

SECTION 26 32 13.13
DIESEL-ENGINE-DRIVEN GENERATOR SET

PART 1 - PROJECT SCOPE

1.1 SUMMARY

- A. This project includes the procurement and installation of a new 60 kW, diesel-fueled generator mounted on a permanent trailer assembly for mobile use. The generator shall be provided with a sub-base, 100-gallon fuel tank, and a level 2 sound-attenuated, weatherproof enclosure suitable for outdoor installation and operation.
- B. The generator shall be configured to serve the facility through an existing automatic transfer switch (ATS) system. A new ATS is currently being installed by others and is not part of this scope of work. All generator connections shall therefore be designed to interface with the ATS provided by others.
- C. The generator shall be equipped with portable, flexible output cabling, consisting of appropriately sized Type DLO (Diesel Locomotive Cable) conductors rated for the generator's full load output. Cables shall include all required phase conductors, neutral, and equipment grounding conductor.
- D. Independent testing agency shall provide a 4-hour load bank test at full load in compliance with NFPA 101 requirements and provide results to owner. Successful completion of this test shall be part of Owner Acceptance.
- E. Contractor shall comply with all air permitting requirements in accordance with Virginia Department of Environmental Quality.

1.2 ASSUMPTIONS AND CLARIFICATIONS

- A. The Contractor shall provide a means of disconnect within the portable cabling assembly itself. This shall be accomplished via one of the following acceptable methods:
 - 1. Inline cam-lock (single-pole) connectors rated for the system voltage and current.
- B. The generator supplier/installer is responsible for providing a complete and functional connection solution from the generator to the ATS, including all cabling, connectors, and terminations required for operation.
- C. The design intent is to maintain a portable generator system, consistent with the existing installation, while maintaining compatibility with the new ATS.
- D. The Contractor shall field-verify ATS connection details, including voltage, phase configuration, available lugs, and physical layout prior to finalizing cable assemblies.

PART 2 - GENERAL

2.1 SUMMARY

- A. Section Includes:
 - 1. Engine generator equipment.
 - 2. Fuel storage tanks.
 - 3. Engine generator enclosures and accessories.

2.2 REFERENCES

- A. Reference Standards:
 - 1. Environmental Protection Agency (EPA):
 - a. 40 CFR Part 60, Subpart IIII, Protection of Environment, Standards of Performance for New Stationary Sources, Standards for Performance for Stationary Compression Ignition Internal Combustion Engines.

2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. MG 1, Motors and Generators.
3. National Fire Protection association (NFPA):
 - a. 70, National Electrical Code (NEC):
 - 1) Article 702, Optional Standby Systems.
4. Underwriters Laboratories, Inc. (UL):
 - a. 2200, Standard for Stationary Engine Generator Assemblies.

2.3 QUALITY ASSURANCE

A. Qualifications:

1. Supplier:
 - a. The engine generator equipment manufacturer or other authorized Supplier has unit responsibility for furnishing all components of required engine generator systems and proper, initial operation of systems required by this Section.

2.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Identification or tag number, engine generator size, location, enclosure type, fuel storage tank capacity, and other pertinent data.
 - b. Dimensioned plan, elevation, sections, and detail drawings for engine generator equipment, enclosures, and other components furnished by engine generator manufacturer.
 - c. Fuel storage tank.
 - d. Wire interconnection drawings.
 - e. Control panel layout drawings and internal wiring diagrams.
2. Product Data:
 - a. Manufacturer's literature and published data for all components and accessories of engine generator systems.
 - b. Engine/generator performance curves.
3. Testing Plans, Procedures, and Testing Limitations:
 - a. Testing procedure, apparatus, and limitations of apparatus and procedure, for:
 - 1) Source quality control activities indicated in this Section.
 - 2) Field quality control activities indicated in this Section.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Generator equipment manufacturer's documentation of engine USEPA certification including USEPA family name and generator equipment model designation.
2. Supplier Instructions:
 - a. Serial numbers of items furnished, equipment nameplate information, and similar information for all items furnished.
 - b. Instructions for handling, installing, and startup.
3. Source Quality Control Submittals:
 - a. Results of tests, inspections, and other quality control activities required by the Contract Documents and performed at the place of production or fabrication.
4. Field Quality Control Submittals:
 - a. Results of tests, inspections, and other quality control activities required by the Contract Documents and performed at the Site.

