start, liquid cooled, vertical in-line or vee, and current manufacture of a type and size that has been service as a prime mover for electric power generation for not less than two years. Turbo supercharged engine acceptable

- providing brake mean effective pressure (BMEP) at rated output does not exceed 1800kPa (225psi). Mechanically driven superchargers not acceptable.
- .2 Engine shall have a minimum of four (4) cylinders.
  - .3 Engine with auxiliary starting aids (e.g., glow plug assist start) not acceptable.
  - .4 Equip engine air intakes with dry type heavy duty air cleaners located close to the inlet manifold. Cleaner element to be directly replaceable with elements of Canadian manufacture.
  - .5 Provide engine wiring in liquid-tight conduit and fittings with insulated bushings. Use stranded, minimum No.14AWG, TEW 105°C and coloured coded wires. Terminate wiring with coded, insulated terminals flanged fork type. Terminal blocks heavy duty, screw type. Wire markers of slip on oil proof type. Junction boxes on unit of liquid-tight type. Maximum of two wires per terminal block.
  - .6 Provide high quality lubricating oil pressure gauge, lubricating oil temperature gauge, tachometer, coolant temperature gauge thermocouple, exhaust pyrometer and other standard gauges and instruments. Calibrate and scale gauges and instrument in both metric and imperial units and symbols. Oil temperature sensors to be mounted on engine full flow pressure line. Hoses or tubing for gauges shall be high pressure reinforced type.
  - .7 Mount unit accessories, including gauges, instruments, and protective sensors, in such a manner that machine vibrations are isolated or damped.
  - .8 Dynamically balance complete engine-flywheel generator arrangement after assembly. Guarantee no torsional or other harmful vibrations within 10% above or below rated speed of unit, when operating unloaded or connected to any load within its rating. Cyclic irregularity to be no greater than 1/250.
  - .9 Provide engine flywheel with graduated marking around its periphery to facilitate fuel injection and valve timing.
  - .10 Provide removable wet type cylinder liners. Furnish cylinder head with removable valve seat insert and guides.
  - .11 Provide personnel safety guards for exposed moving parts and exhaust manifolds. Provide platform for servicing upper part of engine where applicable.
  - .12 Engine control panel shall be complete with:
    - .1 Lubricating oil pressure gauge.
    - .2 Lubricating oil temperature gauge.
    - .3 Coolant temperature gauge.



- .4 Low coolant level gauge.
- .5 Engine switch auto-off-crank-start selector switch and crank pushbutton.
- .6 D.C. main power supply circuit breaker.
- .7 Terminal blocks for connection to D.C. power supply, engine monitoring and shutdown device.
- .8 Provide low oil pressure, high coolant temperature, low coolant level and overspeed protection to shut down engine on manual operation.

## **2.5 COOLING AND VENTILATING SYSTEM**

- .1 Provide a complete cooling and ventilating system for the unit.
- .2 Thermostatically control the system and maintain coolant, ethylene glycol, within engine manufacturer's tolerance, 88°C with unit operating at rated load under specified conditions. Cooling system engine mounted radiator type.
  - .1 Design and supply complete ventilating system where engine mounted radiator is required. Radiator cooling fan to be pusher type, minimum two belt drive with belt adjuster. Fan, pulley and belt to have an easily removable protective cage.
  - .2 Provide multi-fan system suitable for indoor or outdoor installation complete with electrical controls and breaker type combination starters. Starters mounted in control panel. Motor of splash proof enclosure.
- .3 Provide drain valves for draining coolant from engine block and radiator. Drain coolant conveniently into large container through flexible extensions. Dripping valves or leaking connections will not be permitted.
- .4 Ventilation system shall be complete with canvas connections, mounting hardware, modulating damper motors, dampers, inlet and outlet hoods, bird/insect/screen, air filters, manual potentiometer, damper linkages, low voltage transformer, thermostat, fan motor. Provide positive seal, zero heat loss louvers. Air filter shall be 25mm deep disposable type with fiberglass filter media and an initial static pressure drop not to exceed 25Pa based on face velocity of 2.54m/s. American Air Filter #M57 Heavy Duty Industrial.
- .5 Ventilating system shall operate as follows:
  - .1 Air inlet and outlet damper closed when engine not running.
  - .2 On engine start, air inlet damper to open. Inlet damper minimum opening to be set by manual potentiometer. Thermostat shall modulate inlet and outlet dampers to maintain set room temperature. Fan to start when inlet louvers 90% open (adjustable).

