

SECTION 16230

DIESEL ENGINE GENERATORS

PART 1 - GENERAL

1.1 CONDITIONS & REQUIREMENTS: Refer to the General Conditions and Supplementary General Conditions.

1.2 DESCRIPTION:

A. Work included in this Section

1. Standby Power Engine Generator including load test.
2. Sub-base fuel tank
3. Connection for portable load bank
4. Sound Attenuated Enclosure with vertical cooling air discharge

1.3 CODES AND STANDARDS: The following apply to this section:

- A. 2004 California Electrical Code (CEC)
- B. 2001 California Fire Code (CFC)
- C. 2001 California Mechanical Code
- D. 2001 California Building Code
- E. Underwriters Laboratories (U.L.) standards for above ground fuel tank
- F. NFPA Standard 30, Flammable and Combustible Liquids Code (Current Edition)
- G. NFPA Standard 37, Stationary Combustion Engines and Gas Turbines (Current Edition)
- H. NFPA Standard 110, Standard for Emergency and Standby Power Systems (Current Edition)
- I. Santa Clara County *Installation Guidelines: Aboveground Fuel Tanks for Emergency and Standby Power Systems* (Unified Documents #UN-018, <http://www.unidocs.org/>). This applies in the County and in the City of Palo Alto.
- J. Bay Area Air Quality Management District (BAAQMD) permit requirement in effect at time of bidding including air toxic limits in accordance with BAAQMD approved risk screen procedures.

1.4 SUBMITTALS:

- A. Mark all proposed deviations from Specifications prominently in the submittals. Indicate compliance with the Specifications except for specifically identified exceptions. Submittals that do not clearly indicate compliance with the Specifications may be rejected. **Bills of Material that do not correspond with the Specifications are not sufficient to establish compliance.**

- B. Review of submittals is for general conformance to design concept and general compliance with Specifications. Review comments do not imply waiver of Specifications unless specifically noted.
- C. The County of Santa Clara Requires a Tank System Installation Supplement as part of the permit process. Provide a copy of the Supplement to the Project Manager.
- D. Submittals shall include:
 - 1. Shop drawings and operating manuals.
 - 2. Color sample for enclosure for approval when non-standard color is specified.
 - 3. Mounting details and information for seismic calculations for anchorage of the generator and tank assembly.
 - 4. Operating check and test reports of the generator, tank, and transfer switch.
 - 5. Engine block heater electrical requirements.
 - 6. Certified Air Emissions Specifications in accordance with EPA, California Air Resources Board and BAAQMD requirements. Include EPA engine Family Number.

1.5 TESTS

- A. The generator set shall receive the manufacturer's standard factory load testing.
- B. After installation equipment shall be subjected to a six hour load test at unity power factor to show that it is free of defects and will start and transfer load automatically. Use a load bank for full load test and use actual connected loads to verify proper operation of system.
- C. Provide a field pressure test before fuel is added.
- D. Provide a Final Acceptance Test, coordinated by the Contractor, and performed in the presence of the City Fire Marshal, the University Fire Marshal, City Hazardous Materials Official, and the Project Manager.
- E. START-UP: On completion of the installation, start-up shall be performed by a factory-trained dealer service representative who shall demonstrate proper operation and instruct Owner's operating personnel in procedures. Time for instruction shall be designated by Project Manager.
- F. Reference Section 01770 – Closeout and Turnover Procedures

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION:

- A. System shall consist of a diesel engine-generator set in a sound attenuated weatherproof enclosure complete with all necessary accessories to provide an electrical standby source that will be activated automatically and start within ten seconds in the event of utility power failure and maintain electrical service to critical loads.
- B. All materials, equipment and parts comprising the units specified herein, shall be new and unused, of current manufacture and of highest grade.
- C. It is the intent that the engine-generator manufacturer will furnish all accessories required for operation of the set and compliance with Codes whether specifically mentioned or not.
- D. Acceptable Products:

- 1. Caterpillar: Peterson Power Systems
2828 Teagarden Street
San Leandro, CA 94577
510-895-8400
- 2. Cummins: Cummins West, Inc.
14775 Wicks Blvd.
San Leandro, CA 94577
510-351-6101

E. GENERATOR SET CHARACTERISTICS:

Voltage	480Y/277, 3Ø
Standby kW	See Exhibit
Standby KVA	See Exhibit
Power Factor	0.8
Frequency	60 Hz

- F. The specified standby kW shall be for continuous electrical service during interruption of the normal utility source. These ratings must be substantiated by manufacturer's published curves. Special ratings or maximum ratings are not acceptable.