- b. Test reports: Sound attenuating enclosure test measurements.
- 5. Supplier Site Visit Reports:
 - a. Report of each visit to the Site by Supplier, summarizing purpose of visit, activities while onsite, problems encountered, advice given to Contractor or Subcontractor, and actions taken.
- 6. Qualifications:
 - a. Contractor's, Subcontractor's, or Supplier's delegated design professional.
- C. Closeout Submittals: Submit the following:
 - 1. Operation and Maintenance Data:
 - 2. Post-Startup Statement:
 - a. Equipment installation, startup, and operational statement for each engine generator system provided.
 - 3. Keying:
 - a. Upon Substantial Completion, furnish to Owner or facility manager (if any) not less than two sets of keys for locks on generator system enclosures.
- D. Maintenance Material Submittals:
 - 1. Furnish the following items and submit documentation of delivery to and acceptance of such items by Owner or facility manager (if any).
 - a. Spare Parts and Extra Materials:
 - 1) Furnish spare parts and extra materials sufficient for one year of operation as recommended by generator system manufacturer, for each generator system furnished.

2.5 FIELD CONDITIONS

- A. Ambient Conditions:
 - 1. Ambient Air Temperature:
 - 2. Minimum: 0 degrees F.
 - 3. Maximum: 100 degrees F.
- B. Existing Conditions:
 - 1. Site Elevation: 35 feet above sea level.

PART 3 - PRODUCTS

3.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Engine generator unit:
 - a. Bobcat PG70
 - b. Generac MDG75DF4
 - c. Cummins C60D6C (with mobile capable platform option to include trailer package)
 - d. Atlas Copco QAS-70
 - e. Multiquip DCA85US
 - 2. Silencers:
 - a. Generator equipment manufacturer's standard.
 - 3. Battery charger:
 - a. Generator equipment manufacturer's standard.
 - 4. Governor:

- a. Generator equipment manufacturer's standard.
 - b. Or equal.
- 5. Radiator:
 - a. Generator equipment manufacturer's standard.
- 6. Vibration isolators:
 - a. Generator equipment manufacturer's standard.
 - b. Or equal.
- 7. Day tank:
 - a. Generator equipment manufacturer's standard.
 - b. Or equal.

3.2 DESCRIPTION

- A. Engine generators will be used and rated for:
 - 1. Optional standby power during a utility power outage, NFPA 70, Article 702.

3.3 EQUIPMENT

- A. Emissions Requirements:
 - 1. Each generator system's exhaust emissions shall comply with Laws and Regulations. Federal, State and Local government requirements, including but not limited to:
 - a. Environmental Protection Agencies (USEPA) New Source Performance Standards (NSPS), 40 CFR Part 60, Subpart IIII.
 - b. Air permitting per Virginia Department of Environmental Quality.

