

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.

1 **Product Data:** Submit manufacturer's data on diesel engine driven generator sets and components. Include
2 manufacturer's standard product warranty, for duration of not less than one-year, for replacement of materials and
3 equipment used in diesel generator systems. As a minimum provide the following product information:
4

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

10
11 **Shop Drawings:** Submit layout drawings of diesel engine driven generator units and accessories including, but not
12 limited to, remote mounted automatic transfer switch, fuel line piping, exhaust line piping, remote start-stop stations,
13 annunciator stations, and instrumentation. In addition, show diesel generator set unit and its spatial relationship to
14 associated equipment. Allow adequate clearance space for removal of engine generator elements for maintenance
15 purposes.
16

17 **Wiring Diagrams:** Submit wiring diagrams for diesel engine driven generator units showing connections to electrical
18 power panels, feeders, automatic transfer switches, annunciators, and ancillary equipment. Differentiate between
19 portions of wiring that are manufacturer-installed and portions that are field installed.
20

21 **Certifications:** Provide diesel engine driven generator sets certified test record of the following final production
22 testing:
23

- 24 Single-step load pickup
- 25 Transient and steady-state governing
- 26 Safety shutdown device testing
- 27 Voltage regulation
- 28 Rated power
- 29 Maximum power

30
31 **Provide certified test record** prior to engine-driven generator set being shipped from factory to project location.
32

33 **Agreement to Maintain:** Prior to time of final acceptance, the Contractor shall submit four (4) copies of an agreement
34 for continued service and maintenance of diesel engine driven generator set, for Owner's acceptance. Offer terms
35 and conditions for furnishing parts and providing continued testing and servicing, including replacement of materials
36 and equipment, for one-year period with option for renewal of Agreement by Owner.
37

38 **PART 2 - PRODUCTS**

39 **DIESEL GENERATOR SETS**

40
41
42 **General:** Except as otherwise indicated, provide manufacturer's standard diesel engine-driven generator set and
43 auxiliary equipment as indicated by published product information, and as required for a complete installation.
44

45
46 **Diesel Engine-Driven Generator:** Provide packaged electrical power diesel engine-driven generator assembly unit as
47 indicated, rated 200 kW, 250 kVA at 0.8 PF, at a governed speed of 1,800 RPM, and standby rated at 80 percent
48 power factor for operation at 480Y/277 Volt, 3-phase, 4-wire, 60 Hz, 301 Amperes at 500 feet altitude, at 105° F.
49 Alternator shall be 2/3 electrical pitch. Equip generator with 4-cycle, 6-cylinder, 320 HP diesel engine sized to
50 support the generator load, and fueled with diesel fuel, Grade DF-2. Maximum piston speed shall not exceed 2,250
51 feet/minute. The generator prime mover shall be liquid cooled with a unit-mounted radiator, blower fan, water pump,
52 thermostat, and radiator duct flange capable of cooling engine with up to 0.25 inches water static pressure on fan.
53 Connect engine drive directly to revolving-field type single, maintenance-free, sealed bearing generator through
54 semi-flexible steel disk coupling. Equip set with associated control equipment to automatically start engine, transfer
55 load to standby power upon failure of normal power source, transfer load back to normal power upon its restoration,
56 and stop engine.
57
58

1 Cushion-mount engine-generator on heavy steel base with vibration isolators to reduce possibility of torsional
2 vibration. Equip engine with low-oil pressure, high-water temperature, and automatic overspeed safety shutdown
3 devices. Equip generator with exciter and voltage regulator to maintain voltage within ½ percent of rated value from
4 no load to full load. Construct unit in compliance with applicable standards; and with additional construction features
5 as indicated.
6

7 Where a generator enclosure is specified in this section, enclosure shall not contribute to de-rating of generator below
8 values specified above. Incorporate provisions into enclosure and/or radiator system designs to offset resulting
9 reductions in generator capacity and maintain specified ratings.
10

11 While the fire pump is in operation, the generator shall continue to produce rated nameplate power without shutdown
12 or derate for alarms and warnings or failed engine sensors, except for overspeed shutdown.
13

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

- 16 AC voltmeter.
- 17 AC ammeter.
- 18 AC frequency meter.
- 19 DC voltmeter (alternator battery charging).
- 20 Engine-coolant temperature gage.
- 21 Engine lubricating-oil pressure gage.
- 22 Running-time meter.
- 23 Ammeter-voltmeter, phase-selector switch(es).
- 24 Generator-voltage adjusting rheostat.
- 25 Off-Automatic-Run switch.
- 26 Overspeed shutdown device.
- 27 Coolant high-temperature shutdown device.
- 28 Coolant low-level shutdown device.
- 29 Oil low-pressure shutdown device.
- 30 Fuel tank derangement alarm.
- 31 Fuel tank high-level shutdown of fuel supply alarm.
32

