
SECTION 263213 - DIESEL GENERATOR SET

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of generators, of types and ratings required in this Section, whose products are Listed and Labeled for the purpose intended. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label electrical and mechanical equipment. Subject to compliance with requirements provide equipment equivalent to that provided by one of the following manufacturers:

Caterpillar, Inc.
Cummins/Onan Corporation
Kohler
MTU Onsite Energy

Agreement to Maintain: Engage installer who is willing to execute with the Owner, required agreement for continued maintenance of diesel engine driven generator units.

Codes and Standards:

Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 517, 700, 701, and 702 pertaining to construction and installation of emergency and standby systems as appropriate to the installation.

NFPA Compliance: Comply with applicable requirements of NFPA 30, *Flammable & Combustible Liquids Code*; NFPA 37, *Installation and Use of Stationary Combustion Engines and Gas Turbines*; NFPA 101, *Code for Safety to Life from Fire in Buildings and Structures*; and NFPA 110, *Standard for Emergency and Standby Power Systems*. The present system is considered to be a Level 1 Emergency Power Supply.

UL Compliance: Comply with applicable requirements of UL 1008, *Automatic Transfer Switches*; UL 486A, *Wire Connectors and Soldering Lugs for Use with Copper Conductors*, UL 486B, *Wire Connectors for Use with Aluminum Conductors* and UL 2200, *Stationary Engine Generator Assemblies*.

ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA MG 1, *Motors and Generators*; and MG 2, *Safety and Use of Electric Motors and Generators*.

NEMA Compliance: Comply with applicable requirements of NEMA's Stds. Pub No. 250, *Enclosures for Electrical Equipment (1,000-Volts Maximum)*.

IEEE Compliance: Comply with applicable portions of IEEE Std. 446, *IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications*.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 019913. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's data on diesel engine driven generator sets and components. Include manufacturer's standard product warranty, for duration of not less than one-year, for replacement of materials and equipment used in diesel generator systems. As a minimum provide the following product information:

- Generator set physical and electrical specifications.
- Dimensional outline plan and elevations drawings of engine generator set and other components being furnished.
- Thermal damage curve for generator
- Time-current characteristic curves for generator protective device.

Shop Drawings: Submit layout drawings of diesel engine driven generator units and accessories including, but not limited to, remote mounted automatic transfer switch, fuel line piping, exhaust line piping, remote start-stop stations, annunciator stations, and instrumentation. In addition, show diesel generator set unit and its spatial relationship to associated equipment. Allow adequate clearance space for removal of engine generator elements for maintenance purposes.

Wiring Diagrams: Submit wiring diagrams for diesel engine driven generator units showing connections to electrical power panels, feeders, automatic transfer switches, annunciators, and ancillary equipment. Differentiate between portions of wiring that are manufacturer-installed and portions that are field installed.

Certifications: Provide diesel engine driven generator sets certified test record of the following final production testing:

- Single-step load pickup
- Transient and steady-state governing
- Safety shutdown device testing
- Voltage regulation
- Rated power
- Maximum power

Provide certified test record prior to engine-driven generator set being shipped from factory to project location.

Agreement to Maintain: Prior to time of final acceptance, the Contractor shall submit four (4) copies of an agreement for continued service and maintenance of diesel engine driven generator set, for Owner's acceptance. Offer terms and conditions for furnishing parts and providing continued testing and servicing, including replacement of materials and equipment, for one-year period with option for renewal of Agreement by Owner.

PART 2 - PRODUCTS

DIESEL GENERATOR SETS

General: Except as otherwise indicated, provide manufacturer's standard diesel engine-driven generator set and auxiliary equipment as indicated by published product information, and as required for a complete installation.

Diesel Engine-Driven Generator: Provide packaged electrical power diesel engine-driven generator assembly unit as indicated, rated 200 kW, 250 kVA at 0.8 PF, at a governed speed of 1,800 RPM, and standby rated at 80 percent power factor for operation at 480Y/277 Volt, 3-phase, 4-wire, 60 Hz, 301 Amperes at 500 feet altitude, at 105° F. Alternator shall be 2/3 electrical pitch. Equip generator with 4-cycle, 6-cylinder, 320 HP diesel engine sized to support the generator load, and fueled with diesel fuel, Grade DF-2. Maximum piston speed shall not exceed 2,250 feet/minute. The generator prime mover shall be liquid cooled with a unit-mounted radiator, blower fan, water pump, thermostat, and radiator duct flange capable of cooling engine with up to 0.25 inches water static pressure on fan. Connect engine drive directly to revolving-field type single, maintenance-free, sealed bearing generator through semi-flexible steel disk coupling. Equip set with associated control equipment to automatically start engine, transfer load to standby power upon failure of normal power source, transfer load back to normal power upon its restoration, and stop engine.

