

SECTION 263213 – ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. This Section specifies emergency generator equipment for buildings and structures emergency electrical systems.
- 2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein for a complete operating system.

- B. Related Sections:

- 1. Applicable sections of Division 26 - Electrical

1.3 REFERENCES

- A. Emergency generators shall be in accordance with the latest applicable standards as recommended by, SAE, IEEE, and ANSI/NEMA MG-1 Motors and Generators.

1.4 SUBMITTALS

- A. Shop Drawings

- 1. Emergency generator systems including:
 - a. Engine-generator set and foundation requirements.
 - b. Auxiliary and remote equipment.
 - c. Make of engine, number of cylinders, compression ratio, bore and stroke, cylinder displacement, and speed.
 - d. Make of generator, electrical rating, number and type of bearings, and exciter type.
- 2. Plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.

3. Product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer and vibration isolators.
4. Installation instructions.
5. Name, location and phone number of nearest authorized distributor/service facility.
6. Sequence of Operation - Manufacturer shall prepare a detailed, typewritten sequence of operation and submit as part of the approval documents. Final approved sequence of operation shall be permanently encapsulated in plastic laminate and permanently attached to the equipment. Format shall be 8½" x 11" or 11" x 17" as appropriate. Include schematic one-line diagram with appropriate symbols and nomenclature properly referenced to text.

B. Manuals and Test Data

1. Operation and Maintenance Manuals for all major components including instructions for normal operation, routine maintenance requirements, service manuals for generator, engine, oil sampling and analysis for engine wear, and emergency maintenance procedures.
2. Test data required in 1.5 Quality Assurance.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70, "National Electrical Code"
- C. Submit certified performance test data for this or an exact duplicate prototype unit. Test shall include a full load test conducted at the specified ambient temperature for at least four (4) hours. The test shall be conducted with all components intended for this project including engine, generator fan and radiator. Single pass cooling systems shall NOT be used to replace the radiator for testing. Test shall include actual surge and steady state performance data for "0-to-50%", "0"-to-100%" and "50-to-100%" instantaneous load applications. Steady state performance shall be recorded at no greater than 15 minute intervals, application as well as 100% steady state performance. Test results shall include oil pressure, oil temperature, coolant temperature, fuel pressure, ambient temperature, load in kW, kVA, amperes and output voltage. Load characteristic shall be sinusoidal, 80% power factor and steady state performance testing shall also include at least four (4) hours at 100% rating, with load characteristic of 80% power factor and total harmonic distortion of 50%.
- D. Guarantee

1. Furnish full parts and labor warranty to cover the entire engine generator package including all accessories for one year from date of installation.

1.6 MATERIALS TURNED OVER TO OWNER

- A. Provide two spare sets of each oil, and air filter element required for each engine generator system.

PART 2 - PRODUCTS

2.1 GENERAL INFORMATION

Note information to be shown on drawings.

- A. Furnish and install new natural gas engine driven electric generating unit, factory assembled single unit generator set, with continuous output ratings as shown on the drawings at 0.8 power factor, 60 hertz, grounded neutral service, fully rated for operation at 1000 feet above sea level in an ambient temperature range of 120 deg.F. maximum to -20 deg.F. minimum, consisting of a natural gas engine, electric jacket heater, direct-connected generator, exciter, radiator and fan cooling system, exhaust system with muffler and weathercap, automatic battery starting equipment, battery rack with heater, batteries and charger, instrument panel, control panel, instruments and controls, all mounted on a common steel base suitable for mounting on a concrete foundation pad, complete with a remote mounted automatic transfer switch, remote mounted derangement panel and all accessories as specified and required for normal operation in standby service.
- B. Generator set shall be manufactured by Caterpillar, Cummins/Onan, or Kohler.
- C. Manual and Automatic Start - Unattended Operation
 1. Manual start shall be done by operating the "start" button on the generator or selecting "manual" on the manual-off-automatic selector switch on the automatic transfer switch.
 2. Automatic start shall be done by the automatic transfer switch when the manual-off-automatic selector switch on the automatic transfer switch is in the "automatic" position.
- D. Voltage and frequency regulation
 1. Engine/generator shall deliver rated output (kVA) at rated frequency and power factor, at not more than 2% above or below rated voltage.
 2. Voltage regulation shall be plus or minus 2% for any constant load between no load and rated load. Random voltage variation shall not exceed .5% for any constant load. Voltage recovery to 100% normal output shall take no longer than two seconds after single step application of 100% rated load.

3. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.
4. The engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
- E. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic. Telephone influence factor shall be less than 40.
- F. Furnish all necessary electrical connections, transfer switch, control panel, relays, etc., for installation of new generator set.
- G. Generator and engine shall be mounted on vibration isolating supports capable of 95% isolation to minimize vibration of the remainder of the skid-mounted equipment and transmission of vibration to the supporting pad.
- H. Generator shall be fully enclosed or suitably guarded to prevent exposure to all parts which operate at extremely high temperatures, electrically energized, or rotating. All noncurrent carrying parts shall be grounded.
- I. Thoroughly clean all equipment, and prime and finish paint with manufacturer's standard paint finish.
- J. The engine/generator set shall be suitable for indoor installation. Units for outdoor installation shall be totally enclosed and rated for outdoor use.

Use the following paragraph when the unit is installed outdoors.

- K. Outdoor Weather-Protective Housing: Factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation and exclude entry of moisture into interior components. The housing shall have hinged side-access doors and rear control door. All doors shall be lockable. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color.

2.2 ENGINE

- A. Engine shall be standby power rated, multi-cylinder, spark ignited four stroke cycle, liquid cooled, internal combustion engine for use with natural gas fuel, industrial type, designed for full rated power output at 1800 rpm, 60 hertz. Aspiration may include turbocharger with after-cooler system. Block and head shall be cast-iron with replaceable cylinder liners.
- B. Governor shall be electronic isochronous type no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Random frequency variation shall not exceed

$\pm 0.25\%$ of its mean value for constant loads from no load to full load. Governor shall be provided with means for manual operation and adjustment.

C. Lubrication system.

1. Full pressure type with engine driven positive displacement sump pump.
2. Full flow strainer.
3. Full flow filter.
4. Pressure relief and automatic bypass valves.
5. Crankcase ventilator with filter and connection for outside venting.
6. Bayonet type oil level indicating pressure gauges on the upstream and downstream side of the strainer and filter.
7. Drain connection.
8. Oil cooler.
9. Low oil pressure safety shutoff device.
10. Provide water shutoff valves and drain on the oil cooler to facilitate draining water without draining the complete engine cooling system.
11. Provide a radiator coolant level sight glass.

D. Cooling System

1. Pressure type, with radiator, blower type fan.
2. Engine driven circulating pump.
3. Radiator cap incorporating a pressure-vacuum valve.
4. Thermostat in conjunction with a radiator bypass.
5. Drain connection.
6. High coolant temperature safety device.
7. Fan shall be sized to maintain safe engine temperature in ambient temperature of 120 degrees F.
8. Provide gaskets and packing in the cooling system which are unaffected by ethylene glycol base coolant.
9. Provide a 50% ethylene glycol antifreeze solution for the coolant.
10. Radiators shall be provided with a duct adapter flange permitting the attachment of air discharge duct for directing discharge air through the wall.
11. Radiator and Air Intake/Discharge System Flow Restriction requirement shall be no less than 0.5 inches of water.

E. Provide thermal circulation type engine jacket water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F and suitable for operation at 480 Volts AC. Provide plug-in type connection.

F. Air intake system shall be complete with a dry type filter, and high frequency filter-type silencer for reducing the sound level at the intake to a point acceptable for residential use.

G. Air shutoff for emergency shutdown.

H. Engine exhaust system shall be complete with residential type silencer capable of reducing ambient exhaust noise level to 60 dBA when measured 50 feet from the engine under full engine load and clear weather. Silencer shall be supported independently of the engine.

Flexible exhaust connection shall be provided from the engine exhaust manifold to the silencer. An exhaust condensation trap with manual drain valve shall be provided to prevent condensation from entering the engine. Furnish and install a rain cap at the exhaust stack outlet.

- I. Standard SAE nuts, bolts, and studs.
- J. Standard NPT or SAE tubing and fittings.

2.3 GENERATOR

- A. Generator shall be alternating current, three phase, four pole, reconnectible brushless revolving field synchronous type with brushless exciter directly connected to the generator field windings without slip rings or commutators.
- B. Generator shall have a single prelubricated sealed bearing, direct connected to the engine, and air cooled by a direct drive centrifugal blower fan.
- C. Insulation shall be Class H in a self-ventilated enclosure. Temperature rise shall be 125 deg C. max over ANSI 40 deg C. ambient for standby service.
- D. Bring out all leads from each winding to a generator main lead terminal box adequate in size for making up all connections and grounding the neutral to the generator set supporting frame.
- E. Voltage regulation shall include 3 phase sensing, generator-mounted volts per Hertz exciter-regulator to match engine and generator characteristics. Include manual controls to adjust voltage output plus or minus 5% of nominal voltage level.
- F. The generator shall have the necessary excitation control circuitry to prevent the loss of excitation on fault conditions allowing quick return to full voltage and power to normal and faulted circuits.
- G. Furnish NEMA 1 output terminal and outgoing cable termination compartment integral with the engine-generator frame.