33 Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support
34 specified items. Locate sensors and other supporting items on engine, generator, or elsewhere as indicated. Where
35 not indicated, locate to suit manufacturer's standard.
36

37 Connection to Data Link: A separate terminal block, factory wired to Form "C", dry contacts, for each alarm and
38 status indication is reserved for connections for data link transmission of indications to remote data terminals. Data
39 system connections to terminals are covered in another Section.
40

41 Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary
42 contacts and terminals in control and monitoring panel. Locate audible device and silencing means where indicated.
43

44 Generator Set Performance: The generator set shall meet the following minimum performance requirements. It shall
45 be permissible to oversize the generator and/or engine from the above stated values to meet the requirements of this
46 section.
47

48 Steady State Voltage Operational Bandwidth: within 2 percent band of rated output voltage from
49 no load to full load.
50

51 Steady-State Voltage Modulation Frequency: Less than 1 Hz.
52

53 Transient Voltage Performance: Not more than 20 percent variation for 90 percent step-load
54 increase or decrease. Voltage shall recover and remain within the steady-state operating band
55 within 1.5 seconds.
56

57 Steady State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full
58 load.
59
60

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

4
5 Transient Frequency Performance: Less than 5 percent variation for a 90 percent step-load
6 increase or decrease. Frequency recovers to remain within the steady-state operating band within
7 five seconds.

8
9 Output Waveform: At no load and for any load up to rated load with power factors between 80 and
10 100 percent, Total Harmonic Distortion (THD) of the voltage waveform measured line to line or line
11 to neutral shall not exceed 5 percent and 3 percent for single harmonics. The telephone influence
12 factor, determined according to NEMA MG 1, shall not exceed 50.

13
14 Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals,
15 the system will supply a minimum of 250 percent of rated full-load current for not less than 10
16 seconds and then clear the fault automatically, without damage to any generator system
17 component.

18
19 Excitation System: Generator automatic voltage regulation system shall use three-phase sensing
20 to isolate regulator from voltage distortion caused by non-linear loads applied to the generator set.
21 Regulator circuits shall be filtered to isolate field control power from effects of load distortion.

22
23 Maximum Start & Load Transfer Time: 10 Seconds.

24
25 Generator Disconnect: Provide circuit breaker main disconnect(s) for generator. The circuit breaker(s) shall have
26 screw adjustments for timing function adjustment and shall be equipped with a sealable cover to prevent tampering.

27
28 Fire Pump: 80 Amp, 480Y/277 Volt, 3 pole, 10,000 AIC, with short circuit function only. This breaker shall be
29 coordinated with the breaker in the fire pump ATS/Controller prior to purchase, allowing a 30 second minimum
30 retention at locked rotor current.

31
32 Emergency Source: 100 Amp, 480Y/277 Volt, 3 pole, 10,000 AIC, electronic trip unit function.

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

34
35 Circuit breakers shall be selectively coordinated as directed by the project engineer. Selective coordination shall be
36 demonstrated for all branches of the emergency power system for all sources including the normal power supply
37 system.

38
39 Ground Fault Sensor: The generator circuit breaker shall be equipped with an adjustable sensor, sized to
40 match the circuit breaker size, to detect ground fault conditions. The sensor shall be field programmable to
41 either trip generator disconnect circuit breaker or to close a set of dry contacts.

42
43 Ground Fault Remote Annunciator: Provide a remote annunciator for ground fault conditions. The alarm
44 shall provide a visual and aural alarm in the event of a ground fault in excess of the setting of the ground
45 fault sensor of the generator circuit breaker. Use of a spare light on the generator remote annunciator is
46 acceptable provided that the light is labeled to match other labeling on the annunciator.

47
48 The circuit breaker, including neutral current transformer, shall be factory assembled to the generator. The circuit
49 breaker with related components and enclosure shall be suitable for use in wet locations for outside generator sets.

50

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

5
6 Starting Batteries: Starting Batteries shall be lead-acid type. Batteries shall be racked on corrosion
7 resistant rack(s) located adjacent to the generator set or as shown on the Drawings. Line supplied and
8 generator mounted charging alternator shall be configured to match battery type furnished with the
9 generator set.

10
11 Battery Heater: Provide a line powered battery heater to maintain the temperature of the cranking battery no
12 lower than 40° F.

