

PART 1 - GENERAL

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| <u>1.1 REFERENCES</u> | .1 | CSA International |
| | .1 | CSA-B139, Installation Code for Oil Burning Equipment. |
| | .2 | International Organization for Standardization (ISO) |
| | .1 | ISO 3046-1, Reciprocating Internal Combustion Engines - Performance - Part 1: Declarations of Power, Fuel and Lubricating Oil Consumptions, and Test Methods. |
| <u>1.2 GENERAL REQUIREMENTS</u> | .1 | The complete emergency generator system to be provided as a total package from one manufacturer. |
| <u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u> | .1 | Submit shop drawings in accordance with Section 26 05 00 - Common Work Results for Electrical. |
| | .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 | 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 | Battery: make, type and capacity. |
| | .6 | Battery charger: make, type and model. |
| | .7 | Alternator control panel: make and type of meters and controls. |
| | .8 | Governor type and model. |
| | .9 | Dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, drip trays, and total weight. |
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1.3 ACTION AND
INFORMATIONAL
SUBMITTALS
(Cont'd)

- .3 Shop Drawings: (Cont'd)
 - .10 Continuous full load output of set at 0.8 PF lagging.
 - .11 Load bank test connection box.
 - .12 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.

1.4 CLOSEOUT
SUBMITTALS

- .1 Provide operation and maintenance data for diesel generator for incorporation into manual.
 - .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, battery charger, battery, fuel 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.
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| 1.4 CLOSEOUT
SUBMITTALS
(Cont'd) | .2 (Cont'd)
.2 Technical data:(Cont'd)
.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 Packaging Waste Management: remove for reuse
or return of pallets, crates, padding,
banding, and packaging materials as specified
in Construction Waste Management Plan in
accordance with Section 01 74 21 -
Construction/Demolition Waste Management and
Disposal and Section 01 35 21 - LEED
Requirements. |
| 1.6 MAINTENANCE
MATERIAL SUBMITTALS | .1 Provide maintenance materials.

.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 WARRANTY | .1 For Work of this section, the warranty period
is extended to 60 months or 1500 operating
hours, whichever occurs first, from date of
final certificate of completion. Provide a
written guarantee signed by the contractor and
the manufacturer stating such. Include copy in
the maintenance manuals. |
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PART 2 - PRODUCTS

2.1 SYSTEM <u>DESCRIPTION</u>	<ul style="list-style-type: none">.1 Generating system consists of:<ul style="list-style-type: none">.1 Diesel engine..2 Alternator 230 kW, 347/600 V, 60 Hz, 4W..3 Alternator control panel..4 Automatic transfer equipment with by-pass..5 Battery charger and battery..6 Exhaust system..7 Steel mounting base..8 Remote annunciator..9 Load test connection..2 System designed to operate as emergency standby..3 Fuel supply and ventilation is included in the mechanical documents.
2.2 DIESEL ENGINE <u></u>	<ul style="list-style-type: none">.1 Diesel engine: to ISO 3046-1..2 Turbo charged and after cooled, synchronous speed 1800 rpm..3 Capacity:<ul style="list-style-type: none">.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.<ul style="list-style-type: none">.1 Under following site conditions:<ul style="list-style-type: none">.1 Altitude: at building elevations above sea level..2 Ambient temperature: 10 degrees C..3 Relative humidity: 65 %..4 Cooling System:<ul style="list-style-type: none">.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 degrees C.

2.2 DIESEL ENGINE
(Cont'd)

- .4 Cooling System: (Cont'd)
 - .2 To maintain manufacturer's recommended engine temperature range at 10% continuous overload in ambient temperature of 40 degrees 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 degrees C.
 - .1 Switch and fuse in heater circuit, mounted in engine-alternator control cubicle and fed from line side of automatic transfer switch.
 - .5 Fuel: to CAN/CGSB-3.6, Type A, Arctic Grade ultra-low sulphur.
 - .6 Fuel system: solid injection, mechanical fuel transfer pump, fuel filters and air cleaner, fuel rack solenoid energized when engine running.
 - .7 Governor: mechanical hydraulic with:
 - .1 Steady state speed band of plus or minus 0.5%.
 - .2 Speed regulation no load to full load 5% maximum.
 - .3 Electronic load sharing type, electric actuator, speed droop externally adjustable from isochronous to 5%, temperature compensated with steady state speed maintenance capability of plus or minus 0.25%.
 - .8 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.
 - .9 Starting system:
 - .1 Positive shift, gear engaging starter 12 or 24V dc.
 - .2 Cranking limiter to provide three (3) cranking periods of 10s duration, each separated by 5 s rest.
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- 2.2 DIESEL ENGINE (Cont'd)
- .9 Starting system: (Cont'd)
 - .3 12 or 24V storage battery with sufficient capacity to crank engine for 1 min at 0 degrees 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: plus or minus 1% output for plus or minus 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.
 - .10 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.
 - .11 Guards to protect personnel from hot and moving parts.
 - .1 Locate guards so that normal daily maintenance inspections can be undertaken without their removal.
 - .12 Drip tray.
- 2.3 ALTERNATOR
- .1 Alternator: to NEMA MG1.
 - .2 Rating: 3 phase, 347/600 V, 4 wire, 230 kW, 60 Hz, at 0.8 PF.
 - .3 Output at 40 degrees C ambient:
 - .1 100% full load continuously.
 - .2 110% full load for 1 hour.
 - .4 Revolving field, brushless, single bearing.
 - .5 Drip proof.
 - .6 Amortisseur windings.
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2.3 ALTERNATOR
(Cont'd)