2.4 VOLTAGE REGULATION

- A. Static type, three phase, mounted either on the generator control panel or combined with the exciter. Voltage shall have "manual-automatic" switch and be adjustable +/- 10% under all operating conditions.

2.5 ELECTRIC START SYSTEM

- A. Engine starting system shall be a 12 volt or 24 volt DC system depending on size of engine/generator, consisting of a heavy duty electric cranking motor(s) with drive mechanism, heavy duty batteries with metal frame or box, engine driven alternator, battery charger, and transistorized voltage regulator.

- B. Cranking motor shall be capable of starting the engine five times in rapid succession without overheating the motor and at sufficient speed for starting in ambient temperatures as low as -10 deg.F.
- C. Storage batteries shall be lead acid type of voltage and capacity as determined by the engine manufacturer, with sufficient capacity to start the generator set five times consecutively in rapid succession.
- D. Battery charger shall be an automatic, self-protected, self-regulated, dual rate rectifier type of a capacity determined by the engine manufacturer and sufficient to automatically recharge the batteries quickly according to the requirements governed by battery discharge duty, and suitable for 120 volt, single phase, 60 hertz input service from a remote receptacle panel.
- E. Engine governor shall be a hydraulic, adjustable, isochronous type designed to maintain a constant engine speed from no load to full load. The frequency at any constant load, including no load, shall remain within a steady state band width of plus or minus 0.25% of rated frequency. The governor shall not permit frequency modulation to exceed one cycle per second.
- F. Fuel system shall be natural gas type designed for a fuel pressure at the inlet of the safety valve of 5 inches water gauge. Unit shall be complete with all code required operating and safety controls and valves.

2.6 ACCESSORIES

- A. Exhaust silencer: critical grade silencer, with muffler companion flanges and flexible stainless steel exhaust fitting, suitable for orientation, sized in accordance with engine manufacturer's instructions.
- B. Batteries: Heavy duty, engine starting type lead-acid storage batteries (2 batteries at 225 ampere - hours each) minimum capacity, thermostatically controlled battery heater, powered by the battery charger. Match battery voltage to starting system. Include necessary cables and clamps.
- C. Battery Tray: Plastic coated metal for electrolyte resistance, constructed to contain spillage of electrolyte.
- D. Battery Charger: Current limiting type designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell. Include overload protection, full wave rectifier, voltmeter and ammeter, and 120 volt AC fused input. Charger shall include NEMA 1 enclosure (may be NEMA 1 if the entire assembly is provided in an integral outdoor weatherproof enclosure). Package shall include provisions for single point connection of 120V power for charger, for engine jacket water heater, and any other devices requiring energization while in storage. External charger shall automatically disconnect from the engine battery charging system immediately on engine starting.
- E. Two output circuit breakers. One shall be configured as the main circuit breaker and equipped with shunt trip. The other shall be for connection of loadbank leads for periodic testing.

- F. CT's with shorting blocks and potential connections with fuse blocks for metering.

2.7 ENGINE-GENERATOR CONTROL PANEL

- A. Control panel shall be engine generator frame mounted in NEMA 1 enclosure, totally front accessible. Control panel shall be completely factory pre-wired. All external connections shall be wired out to terminal blocks for field wiring. Control panel shall be complete with all engine and generator controls and indicators. Include front hinged double doors with latches and provision for padlock.
- B. Control panel shall provide a contact closure to initiate operation of the ventilation system. Wire out to terminal block. Contact shall be field wired by manufacturer as indicated on the Drawings.
- C. Control panel shall include the following fully identified by means of permanent nameplates:
 - 1. Control
 - a. Output voltage adjustment.
 - b. Cranking limiter relay.
 - c. Overspeed shutdown.
 - d. Low oil pressure shutdown.
 - e. High coolant temperature shutdown.
 - f. Remote Alarm Contacts: Pre-wired SPST contacts to terminal strip for remote indication of all alarm functions.
 - g. Battery operated service light to illuminate panel during power outage conditions.
 - h. Manual-off-auto engine start switch.
 - 2. Visual monitoring
 - a. Frequency Meter: 45-65 Hz range, 3½ inch (89 mm) dial.
 - b. AC Output Voltmeter: 3½ inch dial, 2 percent accuracy, with phase selector switch (phase-to-phase and phase-to-ground).
 - c. AC Output Ammeter: 3½ inch dial, 2 percent accuracy, with phase selector switch and 3 current transformers.
 - d. Push-to-test indicator lamps, one for each:
 - 1) Engine run
 - 2) Low oil pressure
 - 3) High water temperature
 - 4) Overspeed and overcrank
 - 5) Overspeed shutdown
 - 6) Failure to crank
 - 7) Failure to establish voltage or frequency
 - 8) Failure to reach rated voltage at transfer switch in ten seconds
 - e. Engine running time meter.
 - f. Electrical oil pressure gauge.