13
14 Starting Battery Disconnect: Provide a battery disconnect(s) capable of being locked on the "off" position
15 with a hasp-type lock(s). The battery disconnect shall be electrically arranged such that when it is in the "off"
16 position all battery voltage is effectively removed from the generator and related systems. The battery
17 disconnect shall be configured to comply with OSHA Hazardous Energy (Lockout/Tagout) as described in 29
18 CFR 1910.147.

19
20
21 **ENGINE-GENERATOR SET ACCESSORIES**

22
23 Weather Protective Housing: Provide rust-resistant sound attenuating weather-protective housing for diesel
24 generator unit made of heavy gage reinforced steel; mate and match to the unit enclosed, which permits proper
25 cooling, and access to both controller and service points. Enclosure shall be vandal-resistant and lockable with pin-
26 type locks; access panels, once unlocked, shall be removable without the use of tools. Doors shall permit escape
27 from within, once locked from the outside. Overall, the structure shall be constructed to withstand loads imposed by
28 120 MPH winds. The maximum sound level permitted shall not exceed 74 dBA at a distance of 23 feet from the
29 generator set enclosure. Ventilation opening louvers shall be motor operated for closed position and spring loaded
30 for open position. All exterior components of the enclosure shall be assembled utilizing stainless steel hardware and
31 all seams shall be sealed to prevent leaks. The enclosure shall primed with minimum of two (2)
32 coats of rust inhibiting primer and two (2) finish coats. Color of the enclosure shall be as selected by the
33 Designer/Owner.

34
35 Protective Enclosure Illumination: Provide switched illumination for the interior of the generator enclosure
36 powered from the generator cranking battery system. Illumination shall be a minimum of 30 fc at all
37 locations within the generator enclosure requiring maintenance or inspection. Switch for controlling lights
38 shall be a wind-up timer type, with pre-set limit of 1 hour.

39
40 Diesel Generator Set Access Platform: Provide OSHA approved generator access platform to match generator sub-
41 base tank. Generator access platform shall be constructed of steel, shall have a minimum clear width of 42", a safety
42 railing, and shall provide access to all genset doors; provide additional walkway width if necessary to clear genset
43 door swing. Elevation of the platform walkway shall be at the base elevation of the genset. Platform shall have stair
44 or ladder from ground elevation to the walkway. Access platform shall be painted with a black corrosion resistant
45 finish and shall be set in concrete footings that match the generator concrete base depth and general construction.
46 Provide platform shop drawings for review prior to construction.

47
48 Provide factory-fabricated free standing automatic load-transfer switch control as specified in Section 263623,
49 *AUTOMATIC AND NON-AUTOMATIC TRANSFER SWITCHES.*

50
51 Provide integral, UL-142 listed, double walled sub-base diesel tank, 1000 gallons capacity, completely installed under
52 generator set upon arrival to job site.

53
54 Sub-Base tank assembly shall consist of a frame to support the total weight of the generator set with the fuel
55 tank separate and contained within the frame. No generator weight is to be supported by the tank. The
56 frame shall be constructed suitably to form a rupture basin for the tank if a leak should develop. Provide a
57 drain plug at one end of the rupture basin. Provide vibration isolators between generator set and tank
58 assembly. Provide fuel low level and leak detection alarm contacts to remote mounted annunciator.
59

1 The exterior surface of the sub-base tank assembly shall be protected from corrosion by the factory
2 application of a corrosion-resistant coating. The sub-base tank shall be physically arranged such that the
3 lower surface of the tank does not come into direct contact with the generator set concrete pad. Provide
4 additional fill/return ports in fuel tank for future connection of mobile fuel polishing system.
5

6 Provide remote annunciation system per NFPA 76A, 101, and 110. Remote annunciator panels shall have visual and
7 audible alarms to monitor and warn of emergency operating conditions affecting line and generator power sources.
8 As a minimum the remote annunciator shall indicate the following:
9

10 Engine high-temperature shutdown.
11 Lube-oil low-pressure shutdown.
12 Overspeed shutdown.
13 Remote emergency-stop shutdown.
14 Engine high-temperature pre-alarm.
15 Lube-oil low-pressure pre-alarm.
16 Fuel tank low level.
17 Overcrank shutdown.
18 Coolant low-temperature alarm.
19 Control switch not in auto position.
20 Battery-charger malfunction alarm.
21 Battery low-voltage alarm.
22 Additional items as described elsewhere.
23

24 Remote Shutdown Switch: The remote annunciator panel shall have a red locking-type mushroom head emergency
25 generator shut-down button either built into the annunciator panel or located adjacent to the annunciator panel
26 location. Activation of the emergency shut-down button shall cause the generator to shut-down and shall illuminate a
27 "generator not in automatic" light on generator control panel and the annunciator panel.
28