3.4 COMPONENTS

- A. Engine Generator Unit General:
 - 1. Diesel engine direct-connected to alternating current generator mounted on suitable rigid steel skid supports.
 - 2. Mount unit on skid suitable for installation on portable trailer.
 - 3. Base rating on operation at rated RPM when equipped with all operating accessories.
 - 4. Standards: UL 2200.
 - 5. 60kW, 208/120V, 3-phase, 4-wire, 60Hz.
- B. Engine:
 - 1. Four-cycle, full compression ignition, single acting, solid-injection unit, either vertical or V-type pistons naturally aspirated with inner and after cooling.
 - 2. Fuel supply: No. 2 Diesel.
 - 3. Removable full wet-type cylinder liners of close grained alloy iron, heat treated for proper hardness to obtain maximum life.
 - 4. Capable of operating at idle or light loads for extended periods of time.
- C. Injection Pumps and Valves:
 - 1. Type not requiring adjustment in service, which may be individually removed and replaced.
 - 2. Individual injection pump and valve for each cylinder.
 - 3. Fuel injection pumps: Positive action, constant-stroke, actuated by cam driven by gears from engine crankshaft.
 - 4. Fuel lines between injection pumps and valves: Heavy seamless steel tubing.
 - 5. Flexible fuel line connectors for supply and return connections at pump.
- D. Oil Pump:
 - 1. Gear-type lubricating oil pump to supply oil under pressure to main bearings, crank pin bearings, pistons, timing gears, camshaft bearings and valve rocker mechanism.

2. Spray cool and lubricate pistons.
 3. Oil filters so located that lubricating oil is continuously filtered, except during periods when oil is automatically by-passed to protect vital parts when filters are clogged.
 4. Filter elements accessible and easily removable.
 5. Filter elements: Effective full flow, replaceable resin-impregnated cellulose type.
 6. Equip filter system with spring-loaded by-pass valve.
 7. Oil cooler: Water-cooled, engine-mounted.
- E. Fuel System:
1. Fuel pump: Built-in gear-type, engine-driven fuel transfer pump.
 2. Equip fuel system with replaceable fuel filter elements arranged for easy removal without breaking any fuel line connections or disturbing fuel pumps or any other part of engine.
 3. Locate all fuel filters in an accessible housing, ahead of injection pumps to thoroughly filter fuel before it reaches the pump.
 4. Use no screens or filters requiring cleaning or replacement of injection pumps or valve assemblies.
- F. Governor: Fully enclosed electronic type governor with actuator capable of providing accurate speed control within 1% of rated speed, complete with panel-mounted electronic assembly with ramp generator and speed-sensing modules.
- G. Air Cleaners: Engine-mounted, dry type air cleaners of sufficient capacity.
- H. Electric Starting System:
1. Sufficient capacity to crank at speed which will start engine under normal operating conditions.
 2. Controls to provide automatic cranking of engine when generator is called to start.
 3. Prevent excessive cranking which could damage cranking motor.
 4. Automatic stop controls.
 5. Starter motors with positive-engagement feature.
- I. Cooling System:
1. Capacity for cooling engine at the specified operating conditions.
 2. Engine driven, centrifugal type water circulating pump and thermostatic valve to maintain the engine at recommended temperature level.
 3. Unit mounted radiator.
 - a. Site glass at top of unit.
 - b. Engine driven blower fan.
 - c. Low water level cutoff switch.
 4. Provide fan guards.
- J. Heater:
1. Thermostatically controlled jacket water heater(s) to maintain cooling jacket at the manufacturer's recommended temperature at the specified low ambient temperature.
- K. Silencer:
1. Suitable type critical silencing.
 2. Seamless, stainless steel, flexible, exhaust adapter for exhaust outlet to silencer.
- L. Engine Instruments and Controls:
1. Engine-mounted instruments:
 - a. Oil pressure gauge.
 - b. Water temperature gauge.