## **2.6 LUBRICATION SYSTEM**

- .1 Provide a full pressure lubricating system complete with duplex filters and oil cooler.

- .2 Oil pump shall be engine driven gear type complete with strainer.
- .3 Equip filters with automatic by-pass valve and full flow filter elements conveniently located for servicing and directly replaceable with elements of Canadian manufacture. Cooler to have sufficient capacity to maintain oil temperature within engine manufacturer's tolerances with unit operating at rated load under conditions specified.
- .4 Equip engine oil sump with oil drain pipe, gate valve and pipe cap. Permit complete drainage in a convenient manner.
- .5 Operational requirements are such that unit may lay idle for periods up to one month and then be required to start and assume full rated load within the specified (15seconds) time period. To protect service life of engine components, provide an electrical motor driven, integrally mounted, gear type oil priming pump with interval timer and breaker type combination starter. Starter mounted in control panel. Lubrication oil pressure switch to stop priming pump when engine is running. Where pump is not being provided, submit a letter with Tender certifying that oil pump is not required for these conditions and will not detract from the service life of engine components.
- .6 All metallic oil hoses shall be of the steel reinforced rubber type with crimped or swaged end fittings.

## **2.7 FUEL SYSTEM**

- .1 Provide a complete fuel system including fuel lift pump fuel transfer pump with hand primer and duplex filters. Filter elements to be directly replaceable with elements of Canadian manufacture.
- .2 Bring fuel supply and return lines to extreme forward part of baseplate with drop ear elbows to be affixed thereto. Connect the other end of each elbow with 1 m of flexible neoprene hose.
- .3 Provide, loose, approximately 9 m of copper tubing and necessary fittings including two SAE flare union nuts (long) with half unions for connecting 12 mm gate valves to be supplied by others.
- .4 All non-metallic fuel hoses shall be of the steel reinforced rubber type with crimped or swaged end fittings.

## **2.8 EXHAUST SYSTEM**

- .1 Provide a complete exhaust system including heavy duty industrial type silencer with condensate drain, plug and flanged couplings; stainless steel, corrugated expansion joints, of suitable length, to absorb both vertical and horizontal expansion; all flanges, bolts, gaskets, adjustable hangers and pipe and pipe-thimble to permit projection of

pipe 1.0 m beyond wall. Exhaust tail pipe end to be cut at 45 degree angle and terminate in bird screen. All interior exhaust piping and silencer shall be insulated

- .2 Arrange exhaust system to suit openings. Where schedule of dimensions does not indicate location of opening, arrange exhaust run best suited to the engine.
- .3 Provide exhaust pyrometers located on common exhaust manifold or two pyrometers on separate manifolds. Pyrometer range to include temperature at 110% load.

## **2.9 JACKET COOLANT HEATER**

- .1 Provide engine jacket coolant heater complete with 20°C to 60°C adjustable immersion type thermostat. Size heater to maintain coolant at 40°C in an ambient temperature of 0°C.
- .2 Obtain circulation of heated coolant on thermosyphon principle. However, if this does not provide sufficient circulation to avoid hot spots in the system, provide electrical motor driven circulating pump to operate automatically when heater is energized. Motor to be 120 V single phase splash-proof type complete with breaker type combination starter. Starter mounted in control panel.
- .3 Heater and aquastat to be Kim Hotstart or equivalent.

