SECTION 26 32 14 - GAS-ENGINE-DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.1 DESCRIPTION

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A. Provide complete factory assembled ~~gasoline /~~ natural gas ~~/ propane~~ engine driven electric generator set and related equipment as specified herein and as shown on the drawings.

B. Provide factory test, startup by a supplier authorized by the equipment manufacturer(s), and on-site testing of the system.

C. The generator set manufacturer shall warrant all equipment provided under this section, whether or not it is manufactured by the generator set manufacturer, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.

1.2 QUALITY ASSURANCE

A. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards, as applicable. The generator set shall include necessary features to meet the requirements of these standards.

1. CSA 282 – Emergency Electrical Power Supply for Buildings.
2. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
3. NFPA37
4. NFPA70 – National Electrical Code with any State modifications. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
5. NFPA99 – Essential Electrical Systems for Health Care Facilities.
6. NFPA110 – Emergency and Standby Power Systems. The generator shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit. Component level type tests will not substitute for this requirement.

B. The generator set and supplied accessories shall meet the requirements of the following standards:

1. NEMA MG1. Alternator shall comply with the requirements of the current version of this standard as they apply to AC alternators.
2. UL142 – Sub-base Tanks
3. UL1236 – Battery Chargers
4. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

C. The control system for the generator set shall comply with the following requirements:
   1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
   2. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.
   3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
   4. FCC Part 15, Subpart B.
   5. IEC8528 part 4. Control Systems for Generator Sets
   6. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.
   7. UL508. The entire control system of the generator set shall be UL508 listed and labeled.
   8. UL1236 – Battery Chargers.

D. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.3 SUBMITTALS

A. Shop Drawings: Detail fabrication, piping, wiring, and installation of the field-installed portions of the system. Include general arrangement drawings showing locations of auxiliary components in relation to the engine generator set and duct, piping, and wiring connections between the generator set and the auxiliary equipment. Show connections, mounting, and support provisions and access and working space requirements. Single-line diagrams of transfer switch units showing connections between automatic transfer switch, power source and load, wiring diagrams, elementary or schematic, differentiating between manufacturer-installed and field-installed wiring, including required interconnection between the generator set, the transfer switch, and the remote annunciator panel.

B. Product Data: Include data on features, components, ratings, and performance. Include dimensioned outline plan and elevation drawings of engine generator set and other system components. Include product data for each transfer switch, including dimensioned plans, sections, and elevations showing minimum clearances; conductor entry provisions; gutter space; installed features and devices; and materials lists. Provide motor-starting KVA performance data (graphical) along with calculations indicating worst-case motor starting scenario. See drawings for loads on the generator, and confirm load sizes with actual equipment to be furnished.

C. Operating and Maintenance Data.

D. Factory Start-Up Test Report.

E. Site Test Report.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Acceptable Manufacturers: Caterpillar, Kohler, Onan, Olympian, Generac, and MTU Onsite Power.

B. Other Manufacturers: Submit Substitution Request prior to bid date.

2.2 GENERATOR SET:

A. Generator set shall be the product of a manufacturer regularly engaged in the production of this type of equipment and one that has a local distributor and service organization. The generator shall have a continuous standby rating as indicated on the drawings.

B. Factory Assembly:
1. The entire generating system shall be built, tested and shipped so as to assure the unit is factory engineered and assembled so there is only one source of supply, service, and warranty responsibility.
2. The manufacturer shall have local parts and service facilities within a 100 mile radius of site to assure prompt emergency service within 24 hours.
3. The manufacturer shall have a flat-rate maintenance agreement program available to the customer.

C. Performance Requirements:
1. Frequency regulation shall by 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 0.5 percent.
2. Voltage manually adjustable from + 5% of nominal voltage.
3. Ambient conditions.
   a. Altitude of site, 1000 feet.
   b. 100 degrees F air temperature at engine intake.
4. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
5. Voltage transient performance +/- 20% line to line with step removal/application 30% of rated load up to 90% of rated load, including motor loads. Recovery time shall not exceed 1.5 seconds.
6. Motor starting performance: 20% maximum line-to-line voltage dip with step removal/application of any motor load while balance of loads are running.
7. On cold start-up voltage and frequency shall stabilize within specified bandwidths at the same time (not to exceed 2 seconds).
8. 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, and no 3rd order harmonics or their multiples. Telephone influence factor shall be less than 40.
9. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust

emission requirements at the time of commissioning.