- g. Electrical water temperature gauge.
 - h. Mechanical fuel pressure gauge.
 - i. Radiator sight glass.
 - j. DC voltmeter and ammeter.
3. Audible monitoring
- a. Low oil pressure alarm condition.
 - b. High coolant temperature alarm.
 - c. Failure to crank.
 - d. Failure to establish voltage or frequency.
 - e. Failure to reach rated voltage at transfer switch in 10 seconds.
- D. Battery charging system including alternator and solid state regulator.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Furnish, as part of the base scope of work, a factory authorized field service engineer to inspect the equipment for proper installation and proper functioning, to direct (and/or perform) all electrical and mechanical adjustments which may be required, to supervise (and/or participate in) all testing and to certify that the installation and equipment is in accordance with Manufacturer's requirements, ready for energization and for being placed in operation.
- B. The equipment shall be operated through all design functions. This shall include all remote control operation, actuation of all alarm and indication devices, mechanical and electrical operation from protective devices. In addition perform all specific inspections and tests as recommended by the manufacturer.
- C. The engineering field service shall include, but not be limited to, the following:
- 1. Examine for evidence of shipping, storage, and handling damage. Identify parts damaged and reorder as required. Expedite equipment as appropriate.
 - 2. Determine that shipping devices and tags have been removed. Direct the removal of such straps, blocks, braces that remain.
 - 3. Examine all interior wiring, breakers, fuses, etc., for any damage.
 - 4. Examine insulation and assembly of phase bus, ground bus, control, sensors, relaying and metering connections. Identify and direct all necessary changes.
 - 5. Check all accessible connections to manufacturer's tightening torque specifications.
 - 6. Verify phasing.

7. Check circuitry for electrical continuity.
 8. Test for circuit integrity with a megohm meter.
 9. Check electrically operable devices by operating several times.
 10. Check that primary and control connections are made. Determine that control voltages are consistent with equipment furnished.
 11. Visually inspect main bus between the generator terminals and the outgoing feeder. Direct the disconnecting of the generator and check the bus with a megohm meter if conditions dictate. Values shall be in accordance with the manufacturer's recommendations.
 12. Megger insulation resistance levels phase-to-phase and phase-to-ground. Values shall be in accordance with the manufacturer's recommendations but no less than 6 megohms on 2500V megohm-meter.
 13. Verify that the equipment is clean and free of debris.
 14. Assure that the equipment is level, properly secured to the floor, physically connected to the grounding system, and that doors swing properly and can be readily secured closed. Direct any adjustments or additional work required.
 15. Review the field assembly work and, to the extent possible, determine that the work was completed in accordance with the manufacturer's instructions and drawings.
 16. Test temperature relays, gages, switches, alarms, safety shut-down systems, and local and remote control meters and indicating lights for proper installation and operation.
 17. Check operation of auxiliaries, interlocks, etc. Check contact wipe, gaps and clearances as described in the Manufacturer's instruction book.
 18. Verify proper operation of starting battery and charger system.
 19. Set governor, voltage regulator, etc. and verify proper operation under all load conditions.
 20. Assist in energization.
- D. Load Bank Test
1. Furnish a continuous on site four (4) hour full load "Load Bank" test. Test shall be conducted when ambient temperatures are at least 85°F.
- E. Adjusting and Cleaning
1. Adjust operating mechanisms for free mechanical movement.
 2. Touch-up scratched or marred surfaces to match original finishes.
 3. Remove debris, tools, and foreign material from enclosures.

F. Inspection

1. Manufacturer must examine areas and conditions under which the engine-generator and components are to be installed, and notify the Engineer and Owner's Representatives in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until satisfactory conditions have been corrected in a manner acceptable to the Engineer and Owner's Representative.

G. Generator Start-Up, Transfer, and Run

1. Verify the proper functioning of all indicating devices.
2. Verify the proper functioning of all indicating devices.
3. Verify proper phasing, proper frequency and isochronous operation no-load to full-load.

- H. A checklist with this information shall be prepared by the manufacturer and three copies signed and dated by the manufacturer's engineer verifying proper installation, energization, and operation of the equipment shall be submitted to the Owner's Representative.

END OF SECTION 263213