- c. Run time meter.
 - d. Battery voltage meter.
 - 2. Automatic cycle cranking and over-crank protection.
 - 3. Safety controls: Equip engine with automatic safety controls to shut down engine in event of low lubricating oil pressure, high jacket water temperature, overspeed or overcrank.
 - 4. Auxiliary control devices: Either integral with specified engine instruments, control, and safety devices or as separate devices as required to operate various signal circuits specified for remote annunciator panel.
 - 5. Three NO auxiliary contacts for interface with louvers, fans or other miscellaneous equipment.
 - a. Contacts shall close when generator is started.
- M. Fuel Day Tank:
- 1. Double wall sub-base day tank mounted underneath engine generator unit.
 - 2. Steel construction, top and bottom baffles, steel channel side supports, weatherproof secondary containment, rust preventive interior coating, rust proofed and finish painted exterior.
 - 3. Tank connections: Fuel level gauge, fuel lines to generator, fill, vent, drain and pressure relief.
 - 4. Manual overfill protection.
 - 5. Low level warning with contacts for remote alarm.
 - a. Set to alarm at 50% of capacity.
 - 6. Critical low level shutoff with contacts for remote alarm.
 - 7. Leak detection alarm with contacts for remote alarm.
- N. Batteries:
- 1. Lead acid type.
 - 2. Furnish electrolyte separately for use when installation is complete and unit is ready for testing.
- O. Battery Charger:
- 1. Output current rating of at least 1/20th of ampere hour capacity of battery and capable of automatically switching between low rate (float) mode and high rate (equalize) mode.
 - 2. Solid state rectifiers, DC voltmeter and ammeter, fuse input and output, and 115 VAC input.
 - 3. Malfunction alarm contacts (minimum): low and high battery voltage, weak battery and charger failure.
- P. Generator:
- 1. Brushless, 4-pole drip-proof revolving field type with permanent magnet, 2/3 pitch stator, direct-coupled rotor, Class H insulation.
 - 2. Minimum continuous standby ratings:
 - a. Substantiated by manufacturer's standard published curves and conform to NEMA MG 1 specification.
 - b. Special ratings or maximum ratings are not acceptable.
 - 3. Rated to serve up to 50% non-linear load without exceeding rated temperature rise.
 - 4. Minimum efficiency: 92% at 50 to 110% of nominal standby rating, less than 30% instantaneous voltage dip at full load and rated power factor and suitable for simultaneous operation with other future units connected in parallel.
 - 5. Stator and rotor: 130 degrees C temperature rise with minimum Class H insulated with 100 percent epoxy impregnation and overcoat of resilient insulating material to reduce possible fungus and/or abrasive deterioration.
 - 6. Directly connect stator to engine flywheel housing.

7. Drive rotor through semiflexible driving flange to ensure permanent alignment.
8. Self-ventilating with suitable blower, air inlet and outlet openings.
9. Provide terminal box of adequate size for entrance of conduit and termination of conductors.
10. Generator drive free from critical torsional vibration within operating range.
11. Provide generator mounted main circuit breaker(s):
 - a. Solid state molded case type.
 - b. Sized in accordance with generator manufacturer's established full-load output current at 208V, 3-phase, and not smaller than required for the full rated generator output. Coordinate exact sizing per existing connector parameters, described below.

Q. Voltage Regulator:

1. SCR type, to maintain 2% voltage regulation from 0 to full load with steady state modulation not exceeding plus 1/2% including cross-current compensation to provide maximum of 5% unbalance in kVA load sharing between this unit and possible future generators.
2. Automatic protection against short circuits on system.
3. Permit unit to operate at no load below rated frequency for engine start up and shut down procedures.
4. Provide voltage level and gain controls for normal operating adjustments.
5. Provide voltage level control with minimum range of plus or minus 5% from rated voltage.
6. Mount regulator, volts per hertz type, in generator housing on suitable vibration isolators.

R. Generator Instruments and Controls:

1. Generator mounted NEMA 3R type, illuminated vibration isolated instrument and control panel(s).
2. AC voltmeter and phase selector switch.
3. AC ammeter and phase selector switch.
4. Frequency meter.
5. Run-off-auto engine, start-stop control switch.
6. Emergency stop.
7. Run time meter.
8. Governor control rheostat.
9. Voltage level adjustment rheostat.
10. Cool down time delay 0-15 minute adjustable.
11. Cycle cranking control.
12. Minimum red shut down indicating lights as follows:
 - a. Overcrank.
 - b. Overspeed.
 - c. Low lubricating oil pressure.
 - d. High engine water temperature.
13. Minimum amber alarm indicator lights as follows:
 - a. Control switch not in auto position.
 - b. Low engine water temperature (less than 70 degrees F).
 - c. Low fuel in day tank.
 - d. Day tank leak.
 - e. Battery charger malfunctioning.
 - f. Low battery voltage.
14. Minimum amber prealarm indicator lights as follows:
 - a. High engine water temperature.

