
Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .3 Section 26 36 23 - Automatic Transfer Switches.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-3.6-2000, Amend. 2, Regular Sulphur Diesel Fuel.
- .2 Canadian Environmental Protection Act (CEPA).
 - .1 CCME PN 1326-2008, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products.
- .3 CSA International.
 - .1 CSA C22.2 No. 100-04 (R2013), Motors and Generators.
 - .2 CSA C282-09, Emergency Electrical Power Supply for Buildings.
 - .3 CSA Z299.3, Quality Assurance Program.
- .4 International Organization for Standardization (ISO).
 - .1 ISO 3046-1-2002, Reciprocating Internal Combustion Engines - Performance - Part 1: Declarations of Power, Fuel and Lubricating Oil Consumptions, and Test Methods - Additional requirements for engines for general use.
 - .2 ISO 8528, The Amps Guide Part 1 & Part 4.
- .5 National Electrical Manufacturers Association (NEMA).
 - .1 NEMA MG 1-2006(R2007), Motors and Generators.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and data sheets for power generators and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada, and include:
 - .1 Engine: make and model, with performance curves.

- .2 Alternator: make and model.
- .3 Voltage regulator: make, model and type.
- .4 Automatic transfer switch: make, model and type.
- .5 Manual bypass switch: make and model.
- .6 Battery: make, type and capacity.
- .7 Battery charger: make, type and model.
- .8 Alternator control panel: make and type of meters and controls.
- .9 Governor type and model.
- .10 Automatic engine room ventilation system.
- .11 Cooling air requirements in m³/s.
- .12 British standard or DIN rating of engine.
- .13 Flow diagrams for:
 - .1 Diesel fuel.
 - .2 Cooling air.
- .14 Dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, drip trays, and total weight.
- .15 Continuous full load output of set at 0.8 PF lagging.
- .16 Description of set operation including:
 - .1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency.
 - .2 Manual starting.
 - .3 Automatic shut down and alarm on:
 - .1 Overcranking.
 - .2 Overspeed.
 - .3 High engine temp.
 - .4 Low lube oil pressure.
 - .5 Short circuit.
 - .6 Alternator over voltage.
 - .7 Lube oil high temperature.
 - .8 Over temperature on alternator.
 - .4 Manual remote emergency stop.

1.4 CLOSEOUT SUBMITTALS

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

- .2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units manufactured by supplier and:
 - .1 Operation and maintenance instructions for engine, alternator, control panel, automatic transfer switch, manual bypass switch, battery charger, battery, fuel system, engine room ventilation system, exhaust system and accessories, to permit effective operation, maintenance and repair.
 - .2 Technical data:
 - .1 Illustrated parts lists with parts catalogue numbers.
 - .2 Schematic diagram of electrical controls.
 - .3 Flow diagrams for:
 - .1 Fuel system.
 - .2 Lubricating oil.
 - .3 Cooling system.
 - .4 Certified copy of factory test results.
 - .5 Maintenance and overhaul instructions and schedules.
 - .6 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Include:
 - .1 2 fuel filter replacement elements.
 - .2 2 lube oil filter replacement elements.
 - .3 2 air cleaner filter elements.
 - .4 2 sets of fuses for control panel.
 - .5 Special tools for unit servicing.

1.7 EXTENDED WARRANTY

- .1 For work covered by this Section (26 32 13.01 - Power Generation Diesel), the warranty period of 12 months provided for in the General Conditions is extended to 60 months.

- .2 Guarantee program shall be a standard form from the manufacturer of the generator set and shall be supported by him and not by a distributor program not supported by the manufacturer.
 - .1 Parts and labor to be available 24 hours a day, 7 days a week.

1.8 ACCEPTABLE PRODUCTS AND MATERIALS

- .1 Where a particular brand name is stipulated, see Instructions to Bidders for procedure for requesting approval of substitute materials and products.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Generating system consists of:
 - .1 Diesel engine.
 - .2 Alternator.
 - .3 Alternator control panel.
 - .4 Automatic transfer equipment.
 - .5 Battery charger and battery.
 - .6 Exhaust system.
 - .7 Steel mounting base.
 - .8 Manual by-pass switch for mobile generator set.
 - .9 Junction boxes for load bank and mobile generator set.
- .2 System designed to operate as emergency standby unattended.

2.2 DIESEL ENGINE

- .1 Diesel engine: to ISO 3046-1.
- .2 Turbo charged and after cooled, synchronous speed 1,800 rpm.
- .3 Diesel engine certified EPA Tier 3.
- .4 Capacity:
 - .1 Rated continuous power in kW at rated speed, after adjustment for system losses in auxiliary equipment necessary for engine operation; to be calculated as follows: Rated continuous output = Generator kW divided by Generator efficiency at full load.
 - .1 Under following site conditions:
 - .1 Altitude: 152 m.
 - .2 Ambient temperature: 40°C.
 - .3 Relative humidity: 60%.