## **2.10 SPEED GOVERNOR**

- .1 Provide full electronic governor with speed changer and dry type actuator. Governing system shall be in accordance with ISO3046/4-1978(E).
- .2 Governor shall provide the following features:
  - .1 Ten turn locking type manual speed adjustment.
  - .2 Speed regulation, steady state, no-load to full load and vice versa: +/-0.25%.
  - .3 Transient peak, no-load to full-load and vice versa +/-10%.
  - .4 Recovery time to steady state condition on application of full load from no load not to exceed 3 seconds.
  - .5 Frequency shall be externally adjustable from zero to 5% while engine is running.
  - .6 Class A accuracy.

## **2.11 STARTING SYSTEM**

- .1 Provide a complete starting system including cranking starting motor(s), batteries, battery stand, heavy-duty battery cables and battery charger.
- .2 Provide positive engaging type cranking motor(s). Cranking motor and flywheel ring gear arrangements which may permit tooth to tooth abutment not acceptable.

- .3 Provide lead acid battery with sufficient capacity in an ambient room temperature of 0°C to crank the unit at engine manufacturer's recommended cranking starting speed for a period of 3 minutes. Voltage measured at starting motor terminals at end of 3 minutes cranking, with cranking current flowing, to be not less than 1.75 V per cell. Size battery on the basis of engine and battery manufacturer's published data. Batteries to be dry charged, specific gravity of electrolyte 1.220 when fully charged at 27°C. Battery termination shall be bolt-on or study type. Terminals and all exposed electrical connections shall be protected from accidental short circuit by falling conductive objects on the battery. Such protection shall be transparent.
- .4 Provide battery stand coated with acid resistant paint and fabricated from angle irons with 20 mm plywood bottom and heavy duty casters for ease of movement.
- .5 Provide battery charger with 120 volt AC input and output equal to 1.20 of the ampere-hour capacity of the battery based on a 8h rate. Output voltage ripple shall be 3% or less. Provide an AC input circuit breaker and a 24h terminating equalizer timer with approximately 4 m of connecting cord and permanent connectors for connecting to battery terminals. Provide 5 spare fuses inside charger panel. Charger to be CSA approved.
- .6 Provide necessary heavy duty, maintenance-free battery cables and connectors. Select cable wire size on the basis of allowing not more than 5% voltage drop at time of peak load. Cable length to be sufficient to allow battery to be located on either side of the engine.

## **2.12 GENERATOR**

- .1 Provide generator, drip proof, single bearing and close coupled to engine with SAE housing. Generator to have a full amortisseur winding, direct connected brushless exciter with easily removable bolt-on diodes with surge protection, and meet or exceed EEMACMG1-22 and current IEEE Standards.
- .2 Maximum deviation of open circuit terminal voltage waveform not to exceed 5%.
- .3 Provide permanent magnet generator (PMG) for generator short circuit sustaining capability not less than 2.4 times rated current.
- .4 Generator winding insulation shall be Class F; winding temperature rise not to exceed 80°C as measured by resistance in an ambient temperature of 40°C.
- .5 Identify generator windings with metal tags. Bring windings to insulated terminals in a metal junction box mounted on the side or top of generator. Size junction box to permit mounting of engine and generator low voltage controls and wiring terminals blocks. Provide barrier in junction box to separate low and high voltage wiring.

- .6 Provide a voltage regulation system complete with auto/manual control module. Voltage regulator shall be capable of withstanding continuous vibration, 15 shock and temperature up to 50°C while maintaining accuracy to plus/minus 1%.
- .7 Steady-state voltage regulation not to exceed 1%. Transient voltage regulation, when full load is applied or removed, not to exceed 10% when measured by oscilloscope or high speed strip chart recorder with recovery time to steady-state less than 3 seconds.
- .8 Design equipment to minimize radio frequency interference (RFI) under all operating conditions. Balanced telephone influence factor (TIF) to meet or better requirements of EEMAC Standard MG1-22.43.