- b. Low lubricating oil pressure.
- 15. Common dry contact and audible alarm to indicate when one or more alarm or prealarm conditions exist.
- S. Vibration Isolators: Vibration system shall consist of engine and generator mount isolators with or without additional mechanical spring isolators rubber pads to control both high and low frequency vibrations between major components, sub-base and structural foundation and to provide required vibration isolation for the seismic zone of the Project.

3.5 ACCESSORIES

- A. Provide interposing relays (24 VDC to 120 VAC) as required for interfacing monitoring system.
 - 1. System shall support remote monitoring via web-based interface.
- B. Generator remote annunciator panel:
 - 1. Surface mounted NEMA 3R enclosure.
 - 2. Circuits:
 - a. 24 VDC powered from starting batteries.
 - b. Verify circuit voltage to match battery voltage.
 - 3. Provide red and green signal lamps, buzzer, silencing switch, lamp test switch, relays, solid-state components, and engraved function identifications.
 - 4. Annunciator functions:
 - a. Green light "ON" to indicate generator is operating to supply power to load.
 - b. Separate red light for each shutdown or alarm condition and amber light for each prealarm condition and common buzzer with silence/ acknowledge switch.
 - c. Shut down indicating lights as follows:
 - 1) Overcrank.
 - 2) Overspeed.
 - 3) Low lubricating oil pressure.
 - 4) High engine water temperature.
 - d. Alarm indicator lights as follows:
 - 1) Control switch not in auto position.
 - 2) Low engine water temperature (less than 70 degrees F).
 - 3) Low fuel in day tank.
 - 4) Fuel in day tank rupture basin.
 - 5) Battery charger malfunctioning.
 - 6) Low battery voltage.
 - e. Prealarm indicator lights as follows:
 - 1) High engine water temperature.
 - 2) Low lubricating oil pressure.
- C. Generator set non-walk-in enclosure:
 - 1. Sheet steel with side servicing panels, air intake louvers and rear control panel access door.
 - 2. Side servicing panels shall have two locking points; all panels and doors shall be key lockable.
 - 3. Pitched roof with silencing exhaust muffler.
 - 4. Completely install enclosure on generator set mounting base.
 - 5. Level 2 Sound Attenuating, NEMA 3R Enclosure:

3.6 SOURCE QUALITY CONTROL

- A. Individually test each prime mover.
 - 1. Apply derating factors for the proposed site to test data.
 - 2. Continuously test for a period not less than two hours.
 - 3. Test procedure shall be as follows:
 - a. Start prime mover and upon reaching rated RPM, pick up 100 percent of nameplate KW rating at rated power factor in one step.
 - b. Observe and record the cranking time(s) required to start and run for each prime mover.
 - c. Observe and record the time required to come up to operating speed for each prime mover.
 - d. Record voltage and frequency overshoot for each prime mover.
 - e. Record voltage, frequency and amperes.
 - f. Record oil pressure, water temperature where applicable and battery charge rate at first load acceptance and at 15 minute intervals thereafter for each prime mover.