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- .5 Cooling System:
 - .1 Liquid cooled: heavy duty industrial radiator mounted on generating set base with engine driven pusher type fan to direct air through radiator from engine side, with ethylene glycol anti-freeze non-sludging above -46°C.
 - .2 To maintain manufacturer's recommended engine temperature range at full load in ambient temperature of 40°C.
 - .3 Block heater: thermostatically controlled lube oil or liquid coolant heater connected to line side of automatic transfer switch to allow engine to start in room ambient 0°C.
 - .1 Switch and fuse in heater circuit, mounted in engine-alternator control cubicle and fed from line side of automatic transfer switch.
 - .6 Fuel: to CAN/CGSB-3.6, Type A, Arctic Grade 2.
 - .7 Fuel system: solid injection, mechanical fuel transfer pump with hand primer, fuel filters and air cleaner, fuel rack solenoid energized when engine running.
 - .8 Electronic type speed regulator, electric actuator, speed droop externally adjustable from isochronous to 5%, temperature compensated with steady state speed maintenance capability of $\pm 0.25\%$.
 - .9 Lubrication System:
 - .1 Pressure lubricated by engine driven pump.
 - .2 Lube oil filter: replaceable, full flow type, removable without disconnecting piping.
 - .3 Lube oil cooler.
 - .4 Engine sump drain valve.
 - .5 Oil level dip-stick.
 - .10 Starting System:
 - .1 Positive shift, gear engaging starter 12 or 24 VDC.
 - .2 Cranking limiter to provide 3 cranking periods of 10s duration, each separated by 5 s rest.
 - .3 Lead acid, 12 or 24 V storage battery with sufficient capacity to crank engine for 1 min at 0°C without using more than 25% of ampere hour capacity.
 - .4 Battery charger: constant voltage, solid state, two stage from trickle charge at standby to boost charge after use.
 - .1 Regulation: $\pm 1\%$ output for $\pm 10\%$ input variation.
 - .2 Automatic boost for 6 hours every 30 days.
 - .3 Equipped with dc voltmeter, dc ammeter and on-off switch.
 - .4 Minimum charger capacity: 7 A.
 - .11 Vibration isolated engine instrument panel with:
 - .1 Lube oil pressure gauge.
 - .2 Lube oil temperature gauge.

- .3 Lube oil level gauge.
- .4 Coolant temperature gauge.
- .5 Coolant level gauge.
- .6 Running time meter: non-tamper type.
- .12 Guards to protect personnel from hot and moving parts.
 - .1 Locate guards so that normal daily maintenance inspections can be undertaken without their removal.
- .13 Drip tray.

2.3 ALTERNATOR

- .1 Alternator: to NEMA MG1.
- .2 Rating: 3 phase, 600 V, 4-wire, 250 kW, 60 Hz, at 0.8 PF.
- .3 Output at 40°C ambient:
 - .1 100% full load continuously.
 - .2 150% full load for 1 minute.
- .4 Revolving field, brushless, single bearing.
- .5 Drip proof.
- .6 Amortisseur windings.
- .7 Synchronous type.
- .8 Dynamically balanced rotor permanently aligned to engine by flexible disc coupling.
- .9 Exciter: permanent magnet.
- .10 NEMA class H insulation on windings.
- .11 Platinum resistance temperature transducers embedded in stator winding and connected to alternator control circuitry.
- .12 Voltage regulator: thyristor controlled rectifiers with phase controlled sensing circuit:
 - .1 Stability: $\pm 1\%$ maximum voltage variation at any constant load from no load to full load.
 - .2 Regulation: 4% maximum voltage deviation between no-load steady state and full-load steady state.
 - .3 Transient: 25% maximum voltage dip on one-step application of 0.8 PF full load.
 - .4 Transient: 30% maximum voltage rise on one-step removal of 0.8 PF full load.
 - .5 Transient: 2.5 s maximum voltage recovery time with application or removal of 0.8 PF full load.
- .13 Alternator: capable of sustaining 300% rated current for period not less than 10 s permitting selective tripping of down line protective devices when short circuit occurs.