## **2.13 PANEL - GENERAL**

- .1 Panel shall be of outdoor, free-standing, dead front, metal-enclosed steel construction complete with lifting eye bolts. Doors shall have formed edges, be reinforced by stiffeners and complete with lockable handles.
- .2 Design and construct panel to withstand strains, jars, vibrations and other conditions incident to shipping, storage, installation and service.
- .3 Panel to be CSA certified. Mount a nameplate bearing CSA monogram in a prominent position on panel.
- .4 Identify all instruments and controls with lamaroid or metal engraved nameplates fastened by rivets or screws for permanent identification. All items mounted on door shall also be identified with nameplates. Nameplates shall not be attached to removable items such as relays and wireway covers.
- .5 Provide panel with bolted rear covers.
- .6 Factory wire panel completely. Use stranded, minimum No.14AWG, TEW 105°C and coloured for control wiring. Use No.10AWG for CT secondary connections:
  - .1 Blue - DC control.
  - .2 Red - AC control.
  - .3 Black - PT secondary connections.
  - .4 Orange - CT secondary connections.
  - .5 Green - non-current carrying ground.
  - .6 White - current carrying ground.
  - .7 Yellow - interlocks.
  - .8 Brown - generator excitation system.
- .7 Code wiring at each wire end with permanent, non-aging slip on markers. Support and run wiring neatly. Protect wiring from mechanical damage by grommets and shields.

- .8 Terminal blocks to be coded, clamp type, serrated for positive grip and of tough, non-brittle, unbreakable nylon, MTE size 3,453/0 or equivalent. For current transformer secondary circuits, provide terminals blocks of dual connector type, Electrovert 9060 or equal. Provide test block for current transformer secondary connections.
- .9 Provide door detent mechanism to maintain hinged door at the open position.
- .10 Supply loose 2 sets of wiring markers for each external wiring connection. Markers shall be contained in a plastic bag and secured inside the panel.
- .11 Use wiring duct for interconnection within panel.
- .12 Direct inter-panel connection not permitted, use terminal blocks.

## **2.14 CONTROL PANEL**

- .1 Provide a control panel for controlling engine generator unit.
- .2 Mount terminal blocks on common mounting strips for interconnection wiring between the following:
  - .1 Sub-panel and panel door.
  - .2 Sub-panel and external wiring from diesel generator unit circuits.
  - .3 Sub-panel and external indicating circuits.
  - .4 Sub-panel and secondary circuits of power sub-cubicle.
- .3 Provide a 1 cm x 4 cm horizontal copper ground bus for the whole length of the enclosure, and two ground lugs; one at each end. The lug shall be capable of accepting grounding conductor of range from No.8 to No.2/0AWG.
- .4 Terminal blocks to be CSA approved, clamp type, serrated for positive grip and of tough, non-brittle unbreakable nylon material. maximum two wires per terminal block. Use factory made terminal block jumpers wherever necessary.
- .5 Provide circuit breakers for equipment protection: fuses shall only be used where breakers are not applicable.
- .6 Provide top and bottom entry for power and control cables. Bottom plate shall be removable and sized 0.45 m by 0.15 m .

## **2.15 ENGINE- GENERATOR TRANSFORMER CONTROLLER**

- .1 Provide a solid state controller complete with all control and power modules for sensing, timing, logic and instrumentation to control the diesel generator set and automatic transfer system. Staticraft Ltd. Model EGT1500 or Thomson Technology Model ECS500.

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- .2 The controller shall include, but not be limited to, the following features:
    - .1 Five position function selection switch - Reset, Off, Auto, Test No. Load, Test Full Load.
    - .2 Inverse time-voltage sensors for monitoring normal and emergency voltage and frequency.
    - .3 All controls necessary to provide system operation as described in 1.2.
    - .4 Annunciator lights for the following as a minimum:
      - .1 Overcrank.
      - .2 Low Oil Pressure.
      - .3 High Coolant Temperature.
      - .4 Low Coolant Level.
      - .5 Overspeed.
      - .6 Frequency Limit.
      - .7 Voltage Limit.
      - .8 Contactor Failure.
  - .3 The function selection shall operate as follows:
    - .1 Reset: to reset the engine-generator set after it has been shut down on a protective device.
    - .2 Off: the engine-generator set is shut off.
    - .3 Auto: provides automatic operation of the engine generator set and transfer system.
    - .4 Test No. Load: exercises the engine generator set without load. In the event normal power fails during this mode, the transfer system will operate to connect load to the set.
    - .5 Test Full Load: simulates normal power failure and runs engine generator set under load. If emergency power fails under this mode, the transfer system shall operate to re-store normal power to the load.
  - .4 Provide sufficiently sized capacitors on power input terminals to the controller to maintain the supply voltage, especially on D.C. power input during engine start.
  - .5 The controller shall include the following time delays and adjustments.
    - .1 Crank delay preset at 3-20 sec.
    - .2 Restart preset at 15 sec.
    - .3 Anticipated fail preset at minimum time setting.
    - .4 Engine start preset at 2 sec.