2.2 ENGINE:

- A. The engine shall be diesel-fueled, liquid-cooled with integrally mounted radiator, fan and coolant pump.
- B. Full pressure lubrication shall be supplied by a positive displacement gear design lube oil pump. The engine shall have coolant and oil filters with replaceable elements; lube oil cooler, air filters and a fuel pump.

- C. Engine speed shall be governed by an electronic governor to maintain isochronous alternator frequency, $\pm .25\%$, from no-load to full-load alternator output.
- D. The engine shall have a DC battery charging alternator with a transistorized voltage regulator.
- E. Safety Devices: Safety shut-offs for high coolant temperature, low oil pressure, over-speed and engine over-crank shall be provided with signal lights and alarm terminals. Engine lube oil shall be supplied by engine manufacturer.
- F. Emissions: Engine shall be equipped with suitable emissions control equipment to ensure that gaseous and particulate exhaust emissions do not exceed applicable Federal, State and BAAQMD emission control regulations including air toxic limits in accordance with approved risk screen procedures.

2.3 COOLING SYSTEM:

- A. Provide an engine-mounted cooling system consisting of a radiator, pump, fan, and thermostat control.
- B. Anti-freeze: The engine cooling system shall be filled with a solution of 50% ethylene glycol.
- C. Provide shut-off valves arranged for replacement of the block heaters without draining the radiator.

2.4 FUEL SYSTEM:

- A. Furnish an integral double contained fuel tank in a sub-base with sufficient fuel for at least fourteen hours of full load operation. Assemble the tank so there is sufficient space between the bottom of the tank and the concrete pad to prevent corrosion. The unit shall include:
 - 1. Complete fuel connections including flexible supply and return lines.
 - 2. Fuel level gauge
 - 3. Low fuel level local alarm and contacts for remote annunciation.
 - 4. Rupture basin with leak detector, local annunciation, and provision for remote monitoring of primary containment failure.
 - 5. Fill Basin with five gallon overfill containment
 - 6. Local high fuel level alarm to prevent overfilling
 - 7. U.L. Listing for above ground storage of Diesel fuel. Provide normal and emergency venting according to the CFC and City/County requirements with 12 foot vent extension above grade.
 - 8. Acceptance pressure test in the field after the unit is installed and before fuel is added according to City/County requirements.

2.5 EXHAUST SYSTEM:

- A. Exhaust Silencer: Provide critical grade silencer including flexible exhaust fitting and rain cap, properly sized and installed, according to the manufacturer's recommendations. Silencer shall be mounted so that its weight is not supported by the engine.
- B. Discharge: The termination point for the exhaust discharge in to the atmosphere shall be according to the UMC but not less than 10 feet above the adjoining grade.

2.6 AUTOMATIC STARTING SYSTEM:

- A. Starting Motor: A DC electric starting system with positive engagement drive.
- B. Automatic Controls: Provide fully automatic generator set start-stop controls in the generator control panel. Controls shall provide shutdown for low oil pressure, high water temperature, over-speed, over-crank, and one auxiliary contact for activating accessory items. Control shall include a 30-second single cranking cycle limit with lockout. Engine shall start and transfer load within 10 seconds. Starting shall be initiated by a remote dry contact closure (at the transfer switch).
- C. Jacket Heater: Furnish a coolant heater that will maintain engine coolant to at 90 degrees F. in an ambient temperature of 20° F. The heater shall be single phase, 60 Hz, 120 or 208V.
- D. Battery: Provide lead-antimony batteries capable of delivering manufacturer's recommended minimum cold cranking amps required at 0°F. and five-ten second cranks of the engine at 20°F. ambient temperature. Provide battery mounting, rated for Seismic Zone 4, within the weatherproof enclosure.
- E. Battery Charger shall be of the fully automatic, two rate type, constant voltage, current limiting, with automatic high-rate charge timer, voltmeter, and ammeter. Locate battery charger within the generator set enclosure, protect from rain that is drawn into the enclosure by the engine.

2.7 GENERATOR:

- A. Type: Generator shall be a three-phase, 60 Hz, with brushless exciter, built to NEMA standards. Class-F insulation (NEMA MG1-1.654) shall be used on the stator and rotor. The generator shall be suitable for linear and not-linear loads (such as UPS).
- B. Regulator: A generator mounted volts-per-Hz type temperature compensated solid state regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be $\pm 2\%$ from no load to full rated load. Readily accessible voltage drop, voltage level and voltage gain controls shall be provided. Voltage level

adjustment shall be a minimum of $\pm 5\%$. The solid state regulator module shall be shock mounted and protected against atmospheric deterioration.