29 Provide engine block heater, (1500 Watt, 120 Volts, single phase) with thermostatic controls to maintain engine
30 coolant at proper temperature. Block heater shall be de-energized when genset is running.
31

32 Provide line operated (120 VAC) float type battery charger connected to maintain the cranking battery in a charged
33 condition. The battery charger shall be matched to the starting battery voltage and have panel mounted meters to
34 indicate the charging current level and the voltage across the starting battery terminals. The charger shall have self-
35 contained provisions for fault detection and shall be connected to the remote annunciator to indicate an overcharged,
36 undercharged, or other abnormal condition of the starting batteries or charging system. The battery charger, when
37 installed in the weather proof housing shall be suitable for use in wet locations.
38

39 Provide insulated critical grade exhaust silencer with drain, piping, and bellows adaptor, completely sealed, metal
40 prime finish, mounted on generator enclosure. The silencer shall be mounted such that weight is supported
41 independent from engine. Thermal expansion of exhaust system shall not impose stress on engine assembly. Match
42 bellows flange to vertical exhaust stack flange. Provide rain cap to prevent entrance of moisture into system.
43 Measured sound level at a distance of 23 feet from the exhaust discharge must be 74 dBA or less.
44

45 Provide anchor bolts of galvanized steel, of types and sizes recommended by manufacturer.
46

47 Provide glycol base antifreeze coolant suitable for operation at -20° F.
48
49

50 **PART 3 - EXECUTION**

51 **FIELD QUALITY CONTROL**

52 Start-up Testing:

53
54 Engage local equipment manufacturer's representative to perform start-up and building load tests upon
55 completion of installation, with the A-E in attendance; provide certified test record. Tests are to include all
56 tests required in NFPA 110 Section 7.13 and the following:
57
58
59

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

3
4 Test prior to cranking engine for proper operation, accessories that normally function while the set
5 is in a standby mode. Accessories include: engine heaters, battery charger, generator strip heater,
6 remote annunciator.

7
8 Check, during start-up test mode, for exhaust leaks, path of exhaust gases outside the building,
9 cooling air flow, movement during starting and stopping, vibration during running, normal and
10 emergency line-to-line voltage and phase rotation.

11
12 Test, by means of simulated power outage, automatic start-up by remote-automatic starting, transfer of load,
13 and automatic shut-down. Prior to this test adjust, for proper system coordination, transfer switch timers.
14 Monitor throughout the test, engine temperature, oil pressure, battery charge level, generator voltage,
15 amperes, and frequency. The capability of the system to pick up full standby service load within 10 seconds
16 of power outage shall be demonstrated.

17
18 Measure voltage total harmonic distortion (THD) for each line-to-line (L-L) and line-to-neutral (L-N)
19 combination at 50 kW increments up to rated power and at rated power factor.

20
21 Prior to acceptance of the installation, the generator shall be subjected to a 4 hour test. This test
22 shall be performed at the job site by the equipment vendor and documented. It shall include 1 hour
23 at 50% load, 1 hour at 75% load, 1 hour at 100% load and 1 hour at 50% load. Upon completion of
24 the four hour load test, the generator shall be shut-down after the cooling period. The generator
25 shall be started immediately upon reaching rated rpm, 100% load shall be applied to demonstrate
26 one step full load capability.

27
28 Upon completion of installation demonstrate capability and compliance of system with requirements. Where possible,
29 correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new
30 units, and proceed with retesting. Initial testing and retesting to be at no cost to Owner.

31
32 At the conclusion of testing and demonstrations fill the fuel tank to its rated capacity and verify that all other
33 consumables are at their maximum level. Unless instructed otherwise by the A-E, leave the unit set up for automatic
34 operation.

35 36 37 **DOCUMENTATION**

38
39 Prior to acceptance, the manufacturer shall supply three (3) copies of complete instruction manuals to the Owner.
40 The manuals shall include operation and maintenance procedures, complete parts lists, dimensional drawings, unit
41 wiring diagrams and schematics, and interconnection wiring drawings.

42 43 **WARRANTY**

44
45 The emergency generator, transfer switch and associated equipment shall be warranted by the manufacturer for a
46 period of five (5) years, from the date of final inspection and acceptance. The warranty shall include all parts, labor
47 (including travel and expenses) and equipment necessary to perform replacement and/or repairs.

48 49 50 **PERSONNEL TRAINING**

51
52 Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing and
53 operating diesel engine-driven generator sets. In addition, train Owner's personnel in periodic maintenance of
54 batteries.

55
56
57 **END OF SECTION 263213**