Cushion-mount engine-generator on heavy steel base with vibration isolators to reduce possibility of torsional vibration. Equip engine with low-oil pressure, high-water temperature, and automatic overspeed safety shutdown devices. Equip generator with exciter and voltage regulator to maintain voltage within ½ percent of rated value from no load to full load. Construct unit in compliance with applicable standards; and with additional construction features as indicated.

Where a generator enclosure is specified in this section, enclosure shall not contribute to de-rating of generator below values specified above. Incorporate provisions into enclosure and/or radiator system designs to offset resulting reductions in generator capacity and maintain specified ratings.

While the fire pump is in operation, the generator shall continue to produce rated nameplate power without shutdown or derate for alarms and warnings or failed engine sensors, except for overspeed shutdown.

Generator Set Indicating and Protective Devices and Controls: As a minimum provide an illuminated generator set mounted control panel with the following:

- AC voltmeter.
- AC ammeter.
- AC frequency meter.
- DC voltmeter (alternator battery charging).
- Engine-coolant temperature gage.
- Engine lubricating-oil pressure gage.
- Running-time meter.
- Ammeter-voltmeter, phase-selector switch(es).
- Generator-voltage adjusting rheostat.
- Off-Automatic-Run switch.
- Overspeed shutdown device.
- Coolant high-temperature shutdown device.
- Coolant low-level shutdown device.
- Oil low-pressure shutdown device.
- Fuel tank derangement alarm.
- Fuel tank high-level shutdown of fuel supply alarm.

Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support specified items. Locate sensors and other supporting items on engine, generator, or elsewhere as indicated. Where not indicated, locate to suit manufacturer's standard.

Connection to Data Link: A separate terminal block, factory wired to Form "C", dry contacts, for each alarm and status indication is reserved for connections for data link transmission of indications to remote data terminals. Data system connections to terminals are covered in another Section.

Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel. Locate audible device and silencing means where indicated.

Generator Set Performance: The generator set shall meet the following minimum performance requirements. It shall be permissible to oversize the generator and/or engine from the above stated values to meet the requirements of this section.

Steady State Voltage Operational Bandwidth: within 2 percent band of rated output voltage from no load to full load.

Steady-State Voltage Modulation Frequency: Less than 1 Hz.

Transient Voltage Performance: Not more than 20 percent variation for 90 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 1.5 seconds.

Steady State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

Steady-State Frequency Stability: When system is operating at any constant load within rated load, there are no random speed variations outside the steady-state operational band and no hunting or surging of speed.

Transient Frequency Performance: Less than 5 percent variation for a 90 percent step-load increase or decrease. Frequency recovers to remain within the steady-state operating band within five seconds.

Output Waveform: At no load and for any load up to rated load with power factors between 80 and 100 percent, Total Harmonic Distortion (THD) of the voltage waveform measured line to line or line to neutral shall not exceed 5 percent and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.

Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, the system will supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to any generator system component.

Excitation System: Generator automatic voltage regulation system shall use three-phase sensing to isolate regulator from voltage distortion caused by non-linear loads applied to the generator set. Regulator circuits shall be filtered to isolate field control power from effects of load distortion.

Maximum Start & Load Transfer Time: 10 Seconds.

Generator Disconnect: Provide circuit breaker main disconnect(s) for generator. The circuit breaker(s) shall have screw adjustments for timing function adjustment and shall be equipped with a sealable cover to prevent tampering.

Fire Pump: 80 Amp, 480Y/277 Volt, 3 pole, 10,000 AIC, with short circuit function only. This breaker shall be coordinated with the breaker in the fire pump ATS/Controller prior to purchase, allowing a 30 second minimum retention at locked rotor current.

Emergency Source: 100 Amp, 480Y/277 Volt, 3 pole, 10,000 AIC, electronic trip unit function.

Standby Source: 100 Amp, 480Y/277 Volt, 3 pole, 10,000 AIC, thermal magnetic function.

Circuit breakers shall be selectively coordinated as directed by the project engineer. Selective coordination shall be demonstrated for all branches of the emergency power system for all sources including the normal power supply system.

Ground Fault Sensor: The generator circuit breaker shall be equipped with an adjustable sensor, sized to match the circuit breaker size, to detect ground fault conditions. The sensor shall be field programmable to either trip generator disconnect circuit breaker or to close a set of dry contacts.