- C. Transient Response: The maximum voltage dip shall not exceed the specified percent as defined by NEMA MG1-16.48.
- D. Generator Control Panel:
1. Type: A generator mounted vibration isolated dead front control panel shall be provided.
 2. Equipment: Panel shall contain, but not be limited to, the following equipment.
 - a. Voltmeter
 - b. Ammeter
 - c. Frequency meter
 - d. Automatic starting controls, as specified in 2.6 above
 - e. Panel illumination lights and switch
 - f. Voltage level adjustment rheostat
 - g. Engine oil pressure gauge
 - h. Engine water temperature gauge
 - i. Fault indicators for low oil pressure, high water temperature, over-speed and over-crank
 - j. Fault indicator for “not-in-auto” that initiates “common trouble.”
 - k. Four position function switch marked “auto”, “manual”, “off/reset”, and “stop”
 - l. Running time meter
 3. Provide a break glass type “Emergency Shut Off” station in a weatherproof enclosure on the exterior of the unit.
- E. Remote Monitoring Interface
1. Provide dry contact (Normally Closed, Open on Alarm) at a terminal strip for the following user connected individual remote alarm.
 - a. Common Trouble (All trouble indicators Including “Not in Auto” and “Ground Fault”)
 - b. Primary Tank Leak
 - c. Engine Run
 - d. Low Fuel
- F. Remote Annunciator Panel
1. Provide a NEMA 1 enclosure with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamp condition shall be clearly apparent under bright room lighting conditions. Provide lamp test and “alarm silence” features. “Alarm silence” shall not prevent the alarm from sounding on subsequent alarms. The generator set control shall indicate the following alarm and shutdown conditions on the display panel.

- a Not-In-Auto (red flashing)
- b Low oil pressure (alarm)
- c Low oil pressure (shutdown)
- d Low coolant temperature (alarm)
- e High coolant temperature (alarm)
- f High coolant temperature (shutdown)
- g Low coolant level (shutdown)
- h Over-crank (shutdown)
- i Over-speed (shutdown)
- j Low fuel (alarm)
- k Ground fault (alarm) when ground fault alarm is specified
- l Primary Tank Leak (alarm)
- m Spare

2.8 CABLE ENTRY: Provide a terminal box arranged to accept conduit connections stubbed up through the pad. Provide sufficient wire bending space to connect the cables to the output circuit breaker.

2.9 MAIN LINE CIRCUIT BREAKER:

- A Provide one generator mounted three-pole insulated case circuit breaker as a load circuit interrupting and protection device. The circuit breaker shall operate both manually for normal switching function and automatically during overload and short circuit conditions.
- B. The trip unit for each pole shall have elements providing adjustable long time, short time, and instantaneous tripping for phase only, no ground fault.
- C. Provide standard lugs on the load side of the main line circuit breaker and one neutral lug.

2.10 LOAD BANK CIRCUIT BREAKER:

- A. Provide one generator mounted three-pole insulated case circuit breaker for connection of a maintenance load bank. Provide a “load dump” trip feature to disconnect the load bank if the generator is activated for emergency service. The circuit breaker shall operate both manually for normal switching function and automatically during overload and short circuit conditions.

2.11 LOAD BANK CONNECTION:

- A Provide a dead front load bank connection panel connected to the load side of the load bank circuit breaker with Cooper/Crouse-Hinds **cam-lock** E1016 Series, 400 amp female connectors, one per phase to 200A and two per phase for larger, black, marked: AØ, BØ,

CØ, and one ground (green). Provide matching insulated caps over the connectors. The load bank connection shall be rated at main breaker amperage.

2.12 ENGINE GENERATOR SET MOUNTING:

- A The engine-generator set shall be mounted with integral vibration isolation on a structural steel base for direct anchoring to concrete pad. If spring isolators are recommended by the manufacturer, they shall be factory installed between the base of the generator set and the top of the fuel tank. The entire assembly shall be braced to withstand seismic forces calculated for UBC, Seismic Zone 4 with importance factor $I_p = 1.5$.
- B Support the fuel tank above the pad to avoid corrosion and accumulation of debris under the tank.
- C Locate the anchor bolt holes so they are accessible and will accommodate the installation of drilled-in anchor bolts.

