

## SECTION 26 32 13

### ENGINE GENERATORS

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. Engine- generator system.
- B. Automatic transfer switch.
- C. Communication capabilities.
- D. Fabrication and shop tests.

##### 1.02 RELATED SECTIONS

- A. Fuel storage tank is specified in Section 26 32 15 - Above Ground Fuel Storage Tanks.

##### 1.03 MEASUREMENT AND PAYMENT

- A. General: Engine generators, as specified herein, will not be measured separately for payment but will be paid for as part of the Contract lump sum price for Electrical Work as indicated in the Bid Schedule of the Bid Form.

##### 1.04 REFERENCES

- A. American National Standards Institute (ANSI):
  - 1. ANSI C37.13 Low-Voltage AC Power Circuit Breakers Used in Enclosures
  - 2. ANSI C37.90 Relays and Relay Systems Associated with Electric Power Apparatus
  - 3. ANSI C39.1 Electrical Analog Indicating Instruments
- B. Bay Area Air Quality Management District (BAAQMD)
- C. Diesel Engine Manufacturers Association (DEMA)
  - 1. Standard Practices for Low and Medium Speed Stationary Diesel and Gas Engines
- D. Electronic Industries Association (EIA):
  - 1. EIA RS-282 Silicon Rectifier Diodes and Stacks
- E. National Electrical Manufacturers Association (NEMA):
  - 1. NEMA ICS 1 Industrial Controls and Systems
  - 2. NEMA MG 1 Motors and Generators

3. NEMA PB 2 Dead-Front Distribution
- F. National Fire Protection Association (NFPA):
1. NFPA 30 Flammable and Combustible Liquids Code
  2. NFPA 37 Stationary Combustion Engines and Gas Turbines
  3. NFPA 70 National Electrical Code (NEC)
  4. NFPA 110 Emergency and Standby Power Systems
- G. Tubular Exchanger Manufacturers Association (TEMA):
1. Standards of Tubular Exchanger Manufacturers Association
- H. Underwriters Laboratories, Inc. (UL):
1. UL 142 Steel above ground tanks for flammable and combustible liquids. |
  2. UL MH 799 Underground Flammable Liquid Tanks. |
  3. UL 1008 Automatic Transfer Switch Equipment. |
  4. UL 2200 Stationary Engine Generator Assemblies. |
  5. UL 2085 Protected above ground tanks for flammable and combustible liquids. |

### 1.05 SUBMITTALS

- A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.
- B. Shop Drawings: Submit schematic and interconnection drawings, as follows:
1. Schematic diagrams of the following:
    - a. Engine control;
    - b. Generator control; and
    - c. Automatic engine starting.
  2. Wiring diagrams and interconnection between generator set and automatic transfer switch.
  3. Description of the system operation.
  4. Piping connection and instrumentation diagrams.

5. Outline dimensions and foundation requirements.
- C. Product Data: Submit manufacturers' product data, certificates, and test reports as follows:
1. Specification sheets showing all standard and optional accessories to be supplied;
  2. Performance data, including curve of engine fuel consumption versus kilowatt output at no load, half load, three-quarter load and full load;
  3. Parts and special tools lists, specifying quantity of each item;
  4. Certificates of compliance for specified products; and
  5. Test reports verifying specified performance requirements for equipment.
- D. Operation and Maintenance Manual: Refer to Section 01 78 23 - Operation and Maintenance Data, for requirements.
- E. Sound-Retardant Data: Submit noise control data and vibration isolation instructions.
- F. The approved permit to operate diesel generator by BAAQMD.