D. Construction
   1. The generator set shall consist of one natural gas engine directly coupled to one AC alternator, mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.
   2. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3R enclosure. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

E. Connections
   1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
   2. Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.
   3. Generator set control interfaces to other system components shall be made on a permanently labeled terminal block assembly. Labels describing connection point functions shall be provided.

F. Engine and Engine Equipment: The engine shall be natural gas, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. Engine accessories and features shall include:
   1. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed. The governing system shall include a programmable warm up at idle and cooldown at idle function. While operating in idle state, the control system shall disable the alternator excitation system.
   2. Skid-mounted radiator and cooling system rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at the alternator air inlet. Radiator fan shall be suitable for use in a system with 0.5 in H2O restriction. Radiator shall be sized based on a core temperature that is 20F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture prior to shipping. Rotating parts shall be guarded against accidental contact.
   3. Electric starter(s) capable of three complete cranking cycles without overheating.
   4. Positive displacement, mechanical, full pressure, lubrication oil pump.
   5. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.

6. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element. Fuel cooler, suitable for operation of the generator set at full rated load in the ambient temperature specified shall be provided if required for operation due to the design of the engine and the installation.
7. Replaceable dry element air cleaner with restriction indicator.
8. Flexible supply and return fuel lines.
9. Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.
10. Coolant Heater
    a. Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.
    b. The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall have provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.
    c. The coolant heater shall be provided with a DC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.
    d. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 104F (40C) in a 40F (4C) ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.
11. Provide vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.
12. Starting and Control Batteries shall be calcium/lead antimony type, 24 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors. The batteries shall be capable of a minimum of three complete 15-second cranking cycles at 40F ambient temperature when fully charged.
13. Provide exhaust silencer(s) for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. The muffler(s) shall be critical grade. Exhaust system shall be installed according to the engine manufacturer’s recommendations and applicable codes and standards.
14. Provide a minimum 12 amp battery charger for each.
15. All lube oil filters shall be "spin-on" type.
16. An immersion-type oil heater operating on 120 VAC shall be installed in lube pan sump.
17. Engine starting shall be initiated via the generator control panel mode selector switch either manually or through remote 2-wire system. It shall include an electric 24V DC starting system.

18. Charging system shall include an engine-driven 35 amp 24V DC battery charging alternator, lead acid starting batteries rated at a minimum of 225 amp hours each, an automatic constant potential battery charger rated 10 amps, operating on 120V AC with voltmeter, ammeter, input and output fuse protection, float equalize switch, and low battery voltage contacts.
19. Cooling system shall be unit-mounted radiator with blower-type fan to cool engine at 100% rated load at 104 degrees F ambient. Provide an immersion-type block heater with adjustable thermostat and oil pressure disconnect switch for operation on 120 V AC. Supply in system a rust inhibitor in addition to the anti-freeze required. Anti-freeze protection shall equal 0 degrees F.
20. Safety alarms shall include an automatic shutdown system to protect from high water temperature, low oil pressure, overspeed, and overcrank.
21. Instrumentation shall include control panel mounted gauges to monitor lube oil pressure, engine coolant temperature, battery charge rate, hours of operation, "Auto-Off/Reset-Test" engine mode selector switch, and push to test pilot lights indicating nature of shutdown conditions.
22. A prime-mover emergency off switch shall be located outside the generator enclosure/room.
23. Remote annunciator shall be installed as indicated on the Drawings. The annunciator shall detect high water temperature, anticipated high water temperature, line power, low oil pressure, anticipated low oil pressure, low battery voltage, and low fuel. Provide cable in 1/2" conduit between generator control panel and remote annunciator as required.
24. A silencer shall be provided with all hangers, etc. as needed for a complete installation.

G. General Description - Alternator:
1. Alternator shall be a brushless, single bearing, and directly coupled to the engine flywheel via a flexible disk. It shall be engine driven, synchronous type, with amortisseur windings. Insulation shall be non-hygroscopic Class H, with a temperature rise not to exceed 105 degrees C above a 40 degrees C ambient. Alternator shall be a 10 or 12 lead machine with leads brought to a terminal box.
2. Voltage regulator shall be a solid-state type with no moving parts. It shall include overvoltage and underfrequency protection and be moisture proof.
3. Alternator and control panel strip heaters for use on 120V AC to raise the temperature 35 degrees C above ambient for moisture protection. Provide relay to disconnect heaters when generator is running.
4. Instrumentation includes control panel mounted gauges to monitor voltage, amps, frequency, four-position phase selector switch, voltage adjusting rheostats, and push to test pilot lights indicating breaker tripped. Engine and breaker must be manually reset after shutdown. Breaker shall not trip on overcrank. The control panel shall contain field adjustable solid-state circuitry for overcrank protection designed to open the cranking circuit after a minimum of three cranking cycles of 30 second crank/15 second pause if engine fails to start.