- .5 EM - normal preset at 20 sec.
- .6 Dead bus preset at 2 sec.
- .7 Cool down preset at 5 min.
- .6 The controller shall be equipped with a cycle crank provision which shall crank the engine three times with an adjustable rest delay of 3-30 seconds preset at 5 seconds.
- .7 The controller shall be equipped with provision to reset the controller to select from a remote location. The emergency supply shall operate as the main source to the load and use the normal source as standby.
- .8 The controller shall provide the following features:
  - .1 Front panel programming and display using keypad and to allow changing of parameters, operating configuration, status, values, etc.
  - .2 Security access code to prevent unauthorized changes.
  - .3 Self diagnostics, continually operating in the background, to ensure proper operation of the microprocessor.
  - .4 Non-volatile memory to store all operating logic, configuration and set points upon total loss of power.
  - .5 Sufficient internal power to maintain control outputs and operating sequence upon loss of DC supply from working battery.
  - .6 Isolation of inputs and outputs to ensure correct operation and no damage in the event of transient voltages.
  - .7 Operation counter for number of diesel starts (non-resettable).
  - .8 Operating temperature 0-50°C.
  - .9 The controller shall be equipped with a communications system and uninterruptible power supply for central remote monitoring and control. The system shall be complete with a modem (300 - 2400 baud), initialized by the controller. The supplier shall provide all necessary hardware, software and configuration for the controller as well as all necessary software for a central remote monitoring and control station.

## **2.16 POWER TRANSFER AND BY-PASS PANEL**

- .1 Provide a 1 cm x 4 cm horizontal copper ground bus for the whole length of the enclosure, and two ground lugs; one at each end. The lug shall be capable of accepting grounding conductor of range from No.8 to No.2/0AWG.



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## **2.17 TOOLS**

- .1 Supply suitable engine barring device and the battery manufacturer's standard set of tools for battery service. Battery service tools to include as a minimum, utilitymeter, one plastic bottle for topping up purposes and one insulated battery terminal wrench.
- .2 Provide a complete set of specialized tools required for the proper care, adjustment and maintenance of equipment supplied.

## **2.18 SIGNS**

- .1 Provide at the front top of each panel and on each generator junction box, a lamacoid or metal engraved identification nameplate. The nameplates to have Departmental Representative's letter and number identification designation to be given at the time of acceptance tests.
- .2 Provide and attach to the unit in a prominent location, a bilingual warning sign.
- .3 Where metric tools are required to service the engine-generator unit, provide a bilingual warning sign.

## **2.19 FINISHING AND PAINTING**

- .1 Properly clean, finish and paint equipment with a smooth and durable finish. Use grey gloss 501.108 except inside of panel to be painted with white gloss 513-101 in accordance with CGSB1-GP-12c schedule of paint colours.
- .2 Provide one half pint can of grey gloss paint for touch up.

## **2.20 WORKMANSHIP**

- .1 Manufacture and construct the equipment with new materials of Departmental Representative's approved quality for their respective use, and in the best workmanship manner.
- .2 Give particular attention to freedom from blemishes, defects, burrs and sharp edges; accuracy of dimensions and marking of parts and assemblies; thoroughness of welding, brazing, painting and wiring, alignment of parts and tightness of assembly screws and bolts.