## **PART 2 – PRODUCTS**

### **2.01 ENGINE-GENERATOR SYSTEM**

- A. General: Calculations for each Engine-Generator System (EGS) shall be prepared and submitted for District approval. The EGS shall be sized and in accordance with the District-approved power calculations to support the connected loads.
1. Engine-generator system rated for minimum calculated emergency load plus 25%. Controller shall be integral part of the engine-generator system. The system shall include all necessary accessories to provide a complete and operating system. All engine-generator system components shall be provided by same manufacturer.
  2. Emergency engine-generator system shall be capable of operating continuously at rated output in accordance with NEMA MG 1-22.84 in an ambient temperature range of 0 degrees C to 50 degrees C.
  3. The engine-generator shall be a completely self-contained unit, fully assembled and mounted on a common self-supporting base, and shall consist of the following components as a minimum:
    - a. Molded case circuit breaker with thermal magnetic trip. Circuit breaker shall be mounted in a NEMA 12 type metal enclosure.
    - b. Control panel in a NEMA 12 type metal enclosure.
    - c. Starting battery complete with charger, battery rack, battery cables, and charger alarm board for remote indication.

## ENGINE GENERATORS

- d. Exhaust mufflers rated for residential use.
  - e. Intake air filters and critical rated intake silencer.
  - f. Day and main fuel tanks in accordance with Section 26 32 15 - Above Ground Fuel Storage Tanks.
  - g. Engine mounted radiator system, complete with duct flange adapter for connection to wall louver.
  - h. All other auxiliary devices, appurtenances, and equipment required to operate the engine-generator.
4. Engine-generator shall have continuous kilowatt rating as indicated. Ratings shall be 480/277 V, 0.8 power factor, 60 Hz, 3 phase, 1800 rpm, and withstand the ambient temperature range specified herein.
  5. Engine-generator shall be vibrationless within the normal operating speed range in accordance with DEMA Standard Practices.
  6. Engine-generator shall be mounted on inertia pad with vibration absorbing isolators as recommended by the generator manufacturer to meet requirements for operation in residential environment.
  7. Lifting lugs or angles and jacking pads shall be provided on the self-supporting base, and on each major component of the engine-generator.
  8. Engine-generator shall be enclosed within a sound attenuation enclosure and the sound power level at rated full load shall not exceed 64 dBA weighted average measured at 5 feet from all sides of the unit.
  9. The engine generator shall be mounted on integral fuel tank, mounted on a concrete slab integral with any required foundation or housekeeping pad. The integral fuel tank shall be designed to include proper spill and overflow containment. The integral fuel tank shall comply with UL 142 and UL 2085.

### B. Diesel Engine

1. The engine shall be four-cycle diesel of the manufacturer's standard design with proven reliability in service. Engine design, materials, and workmanship shall be in accordance with DEMA Standard Practices. Engine exhaust emissions shall meet the regulatory requirements of the Bay Area Air Quality Management District.
2. Brake horsepower rating of the engine shall be not less than that necessary to produce continuous rated generator output at rated speed (1800 rpm maximum) and under the specified service conditions.

ENGINE GENERATORS

3. Each engine shall be provided with at least the minimum equipment according to Chapter 2 of DEMA Standard Practices. In addition, the following components and accessories shall be provided:
  - a. All necessary speed, pressure, and temperature sensors and devices for indication, alarm, and safety trip functions.
  - b. All flexible connections necessary to isolate the engine from piping, conduit and building.
  - c. Manufacturer supplied block heater shall be hardwire to 120VAC to maintain lube oil and jacket water temperatures.
4. The engine shall be equipped with a governor. Speed regulation shall be manually adjustable. Performance of the speed governing system shall be in accordance with the applicable section of IEEE 126.
5. The control shall provide visual warnings, shutdowns, and audible indications for conditions specified in NFPA 110, Level 1.
  - a. Control switches and relays necessary to start the engine locally or remotely and to stop the engine automatically, locally, or remotely.
  - b. Programmable cyclic cranking shall allow at least three crank cycles and 45 seconds of continuous crank time.
6. Jacket cooling water system shall include at least the following for each engine:
  - a. Jacket water radiator and cooling fan.
  - b. Jacket water pump.
  - c. Thermostat valve for automatic temperature control of the jacket water.
  - d. Jacket water block heater, with standard 110-Volt ac cord and plug for connection to a standard style receptacle that is switched by block heater control circuit.
  - e. Valves, piping, and fittings.
7. Engine lubricating system shall include at the least the following for each engine:
  - a. Circulating pumps;
  - b. Filters and/or strainers;
  - c. Lubricating oil cooler;
  - d. Lubricating oil pumps, as necessary;