2.13 ENCLOSURE:

- A The entire engine generator set, including batteries, shall be housed in a sound attenuated, weather-protective, housing. All steel parts shall be chemically cleaned, treated, and painted to provide a rust resistant finish. All mounting hardware shall be galvanized steel.
- B. dBa level: 75 dBa at 23 feet
- C. Provide vertical cooling air discharge
- D. Provide a receiver with absorbent material for crankcase ventilation discharge. The unit shall not drip or discharge oil in any manner.
- E. Openings in the enclosure shall be well secured, fully lockable, and tamper resistant including the fuel filler.
- F Provide lighting inside the enclosure, powered from the battery, with a manual timer control.
- G. Provide “Emergency Stop” weatherproof, oil tight break-glass, operator with hammer on the exterior of the enclosure.
- H. The enclosure shall be shipped with and attached to the unit so that additional installation is not required.

- I. The color of the enclosure shall be black, Kelly Moore 1245-407 acrylic low sheen “carbon” or equal. Submit paint chip for approval by owner prior to fabrication.

PART 3 – EXECUTION (Applies to Installing Contractor)

3.1 INSTALLATION:

- A. Entire installation shall be according to manufacturer’s instructions, a copy of which shall be submitted to the Project Manager in advance of installation.
- B. Maintain clearance from exhaust piping to combustible materials according to the UMC.

3.2 FUEL AND OIL:

- A. Provide sufficient fuel for testing and leave the tank full at the conclusion of the tests. Use a good quality fuel as recommended by the engine manufacturer.
- B. Provide all recommended lubricants

3.3 SIGNAGE:

- A. Furnished by installing Contractor. Place a permanent, engraved sign at the main switchboard indicating the type and location of the emergency power source. The wording shall be substantially as follows: EMERGENCY POWER SERVICE IS PROVIDED TO AN AUTOMATIC TRANSFER SWITCH SERVING PANELS (provide panel identification) FROM AN EMERGENCY GENERATOR LOCATED AT (provide location).
- B. Provide a permanent placard identifying the fuel tank contents in 1” letters as: COMBUSTIVE LIQUID –DIESEL FUEL and provide a NFPA 704 Diamond identification (10” x 10”) sign for diesel fuel (Health Hazard 0, Fire Hazard 2, Reactivity 0).
- C. Provide one standard sign: “NO SMOKING OR OPEN FLAME”

3.4 REMOTE MONITORING BY SHC SECURITY:

- A. The four alarm points described above shall be monitored by SHC Security. Provide cable, conduit, and connections for Security except that termination of the Contractor installed cable to the Security panel will be by Stanford. Coordinate connection and testing of the alarms with the Project Manager.
- B. Wiring: Connect alarm points at generator set for Security with one 18 AWG, eight pair overall shielded cable, Belden 1057A. Cables shall be continuous and without splices

between the generator set and the Security panel. Do not ground drain wires at generator set panel.

- C. Wire Labels: All instrument and output device wiring shall be labeled at both ends, and within 2” of the end at the generator set panel. Labels are required for pairs, and not for individual conductors. Labels shall be machine printed with indelible ink on heat shrinkable plastic tubing (Brady Sleeve Wiremaker Label WMS-211-319).
- D. Remote Annunciator Panel: Provide conduit and conductors and install the remote annunciator at the location shown on the Drawings or directed by Stanford.

3.5 FIRE EXTINGUISHER

- A. Contact the Project Manager and arrange for the installation of a fire extinguisher in a weatherproof enclosure, furnished and installed by the Owner. The extinguisher shall be rated 3A:40-BC and installed within 30 feet of the generator.

3.6 SITE LIGHTING – Ensure adequate lighting around the generators.

- A. When the generator is located inside an enclosure
 - 1. Provide fluorescent lights with weather proof cover and weather proof “on/off” switch to be located inside the enclosure
- B. When the generator is NOT located inside an enclosure
 - 1. Provide two high output fluorescent lights with weather proof cover and weather proof “on-off” switch

3.7 HOSE BIBB

- A. Provide one ¾” hose bib in close proximity to the generator for wash down purposes

3.8 ELECTRICAL OUTLET

- A. Provide one 120V – 20 amp GFI outlet with weather cover

3.9 ASPHALT WALKWAY

- A. A minimum three foot asphalt maintenance path around the generator, the switch-board, and in front of the transformer will be required. Gravel or crushed stone is not acceptable

3.10 GENERATOR ACCESSIBILITY FOR MAINTENANCE

- A. Refueling Trucks come with a 50 foot hose. The truck cannot be more that 50 feet from the generator’s fuel tank fill port.

END OF SECTION