## **3 Execution** **NOT USED**

**END OF SECTION**



## **1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 Closeout Submittals
- .3 Section 26 05 00 - Common Work Results for Electrical.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN3-C13-M83(R2004), Instrument Transformers.
  - .2 CSA C22.2No.178-1978(R2006), Automatic Transfer Switches.
- .2 Reference: CEC C22.1-09, under C22.2 Appendix A - Safety Standards for Electrical Equipment, Canadian Electrical Code, Part II, Pages 346 to 360.
- .3 Reference: CEC-2012.
- .4 American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA)
  - .1 ANSI/NEMA ICS 2-2000, Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.

### **1.3 SYSTEM DESCRIPTION**

- .1 Automatic load transfer equipment to:
  - .1 Monitor voltage on phases of normal power supply.
  - .2 Transfer load from one transformer to the other.
  - .3 Transfer load back when the first transformer is restored.

### **1.4 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include:
  - .1 Make, model and type.
  - .2 Load classification:
    - .1 Blower heater 4 kW.
    - .2 Motor load: 20 hp.

- .3 Total load: 36 kW.
- .3 Single line diagram showing controls and relays.
- .4 Description of equipment operation including:
  - .1 Automatic starting and transfer to standby unit and back to normal power.
  - .2 Test control.
  - .3 Manual control.
  - .4 Automatic shutdown.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Detailed instructions to permit effective operation, maintenance and repair.
- .3 Technical data:
  - .1 Schematic diagram of components, controls and relays.
  - .2 Illustrated parts lists with parts catalogue numbers.
  - .3 Certified copy of factory test results.

## **2 Products**

### **2.1 MANUFACTURERS**

- .1 ASCO Power Technologies Canada.
- .2 Thomson Technology Inc.
- .3 Turnatech Inc.

### **2.2 MATERIALS**

- .1 Instrument transformers: to CAN3-C13.
- .2 Contactors: to ANSI/NEMA ICS2.

### **2.3 CONTACTOR TYPE TRANSFER EQUIPMENT**

- .1 Contact Type Transfer Equipment: to CSA C22.2 No. 178.
- .2 Two (2) - three (3) phase contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, open type with CSA enclosure.
- .3 Rated: 120/208 V, 60 Hz, 200 A, 4 wire, solid neutral.

- .4 Main contacts: silver surfaced, protected by arc disruption means.
- .5 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.
- .6 Auxiliary contact: gold plated.
- .7 Fault withstand rating: 30 kA symmetrical for three (3) cycles.
- .8 Lever to operate switch manually when switch is isolated.
- .9 Solid neutral bar.
- .10 Switchable neutral pole on circuit breaker type equipment.
- .11 Open transition.
- .12 ASCO Power Cat# J07ATBA3200C5XC NEMA3R Inclosure. ASCO7000 Series Automatic Transfer Switch 200 A, 120/208 V/3 Ø/4 wire, Group 5 LCD Microprocessor Controller, ACC29A (maintain toggle switch), ACC85L(Digital Metering Package) or approved equal.

## **2.4 CONTROLS**

- .1 Selector switch -two position "Test", "Auto".
  - .1 Test position - Failure of transformer simulated, transfer takes place Return switch to "Auto" to transfer back.
  - .2 Auto position – normal operation of transfer switch on failure of normal power, retransfers on return of normal voltage.
- .2 Control transformers: dry type with 120 V secondary to isolate control circuits from:
  - .1 Normal power supply.
- .3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:
  - .1 Voltage sensing: three (3) phase for normal power and on one phase only for back-ups, solid state type, adjustable drop out and pick up, close differential, 2 V minimum under voltage and over voltage protection.
  - .2 Time delay: normal power to standby, adjustable solid state, 0 to 60 sec.
  - .3 Time delay during transfer to stop transfer action in neutral position to prevent fast transfer, adjustable, 5 sec intervals to 180 sec.