ENGINE GENERATORS

- e. Valves, piping, and fittings; and
  - f. Control signals for electric motor starter control circuits.
  - g. Lubricating oil heater
8. Fuel oil system equipment shall include at least the following for each engine:
- a. Engine fuel pump designed to transfer the fuel from the adjacent fuel day tank;
  - b. Valves, piping, and fittings;
  - c. Filters and strainer; and
  - d. Fuel oil meter.
9. Welded steel day tank shall have a two-hour capacity and shall include at least the following for each engine:
- a. Level gauge.
  - b. Low-level alarm detector and suitable relay.
  - c. Low and high level switches for transfer pump control and inlet control valve.
  - d. Couplings for inlet, outlet, vent, and overflow.
  - e. Fuel transfer pump to deliver fuel from the fuel storage tank to the day tank. The fuel transfer pump shall deliver 5.0 gpm at 6.0 psi with a suction lift of 7.5 ft.
10. Provide battery rack and cables, capable of supporting the manufacturer's recommended batteries.
11. Provide twelve (12)-Volt lead-antimony batteries capable of delivering the manufacturer's recommended minimum cold-cranking current required at 0 °F, per SAE Standard J-537.
12. Ten (10)-Ampere automatic float and equalize battery charger with  $\pm 1\%$  constant voltage regulation from no load to full load over  $\pm 10\%$  AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambient from -30°C to +50°C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected.
13. Engine governor shall be the electronic, solid-state type. Frequency regulation shall be within  $\pm 0.5$  percent for any load between 20 and 100 percent and frequency dip during full load application shall not exceed 8 cycles per second from rated frequency. Governor components to be provided with the unit shall include: actuator, amplifier, speed sensing, load sensing, burden resistor, and magnetic pickup.

## C. Generator

1. The generator shall be of the synchronous, salient pole type in accordance with NEMA MG 1, for a solidly grounded system, with drip proof enclosure.
2. Voltage, frequency, and nameplate kilowatt rating shall be as specified herein.
3. Generator and excitation system shall provide for operation at the overload capability of the engine, at rated power factor, frequency, and voltage. Insulation shall be NEMA Class F. Temperature rise at continuous rating shall not exceed 95°C, above 50°C ambient temperature, and the temperature rise for standby rating shall not exceed NEMA MG 1, Part 22, requirements for Class F insulation.
4. The exciter-voltage regulator system shall be complete with all components necessary to provide manual voltage control, automatic voltage regulation, automatic field flashing, and positive surge protection for any solid-state components utilized in the system.
5. Stator coils shall be mechanically braced to prevent distortion under short circuit or other transient conditions.
6. Length of leads connecting phase winding to surge protection shall be kept to a minimum. Terminals of surge protection shall be located between feeder cable terminations and phase windings.
7. Accessories shall include the following components:
  - a. Slide rails or sole plates if necessary to provide for stator shift.
  - b. Surge capacitors for generator protection.

## D. Control Panel Assembly

1. Control panel shall consist of individual steel structures, one for each generator bolted together to form a single NEMA 12 type metal enclosed assembly. Control panel shall be mounted no more than 4 feet off the floor or an operator platform.
2. The panel shall contain at least the following devices for remote operation and monitoring of each engine-generator:
  - a. Engine controls including manual START-STOP control, governor control switch, control switches, and red (running) and green (stopped) indicating lights for electric motor driven engine auxiliaries.
  - b. Generator controls, including automatic and manual voltage adjustment rheostats or autotransformers and generator shutdown and reset switches.
  - c. Generator instruments including frequency meter, ac ammeter with phase selector switch, and ac voltmeter with phase selector switch.