2.4 CONTROL PANEL

- .1 Totally enclosed, mounting base isolated from diesel generator.
- .2 Instruments:
 - .1 Digital indicating type, multifunction, 1% accuracy, rectangular face, flush panel mounting:
 - .1 Voltmeter: AC.
 - .2 Ammeter: AC.
 - .3 Wattmeter.
 - .4 Frequency meter.
 - .5 kW.h meter.
 - .6 Button selector.
 - .2 Instrument Transformers
 - .1 Potential-dry type for indoor use:
 - .1 Ratio: 600 to 120.
 - .2 Rating: 600 V, 60 Hz, BIL 10 kV.
 - .2 Current-dry type for indoor use:
 - .1 Ratio: 400 to 5.
 - .2 Rating: 600 V, 60 Hz, BIL 10 kV.
 - .3 Positive action automatic short-circuiting device in secondary terminals.

2.5 CONTROLS

- .1 Engine start button.
- .2 Selector Switch: "Off-Auto-Manual".
- .3 Engine emergency stop button and provision for remote emergency stop button.
 - .1 Alternator output breaker:
 - .1 Circuit breaker, solid state sensing with:
 - .1 Frame containing breaker contacts, arc quenchers, manual mechanism, quick- make, quick-break, spring-loaded overcenter switching mechanism, mechanically trip free from handle, fixed type.
 - .2 Static sensor: current monitors detect overload, short-circuit and ground-fault currents, and send these signals through solid-state circuits to static sensor which acts to trip breaker. Adjustable for current values and time of tripping.
 - .3 Flux-transfer shunt trip- magnetic tripping device actuated by signal from static sensor to open breaker contacts. Requires no external source of power.
 - .2 Voltage control rheostat: mounted on inside of control panel.

- .3 Operating lights, panel mounted:
 - .1 "Normal power" pilot light.
 - .2 "Emergency power" pilot light.
 - .3 Green pilot lights for breaker on and red pilot lights for breaker off.
- .4 Solid state indicator lights for alarm with 1 set manually reset NO/NC contacts wired to terminal block for remote annunciation on:
 - .1 Low fuel level.
 - .2 Low battery voltage.
 - .3 Ventilation failure.
 - .4 Low coolant temperature.
- .5 Solid state controller for automatic shutdown and alarms with 1 set manually reset NO/NC contacts wired to terminal block for remote annunciation on:
 - .1 Engine overcrank.
 - .2 Engine overspeed.
 - .3 Engine high temperature.
 - .4 Engine low lube oil pressure.
 - .5 Short circuit.
 - .6 AC over voltage.
- .6 Lamp test button.
- .7 Provision for remote monitoring.

2.6 AUTOMATIC TRANSFER SWITCH

- .1 Automatic transfer switches as indicated, to Section 26 36 23 - Automatic Transfer Switches.

2.7 MANUAL TRANSFER SWITCH

- .1 Manual transfer switches as indicated, to Section 26 36 23 - Automatic Transfer Switches.

2.8 STEEL MOUNTING BASE

- .1 Complete generating set mounted on structural steel base of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation and under operating conditions on suitable level surface.
- .2 Assembly fitted with vibration isolators and control console resiliently mounted.
 - .1 Spring type isolators with adjustable side snubbers and adjustable for levelling.
- .3 Sound insulation pads for installation between isolators and concrete base.

2.9 EXHAUST SYSTEM

- .1 Heavy duty residential type, aluminized steel, horizontally mounted exhaust silencer with condensate drain, plug and flanged couplings.

- .2 Heavy duty flexible exhaust pipe with flanged couplings as required.
- .3 Fittings and accessories as required.
- .4 Expansion Joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion.

2.10 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Control Panel:
 - .1 Size 4 nameplates for controls including alternator breakers and program selector switch.
 - .2 Size 2 nameplates for meters, alarms, indicating lights and minor controls.

2.11 FABRICATION

- .1 Shop assemble generating unit including:
 - .1 Base.
 - .2 Engine and radiator.
 - .3 Alternator.
 - .4 Control panel.
 - .5 Battery and charger.

2.12 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Alternator control cubicle: paint inside, exterior to match engine and alternator.
- .3 Other ducts and racks grey.
- .4 Supply 0.25 L of grey touch-up enamel.

2.13 SOURCE QUALITY CONTROL

- .1 Factory test generator set including engine, alternator, control panels, transfer switch and accessories in presence of Departmental Representative.
- .2 Notify Departmental Representative 10 days in advance of date of factory test.
- .3 Test procedure:
 - .1 Prepare blank forms and check sheet with spaces to record data and at top of first sheet record:
 - .1 Date.
 - .2 Generator set serial no.
 - .3 Engine, make, model, serial no.