Ground Fault Remote Annunciator: Provide a remote annunciator for ground fault conditions. The alarm shall provide a visual and aural alarm in the event of a ground fault in excess of the setting of the ground fault sensor of the generator circuit breaker. Use of a spare light on the generator remote annunciator is acceptable provided that the light is labeled to match other labeling on the annunciator.

The circuit breaker, including neutral current transformer, shall be factory assembled to the generator. The circuit breaker with related components and enclosure shall be suitable for use in wet locations for outside generator sets.

Starting System: Provide engine-generator unit with 24-Volt, negative ground, starting system including 24-Volt positive engagement solenoid shift-starting motor, batteries and 35-Ampere, or greater, automatic battery charging alternator with solid-state voltage regulation. The starting battery shall be sized to provide a minimum of five full cranking cycles at a temperature of 20° F without recharging.

Starting Batteries: Starting Batteries shall be lead-acid type. Batteries shall be racked on corrosion resistant rack(s) located adjacent to the generator set or as shown on the Drawings. Line supplied and generator mounted charging alternator shall be configured to match battery type furnished with the generator set.

Battery Heater: Provide a line powered battery heater to maintain the temperature of the cranking battery no lower than 40° F.

Starting Battery Disconnect: Provide a battery disconnect(s) capable of being locked on the "off" position with a hasp-type lock(s). The battery disconnect shall be electrically arranged such that when it is in the "off" position all battery voltage is effectively removed from the generator and related systems. The battery disconnect shall be configured to comply with OSHA Hazardous Energy (Lockout/Tagout) as described in 29 CFR 1910.147.

ENGINE-GENERATOR SET ACCESSORIES

Weather Protective Housing: Provide rust-resistant sound attenuating weather-protective housing for diesel generator unit made of heavy gage reinforced steel; mate and match to the unit enclosed, which permits proper cooling, and access to both controller and service points. Enclosure shall be vandal-resistant and lockable with pin-type locks; access panels, once unlocked, shall be removable without the use of tools. Doors shall permit escape from within, once locked from the outside. Overall, the structure shall be constructed to withstand loads imposed by 120 MPH winds. The maximum sound level permitted shall not exceed 74 dBA at a distance of 23 feet from the generator set enclosure. Ventilation opening louvers shall be motor operated for closed position and spring loaded for open position. All exterior components of the enclosure shall be assembled utilizing stainless steel hardware and all seams shall be sealed to prevent leaks. The enclosure shall be primed with minimum of two (2) coats of rust inhibiting primer and two (2) finish coats. Color of the enclosure shall be as selected by the Designer/Owner.

Protective Enclosure Illumination: Provide switched illumination for the interior of the generator enclosure powered from the generator cranking battery system. Illumination shall be a minimum of 30 fc at all locations within the generator enclosure requiring maintenance or inspection. Switch for controlling lights shall be a wind-up timer type, with pre-set limit of 1 hour.

Diesel Generator Set Access Platform: Provide OSHA approved generator access platform to match generator sub-base tank. Generator access platform shall be constructed of steel, shall have a minimum clear width of 42", a safety railing, and shall provide access to all genset doors; provide additional walkway width if necessary to clear genset door swing. Elevation of the platform walkway shall be at the base elevation of the genset. Platform shall have stair or ladder from ground elevation to the walkway. Access platform shall be painted with a black corrosion resistant finish and shall be set in concrete footings that match the generator concrete base depth and general construction. Provide platform shop drawings for review prior to construction.

Provide factory-fabricated free standing automatic load-transfer switch control as specified in Section 263623, ***AUTOMATIC AND NON-AUTOMATIC TRANSFER SWITCHES.***

Provide integral, UL-142 listed, double walled sub-base diesel tank, 1000 gallons capacity, completely installed under generator set upon arrival to job site.

Sub-Base tank assembly shall consist of a frame to support the total weight of the generator set with the fuel tank separate and contained within the frame. No generator weight is to be supported by the tank. The frame shall be constructed suitably to form a rupture basin for the tank if a leak should develop. Provide a drain plug at one end of the rupture basin. Provide vibration isolators between generator set and tank assembly. Provide fuel low level and leak detection alarm contacts to remote mounted annunciator.

The exterior surface of the sub-base tank assembly shall be protected from corrosion by the factory application of a corrosion-resistant coating. The sub-base tank shall be physically arranged such that the lower surface of the tank does not come into direct contact with the generator set concrete pad. Provide additional fill/return ports in fuel tank for future connection of mobile fuel polishing system.