- d. An AUTO-MANUAL selector switch for manual starting in MANUAL position and automatic starting in AUTO position.
  - e. Automatic plant exercise shall be provided to allow the user to choose between 7-day, 14-day, or manual mode to exercise the generator set at a preset time period, and override function to terminate the exercise at any time. The accessories to allow the plant exerciser to run the generator set unloaded and loaded shall be provided.
3. A ground bus shall be furnished and securely bolted to the structural members of the panel. All equipment requiring grounding shall be connected to this bus. Bolted pressure type lugs shall be supplied at each end of the ground bus for connection of station grounding cable.
  4. Bolted type terminal blocks with white marker strip shall be provided for all control and instrument wiring and shall be located for easy access and connection. A minimum of 15 percent spare terminals shall be provided at all terminal boards.
  5. Pushbutton switches and indicating lights shall be heavy duty, oil tight-type.
- E. System Programming
1. It shall be possible to disable programming so the system can only be monitored.
  2. It shall be possible to program the control with the controller keypad or using an IBM compatible personal computer.
  3. Programming access shall be password protected.
- F. Inputs and Outputs
1. Inputs
    - a. There shall be four dry contact inputs that can be user configured to shut down the generator or provide warning.
    - b. It shall be possible to define each user-configured input that will be viewable on the digital display.
    - c. Additional standard inputs required:
      - 1) Input for an external ground fault detector. Digital display shall show "ground fault" upon detection of a ground fault.
      - 2) Reset of system faults.
      - 3) Remote two wire start.
      - 4) Remote emergency stop.

2. Outputs

- a. All NFPA 110 Level 1 outputs shall be provided.
- b. There shall be ten outputs available for interfacing to other equipment:
  - 1) Any of these outputs shall be able to be user-configured from a list of over 25 functions and faults.
  - 2) These outputs shall be dry contacts.

G. Communications

1. The controller shall have capability to communicate to a personal computer (IBM or compatible). Plug connected modules shall be provided.
2. RS-232 communication formats shall be supported.
3. Multiple devices to a PC over phone lines shall be provided.
4. When equipped with communications modules, transfer switches along with the generator controller shall be able to be connected to the same communication network.
5. The capability to connect up to 30 devices (generator set controls and transfer switches) on a single network shall be supported.

H. Personal Computer Software

1. A software package with the following capabilities is required:
  - a. Any combination of transfer switches and generator controls.
  - b. Up to 30 devices at a single site shall be supported.
  - c. The software package shall support communications over phone lines. The software shall allow communications with up to 30 sites.
  - d. Access to individual devices by the software shall be protected by password.
2. All displays, data inquiries, and program functions allowed on the controllers, both generator and ATS, shall also be available through the software.
3. The software shall be menu driven with separate menus for transfer switches and for generator set functions. It shall be possible to reset shutdown faults and restart the generator using the software.

**2.02 AUTOMATIC TRANSFER SWITCH**

- A. General: An automatic transfer switch shall be furnished with the engine-generator. The transfer switch shall transfer electrical load from the utility power source to the engine-generator when the utility power source fails or is reduced more than 20 percent its rated voltage. The transfer switch shall transfer the electrical load back to the utility power source when such source is restored.
- B. Type: The automatic transfer switch shall be of the 3-phase, 4-pole, 4-wire.
- C. Rating: Switch rating shall be compatible with engine generator rating. The switch shall be rated for continuous duty.
- D. Construction:
1. Transfer switch shall be double-throw actuated by a single electrical operator momentarily energized and connected to the transfer mechanism. The switch shall be capable of transferring successfully in either direction at 80 percent of rated voltage.
  2. Normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in position in both the normal and emergency positions without the use of hooks, latches, magnets, or springs and shall be silver tungsten alloy and protected by arcing contacts with magnetic blowouts on each pole.
  3. Transfer switch shall be equipped with manual operator that shall prevent injury to the operating personnel if the electrical operation should suddenly become energized during manual transfer. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.
  4. Transfer switch shall be provided with the following accessories:
    - a. Normal voltage fluctuation time delay to delay transfer and engine start, adjustable 0.5 to 6 seconds;
    - b. Transfer to emergency time delay adjustable 1 to 60 seconds;
    - c. Engine starting time delay, adjustable 1 to 60 seconds;
    - d. Retransfer to normal time delay, adjustable 0 to 15 minutes in one minute increments;
    - e. Unloaded running time delay for engine generator cooldown, adjustable 0 to 5 minutes;
    - f. Momentary test switch to simulate normal power failure;
    - g. Manual reset switch to retransfer to normal power;
    - h. Manual reset switch to bypass time delay on retransfer to normal power supply;