PART 4 - EXECUTION

4.1 INSTALLATION

- A. Install all components as indicated and in accordance with manufacturer's recommendations and instructions.
- B. Fill cooling system with solution of 50-50 water and ethylene glycol anti-freeze to prevent freezing at temperatures as low as minus 30 degrees F.
- C. Provide fuel for a full sub base tank after completion of commissioning.
- D. Install all wiring to engine in conduit.
 - 1. Control wiring on engine may be factory installed in high temperature loom.
- E. Provide control wiring in conduit between generator control panel, remote annunciator panel(s) and remote devices as described under generator instrument and controls paragraph and remote annunciator paragraph of this Specification.
- F. Provide 1-year standard warranty as part of initial generator purchase. Include options for purchasing extended warranties through generator manufacturer at the time of bid.
- G. Sound attenuating engine generator enclosure:
 - 1. Field test installation under load.
 - 2. Use a precision sound measuring instrument meeting ANSI S1.4 Type 1.

4.2 FIELD QUALITY CONTROL

- A. Field Tests and Inspections:
 - 1. Provide two load tests and one cycle crank test.
 - 2. Tests one and two shall be for continuous period of no less than two hours each.
 - 3. Engineer and Owner shall be notified seven days prior to testing.
 - 4. Test number one:
 - a. With prime mover(s) in a "cold start" condition and emergency load at normal operating level, initiate a normal power failure by opening all switches or breakers supplying normal power to facility.
 - b. Observe and record the time delay on engine start.
 - c. Observe and record the cranking time(s) required to start and run for each prime mover.
 - d. Observe and record the time required to come up to operating speed for each prime mover.
 - e. Record voltage and frequency overshoot for each prime mover.

- f. Observe and record time required to achieve steady-state condition with all switches transferred to emergency position.
 - g. Record voltage, frequency and amperes.
 - h. Record oil pressure, water temperature where applicable and battery charge rate at 5-minute intervals for the first 15 minutes and at 15 minute intervals thereafter for each prime mover.
 - i. Return normal power to facility, record time delay on retransfer to normal for each switch and cooldown time delay for each prime mover.
- 5. Test number two:
 - a. Immediately after completion of test number one, start prime mover and upon reaching rated RPM, pick up 100% of nameplate KW rating in one step.
 - 1) Unity power factor is acceptable for on-site testing
 - b. Observe and record the cranking time(s) required to start and run for each prime mover.
 - c. Observe and record the time required to come up to operating speed for each prime mover.
 - d. Record voltage and frequency overshoot for each prime mover.
 - e. Observe and record time required to achieve steady-state condition.
 - f. Record voltage, frequency and amperes.
 - g. Record oil pressure, water temperature where applicable and battery charge rate at first load acceptance and at 15 minute intervals thereafter for each prime mover.
- 6. Cycle crank test:
 - a. Perform test for each prime mover.
 - 1) Utilize any method recommended by manufacturer to prevent prime mover(s) from running.
 - 2) Put control switch into "run" position to cause prime mover to crank.
 - b. A complete cranking cycle shall consist of an automatic crank period of approximately 15 seconds duration followed by a rest period of approximately 15 seconds duration.
 - 1) Upon starting and running of the prime mover, further cranking shall cease.
 - 2) Two means of cranking termination shall be utilized so that one will act as a backup to the other to prevent inadvertent starter engagement.
 - 3) Cranking limiter time shall be 75 seconds for cycle crank.
- 7. Furnish load banks of required ratings necessary for tests.
- 8. Record engine fuel consumption by means of test equipment.
- 9. Test all safeties specified for generator instruments and controls [and generator remote annunciator panel] as recommended by manufacturer and as required to verify proper operation.
- 10. The Contractor shall be responsible for fuel and all consumables use during the test.
- B. Supplier's onsite services: Employ and pay for services of equipment manufacturer's field service representative(s) to:
 - 1. Inspect equipment covered by this Section.
 - 2. Supervise pre-startup adjustments and installation checks.
 - 3. Conduct initial startup of equipment and perform operational checks.
 - 4. Provide Owner written statement that manufacturer's equipment has been installed properly, started up, tested, and is ready for operation by facilities operations and maintenance personnel.
 - 5. Provide training of facility operation and maintenance personnel.