H. Vibration isolation shall be accomplished by mounting unit on a minimum of six spring-type vibration isolators with adjusting screws and earthquake restraints.

I. General Description - Housing:
1. The enclosure shall be formed steel construction, modular design, gasketed roof

bolts, plus rain ledge four sides. All bolts shall be 3/8" (10 mm) rust resistant with lock washers. Hinges shall be corrosion-resistant continuous type with 1/4" (6 mm) brass pins.

2. The roof shall be flanged lap rain tight construction, complete with muffler supports. The doors shall be hinged with fixed open air intake louvers, and equipped with adjustable plated pad type latches and matched keys.
3. There shall be door(s) on each side for easy access. Provide drip flange and gasketed exhaust exit, hinged radiator fill access door, and radiator core guard.
4. Interior lights shall consist of two 5-watt, 12V DC fixtures plus timer adjustable 0-60 minutes to prevent accidental battery run-down.
5. Enclosure to include one 16 gauge formed pan to receive a 12 volt battery plus one 16 gauge formed battery hold down frame with 3/8" (10 mm) anchor bolts. The battery rack shall be permanently attached to the base in a convenient location for servicing.
6. Heavy duty 1/0 257 strand high flex battery cables with neoprene jackets and heavy duty crimp on solderless lugs and terminals for connecting batteries in a 12 volt series shall be provided.
7. The skid base shall consist of two 6" structural channel main rails. Two 4" or 5" (102 mm or 127 mm) schedule 40 tow pipes which limit base twisting and serve as a four-point lift shall be included. The tow pipes shall be capped with 6 1/2" or 7 1/2" (165 mm or 191 mm) end plated to prevent towing/lifting cables from slipping off.
8. The housing/muffler assembly shall be a sound attenuation type which reduces gen-set noise to **[71 dBa (or less)]** at 7 meters from the housing exterior surface.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the engine-generator set, battery charger, and batteries per the manufacturers recommendations and as shown on the Drawings.

B. Provide proper filters for fuel and lubricating oils and fill engine with proper type and amount of oil.

C. Fill the engine cooling system with ethylene-glycol antifreeze solution and water in a 50/50 mixture.

D. Provide all necessary connections for a complete and operating installation.

3.2 MAINTENANCE INSTRUCTIONS

A. All personnel directly concerned with the operation of the system shall be thoroughly instructed in the use of the systems by authorized distributor personnel. Such service shall be provided in conjunction with the system equipment. Allocate 4 hours of site training for Owner’s personnel. Schedule training time with Owner.

3.3 WARRANTY

A. The complete gas-driven engine generator system shall be guaranteed for two years from date of acceptance.

B. In addition to the manufacturer's standard warranty, the warranty shall include 100% parts, labor, travel mileage, transportation costs, and freight associated with failure unless failure is caused by misuse, abuse, or accident (e.g. fires, floods, etc.). Manufacturer's factory service personnel, skilled in the repair of the unit, shall be dispatched to repair the equipment at the site within 24 hours after receiving the purchaser's call.

3.4 TESTING

A. Prior to installation of the engine generator set, a factory test shall be performed and a logged test report issued to the Owner. A resistive load bank shall be connected to the load side of the standby generator. The load bank shall be used to test the generator set for full load and half load. The log shall include the length of time for generator set start-up after the commercial source is interrupted, the length of time for the generator set to reach frequency stability after zero to half load and from half load to full load switching. The generator set shall be run for a minimum of four hours at full load. All the temperatures of the engine and the voltages, frequency and amperages shall be recorded on every 15 minute interval during the test.

B. A site test shall be performed, logged and witnessed by the Owner's representative. The total facility standby load shall be connected to the unit for one full hour. Each breaker shall be used to approximate half and full load. The log shall indicate the same information contained in the pre-installation test. Notify the Owner 72 hours in advance so that his representative can be present at the test.

3.5 ACCEPTANCE

A. Upon satisfactory completion of tests instruction and completion of the project, the system shall be deemed accepted.

END OF SECTION 26 32 14