- .7 Synchronous type.
- .8 Dynamically balanced rotor permanently aligned to engine by flexible disc coupling.
- .9 Exciter: rotating brushless.
- .10 NEMA Class F insulation on windings.
- .11 Thermistors embedded in stator winding and connected to alternator control circuitry.
- .12 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, isolated from generator.
- .2 Instruments:
 - .1 Digital 100% solid state circuitry indicating type 2 % accuracy, rectangular face, flush panel mounting:
 - .1 Voltmeter: ac, scale 0 to 600 V.
 - .2 Ammeter: ac, scale 0 to 600 A.
 - .3 Wattmeter scale 0 to 600 kW.
 - .4 Frequency meter: scale 55 to 65Hz.
 - .5 kW.h meter.
 - .2 Instrument Transformers
 - .1 Potential-dry type for indoor use:
 - .1 Ratio: 250 to 120.
 - .2 Rating: 250 V, 60Hz, BIL 125 kV.
 - .2 Current-dry type for indoor use:
 - .1 Ratio: 250 to 5.
 - .2 Rating: 250 V, 60Hz, BIL 125 kV.
 - .3 Positive action automatic short-circuiting device in secondary terminals.
 - .3 Generator Control System to control ventilation dampers. Coordinate with mechanical.

- 2.5 CONTROLS
- .1 Engine start button.
 - .2 Selector switch: Off-Auto-Manual - Test full load, test no load.
 - .3 Engine emergency remote emergency stop button.
 - .1 Alternator output breakers:
 - .1 Circuit breakers: bolt-on, moulded case, temperature compensated for 40 degrees C ambient, dual thermal-magnetic trip, include two circuit breakers; one for power supply and one for load bank.
 - .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 Synchronization and load sharing.
 - .8 Provision for remote monitoring.
- 2.6 AUTOMATIC TRANSFER SWITCH
- .1 Refer to Section 26 36 23 - Automatic Transfer Switches.
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- 2.7 STEEL MOUNTING BASE .1 Complete generating set mounted on 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.
- .3 Sound insulation pads for installation between isolators and concrete base.
- 2.8 EXHAUST SYSTEM .1 Heavy duty residential type exhaust silencer with condensate drain, plug and flanged couplings.
- .2 Fittings and accessories as required.
- .3 Expansion joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion.
- 2.9 FUEL SYSTEM .1 Refer to mechanical.
- 2.10 FABRICATION .1 Shop assemble generating unit including:
- .1 Base.
- .2 Engine and radiator.
- .3 Alternator.
- .4 Control panel.
- .5 Battery and charger.
- .6 Automatic transfer equipment.
- 2.11 ACCEPTABLE PRODUCTS .1 Acceptable manufacturers for the Generator assembly:
- .1 Cummins Power Generations.
- .2 Kohler Power Systems.
- .3 Wajax (MTU) Power Systems.
- .4 Caterpillar.
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- 2.12 SOURCE QUALITY .1 Factory test generator set including engine, alternator, control panels, transfer switch and accessories.
- CONTROL
- .2 Tests:
- .1 With 100% rated load, operate set for 23 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.
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- 2.12 SOURCE QUALITY .3 In lieu of the above 100% tests, prototype
CONTROL
(Cont'd)
- .4 Demonstrate:
- .1 Automatic starting of set and automatic transfer of load on failure of normal power.
 - .2 Automatic shut down of engine on resumption of normal power.
 - .3 That battery charger reverts to high rate charge after cranking.
- .5 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

- 2.13 LOAD BANK TEST .1 Generator docking station for load bank test, quick connect, UL 1008 listed.
- .2 Hinged lockable access doors and dead front panel, heavy duty stainless steel enclosure, wall mounted.
- .3 Connection fittings color coded for easy connections.
- .4 Identification nameplate Size 7.

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Locate generating unit and install as indicated.
- .2 Complete wiring and interconnections as required.
- .3 Start generating set and test to ensure correct performance of components.
- .4 Install remote annunciator in IT Equipment Room.
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3.2 FIELD QUALITY CONTROL .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Notify Owner's Representative 10 working days in advance of test date.

.3 Provide fuel for testing and leave full tank 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 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 battery recycling facility approved by Departmental Representative.

.3 Divert unused lubricating oil materials from landfill to oil recycling facility approved by Departmental Representative.

.4 Divert unused antifreeze from landfill to antifreeze recycling facility approved by Departmental Representative.

3.3 CLEANING <u>(Cont'd)</u>	.5	Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 01 35 21 - LEED Requirements.
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3.4 MAINTENANCE <u>CLEARANCES</u>	.1	Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and CSA B-139.
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