## **2.5 ACCESSORIES**

- .1 Pilot lights to indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel.
- .2 Auxiliary relay to provide 5 N.O. and 5 N.C. contacts for remote alarms.
- .3 Instruments:
  - .1 Analogue true rms, indicating type 2% accuracy, flush panel mounting:
    - .1 Voltmeter: ac, scale 0 to 1000 V.
    - .2 Ammeter: ac, scale 0 to 5000 A.
- .4 Voltmeter selector switch: rotary, maintained contacts, panel mounting type, round notched handle, four position, labelled "OFF-Phase A-Phase B-Phase C".
- .5 Manual bypass:
  - .1 Support full load current with off-load switching to allow complete removal of transfer switch while ensuring connection to any one of available sources.
- .6 Ammeter selector switch: rotary, maintained contacts, panel mounting type, designed to prevent opening of current circuits, round notched handle, four position labelled "OFF - Phase A - Phase B - Phase C".

## **2.6 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Control panel:
  - .1 For selector switch and manual switch: size 4 nameplates.
  - .2 For meters, indicating lights, minor controls: size 2 nameplates.

## **2.7 SOURCE QUALITY CONTROL**

- .1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested in presence of Departmental Representative during the factory acceptance test.
- .2 Tests:
  - .1 Operate equipment both mechanically and electrically to ensure proper performance.
  - .2 Check selector switch, in modes of operation Test, Auto and record results.
  - .3 Check voltage sensing and time delay relay settings.
  - .4 Check:

- .1 Automatic starting and transfer of load on failure of normal power.
- .2 Retransfer of load when normal power supply resumed.
- .3 Automatic shutdown.

### **3 Execution**

#### **3.1 INSTALLATION**

- .1 Locate, install and connect transfer equipment. Mount into switchgear line-up using direct bus connections.
- .2 Check relays and adjust as required.
- .3 Install and connect UPS and remote alarms.

#### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Energize transfer equipment from normal power supply.
- .3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.
- .4 Set selector switch in "Manual" position and check to ensure proper performance.
- .5 Set selector switch in "Auto" position and open normal power supply disconnect. Load should transfer back to normal power supply when normal is restored.

**END OF SECTION**





## **1 General**

### **1.1 REFERENCES**

- .1 American National Standards Institute (ANSI):
  - .1 ANSI C82.1, Electric Lamp Ballasts Line Frequency Fluorescent Lamp Ballast.
  - .2 ANSI C82.4, Ballasts for High Intensity Discharge and Low Pressure Sodium Lamps.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE):
  - .1 ANSI/IEEE C62.41, Surge Voltages in Low Voltage AC Power Circuits.
- .3 American Society for Testing and Materials (ASTM):
  - .1 ASTM F1137, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 United States of America, Federal Communications Commission (FCC):
  - .1 FCC (CFR47) EM and RF Interference Suppression.
- .5 Reference: CEC C22.1-09, under C22.2 Appendix A - Safety Standards for Electrical Equipment, Canadian Electrical Code, Part II, Pages 346 to 360.
- .6 Reference: CEC-2012.

### **1.2 RELATED SECTIONS**

- .1 This Section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### **1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval by Departmental Representative.
- .3 Photometric data to include: VCP Table, spacing criterion, total input watts, five (5) plane candlepower summary, polar plot candela distribution, zonal lumen summary, luminaire efficiency, CIE type, coefficient of utilization, lamp type and lumen rating in accordance with IESNA testing procedures, lens and louvre type and finish.

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**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 All waste shall be managed and disposed of in accordance with Section 01 74 21 - Construction Waste Management.

**2 Products**

**2.1 NOT USED**

**3 Execution**

**3.1 INSTALLATION**

- .1 Locate and install H.I.D. luminaires as indicated on drawing. Type CAT#VMVS2TW100GP. Manufactured by Champ or equivalent.

**3.2 WIRING**

- .1 Connect luminaires to lighting circuits.

**3.3 LUMINAIRE SUPPORTS**

- .1 As per the drawings.

**3.4 LUMINAIRE ALIGNMENT**

- .1 Align luminaires mounted individually parallel or perpendicular to underpass or building grid lines.

**END OF SECTION**