Provide remote annunciation system per NFPA 76A, 101, and 110. Remote annunciator panels shall have visual and audible alarms to monitor and warn of emergency operating conditions affecting line and generator power sources. As a minimum the remote annunciator shall indicate the following:

- Engine high-temperature shutdown.
- Lube-oil low-pressure shutdown.
- Overspeed shutdown.
- Remote emergency-stop shutdown.
- Engine high-temperature pre-alarm.
- Lube-oil low-pressure pre-alarm.
- Fuel tank low level.
- Overcrank shutdown.
- Coolant low-temperature alarm.
- Control switch not in auto position.
- Battery-charger malfunction alarm.
- Battery low-voltage alarm.
- Additional items as described elsewhere.

Remote Shutdown Switch: The remote annunciator panel shall have a red locking-type mushroom head emergency generator shut-down button either built into the annunciator panel or located adjacent to the annunciator panel location. Activation of the emergency shut-down button shall cause the generator to shut-down and shall illuminate a "generator not in automatic" light on generator control panel and the annunciator panel.

Provide engine block heater, (1500 Watt, 120 Volts, single phase) with thermostatic controls to maintain engine coolant at proper temperature. Block heater shall be de-energized when genset is running.

Provide line operated (120 VAC) float type battery charger connected to maintain the cranking battery in a charged condition. The battery charger shall be matched to the starting battery voltage and have panel mounted meters to indicate the charging current level and the voltage across the starting battery terminals. The charger shall have self-contained provisions for fault detection and shall be connected to the remote annunciator to indicate an overcharged, undercharged, or other abnormal condition of the starting batteries or charging system. The battery charger, when installed in the weather proof housing shall be suitable for use in wet locations.

Provide insulated critical grade exhaust silencer with drain, piping, and bellows adaptor, completely sealed, metal prime finish, mounted on generator enclosure. The silencer shall be mounted such that weight is supported independent from engine. Thermal expansion of exhaust system shall not impose stress on engine assembly. Match bellows flange to vertical exhaust stack flange. Provide rain cap to prevent entrance of moisture into system. Measured sound level at a distance of 23 feet from the exhaust discharge must be 74 dBA or less.

Provide anchor bolts of galvanized steel, of types and sizes recommended by manufacturer.

Provide glycol base antifreeze coolant suitable for operation at -20° F.

PART 3 - EXECUTION

FIELD QUALITY CONTROL

Start-up Testing:

Engage local equipment manufacturer's representative to perform start-up and building load tests upon completion of installation, with the A-E in attendance; provide certified test record. Tests are to include all tests required in NFPA 110 Section 7.13 and the following:

Check fuel, lubricating oil, and antifreeze in liquid cooled models for conformity to the manufacturer's recommendations under environmental conditions present.

Test prior to cranking engine for proper operation, accessories that normally function while the set is in a standby mode. Accessories include: engine heaters, battery charger, generator strip heater, remote annunciator.

Check, during start-up test mode, for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.

Test, by means of simulated power outage, automatic start-up by remote-automatic starting, transfer of load, and automatic shut-down. Prior to this test adjust, for proper system coordination, transfer switch timers. Monitor throughout the test, engine temperature, oil pressure, battery charge level, generator voltage, amperes, and frequency. The capability of the system to pick up full standby service load within 10 seconds of power outage shall be demonstrated.

Measure voltage total harmonic distortion (THD) for each line-to-line (L-L) and line-to-neutral (L-N) combination at 50 kW increments up to rated power and at rated power factor.

Prior to acceptance of the installation, the generator shall be subjected to a 4 hour test. This test shall be performed at the job site by the equipment vendor and documented. It shall include 1 hour at 50% load, 1 hour at 75% load, 1 hour at 100% load and 1 hour at 50% load. Upon completion of the four hour load test, the generator shall be shut-down after the cooling period. The generator shall be started immediately upon reaching rated rpm, 100% load shall be applied to demonstrate one step full load capability.

Upon completion of installation demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. Initial testing and retesting to be at no cost to Owner.

At the conclusion of testing and demonstrations fill the fuel tank to its rated capacity and verify that all other consumables are at their maximum level. Unless instructed otherwise by the A-E, leave the unit set up for automatic operation.

DOCUMENTATION

Prior to acceptance, the manufacturer shall supply three (3) copies of complete instruction manuals to the Owner. The manuals shall include operation and maintenance procedures, complete parts lists, dimensional drawings, unit wiring diagrams and schematics, and interconnection wiring drawings.

WARRANTY

The emergency generator, transfer switch and associated equipment shall be warranted by the manufacturer for a period of five (5) years, from the date of final inspection and acceptance. The warranty shall include all parts, labor (including travel and expenses) and equipment necessary to perform replacement and/or repairs.

PERSONNEL TRAINING

Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing and operating diesel engine-driven generator sets. In addition, train Owner's personnel in periodic maintenance of batteries.

END OF SECTION 263213