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- .4 Alternator, make, model, serial no.
 - .5 Voltage regulator, make and model.
 - .6 Rating of generator set, kW, kV.A, V, A, r/min, Hz.
 - .2 Mark check sheet and record data on forms in duplicate as test proceeds.
 - .4 Tests:
 - .1 With 100% rated load, operate set for 24 hours, taking readings at 30 minutes intervals, and record following:
 - .1 Time of reading.
 - .2 Running time.
 - .3 Ambient temp in degrees C.
 - .4 Lube oil pressure in kPa.
 - .5 Lube oil temp in degrees C.
 - .6 Engine coolant temp in degrees C.
 - .7 Exhaust stack temp in degrees C.
 - .8 Alternator voltage: phase 1, 2, 3.
 - .9 Alternator current: phase 1, 2, 3.
 - .10 Power in kW.
 - .11 Frequency in Hz.
 - .12 Power Factor.
 - .13 Battery charger current in A.
 - .14 Battery voltage.
 - .15 Alternator cooling air outlet temp.
 - .2 After completion of 24 hours run, demonstrate following shut down devices and alarms:
 - .1 Overcranking.
 - .2 Overspeed.
 - .3 High engine temp.
 - .4 Low lube oil pressure.
 - .5 Short circuit.
 - .6 Alternator over voltage.
 - .7 Low battery voltage, or no battery charge.
 - .8 Manual remote emergency stop.
 - .9 High alternator temperature.
 - .3 Next install continuous strip chart recorders to record frequency and voltage variations during load switching procedures. Each load change delayed until steady state conditions exist. Switching increments to include:
 - .1 No load to full load to no load.
 - .2 No load to 70% load to no load.
 - .3 No load to 20% load to no load.

- .4 20% load to 40% load to no load.
- .5 40% load to 60% load to no load.
- .6 60% load to 80% load to no load.
- .5 Demonstrate:
 - .1 Automatic starting of set and automatic transfer of load on failure of normal power.
 - .2 Operation of manual bypass switch.
 - .3 Automatic shutdown of engine on resumption of normal power.
 - .4 That battery charger reverts to high rate charge after cranking.
- .6 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

2.14 ACCEPTABLE PRODUCTS

- .1 Caterpillar.
- .2 Cummins.
- .3 Kohler.
- .4 MTU.
- .5 Replacement materials or products: approved by addendum according to Instructions to bidders.

2.15 JUNCTION BOXES

- .1 Junction boxes for load bank and mobile generator set, stainless steel, with hinged door, handle, lock 2 keys and catch, surface mount.
- .2 Features:
 - .1 Type NEMA 3R;
 - .2 Dimensions : 750 mm x 750 mm x 300 mm.
- .3 Junction box with 5 female Cam-lock type receptacles (3 phases + neutral + ground), 400 A, 600 V.
- .4 Acceptable Products:
 - .1 Model STA-405F-SS of Boîtiers STA Inc.
 - .2 Model SPQCL of SquareD (Schneider Electric).
 - .3 Replacement materials or products: approved by addendum according to Instructions to bidders.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate generating unit and install as indicated.

- .2 Install junction boxes for load bank and for mobile generator set as indicated.
- .3 Complete wiring and interconnections as indicated.
- .4 Start generating set and test to ensure correct performance of components.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Notify Departmental Representative 10 working days in advance of test date.
- .3 Provide fuel for testing and leave full tanks on acceptance.
- .4 Demonstrate:
 - .1 Unit start, transfer to load, retransfer to normal power, unit shut down, on "Automatic" control.
 - .2 Unit start and shut down on "Manual" control.
 - .3 Unit start and transfer on "Test" control.
 - .4 Unit start on "Engine start" control.
 - .5 Operation of manual bypass switch.
 - .6 Operation of automatic alarms and shut down devices.
- .5 Run unit on load for minimum period of 4 hours to show load carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in ventilating system to provide adequate engine cooling.
- .6 At end of test run, check battery voltage to demonstrate battery charger has returned battery to fully charged state.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Divert unused batteries from landfill to approved battery recycling facility.
- .3 Divert unused lubricating oil materials from landfill to approved oil recycling facility.
- .4 Divert unused antifreeze from landfill to approved antifreeze recycling facility.

3.4 ACTIVITIES ON WORK COMPLETION

- .1 Demonstration and training.
 - .1 Conduct a full demonstration of the generator set.
 - .2 Provide necessary training to familiarize the operating and maintenance personnel with the operation of the generator set and the automatic transfer switches.
 - .1 Training to be 8 hours.

- .3 Provide service technician during the period and at intervals necessary to make the installation operational and to familiarize operating personnel with all aspects of maintenance and operation of the equipment.
- .4 Provide fuel for on-site testing of the generator set (diesel fuel, winter type). Refill the tank once testing is completed.

3.5 MAINTENANCE - CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and CSA-B139.

END OF SECTION