- i. Engine control contacts, two normally open and two normally closed;
  - j. White indicating light energized when automatic transfer switch has connected load to utility power source;
  - k. Amber indicating light energized when automatic transfer switch has connected load to engine generator source;
  - l. Bypass/isolation switches for uninterrupted power to the load during switch maintenance and testing;
- 5. All contacts, coils, relays, timers, control wiring, and accessories shall be accessible from the front.
  - 6. The transfer switch, complete with all timers, relays, and accessories shall be in accordance with UL 1008.
  - 7. Assembly and Test: The switch shall be completely wired, assembled, and tested by the switch manufacturer.

### **2.03 COMMUNICATION CAPABILITIES**

- A. The transfer switch shall be capable of being connected in any of the following network configurations. Interactive Windows(tm) software developed for ATS applications shall be available. The software shall monitor, allow alteration of values, and provide system diagnostics. All values and ATS indications shall be available through the networks.
- B. Point-to-Point Connectivity: It shall be possible to connect the ATS directly to a personal computer in the following ways:
  - 1. Local Connection - Maximum cable length 50 feet (15 meters) using RS232.
  - 2. Remote Connection - Utilizing preferred Ethernet TCP/IP (cat 6 cable) or RS232 brought to BARTNet cabinet. If distance exceeds RS232 distance limitation then use multimode fiber media converters.
- C. It shall be possible to connect a printer to the computer for hard copy generation.
- D. The communication cable shall run in separate conduit.
- E. It shall be possible to start and run the generator set for up to 24 hours and control the transfer of the load to the generator set.

### **2.04 FABRICATION AND SHOP TESTS**

- A. Fabrication: Fabrication shall be in accordance with DEMA Standard Practices, NEMA MG 1, NEMA ICS 6, and NFPA 70. The engine-generator set and accessories shall be painted ANSI Z55.1, No. 61 gray.

**B. Shop Tests:**

1. Prior to shipment, each engine-generator unit shall be completely assembled and tested. Testing, tabulation of data, and calculation of results shall be in accordance with "Schedule of Tests," Chapter 18 of DEMA Standard Practices, and "Routine Tests," Part 22.50 of NEMA MG 1, as applicable. Electrical power and control circuits shall be tested to ensure correctness of wiring and functional operation of equipment.
2. Defects detected during testing shall be replaced or repaired, and the component or assembly shall be retested.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. Install engine-generator equipment, appurtenances, and accessories in accordance with the manufacturer's instructions and recommendations and as indicated to withstand seismic forces. Provide all components and accessories as required for a complete and operable standby and emergency power supply. Coordinate and interface installation requirements with other Sections as applicable.
- B. Provide engine-generator isolation from the surrounding building to prevent transmission of vibration and the production of noise. Isolate piping, conduit, and mechanical connections from the building to the engine-generator by means of flexible connections.
- C. Locate exhaust outlet at a minimum of 15 feet above floor level.

**3.02 FIELD QUALITY CONTROL****A. Tests and Inspections:**

1. Field testing shall be performed in accordance with DEMA Standard Practices for Stationary Diesel and Gas Engines. All equipment and apparatus necessary for the tests shall be provided.
2. Testing equipment shall be accurate and the calibration history of each instrument used in testing shall be made available to the Engineer upon request.
3. All defects disclosed by the tests shall be rectified and the tests repeated.
4. An inspection checklist shall be prepared for each unit and auxiliary equipment. An operational test shall be performed to ensure proper operation of all systems.
5. The fuel used in the field tests shall be the same as the fuel to be used in operating the plant.
6. Provide a full fuel tank prior to any operational testing of the engine generator and return the fuel tank to the full fuel level prior to acceptance of the contract.

ENGINE GENERATORS

B. Manufacturer's Field Services:

1. The engine-generator manufacturer shall provide appropriate field or job service at no additional cost to the District.
2. Contractor shall make all necessary arrangements with the manufacturer of the engine-generator equipment to provide on-site consultation and inspection services to assure the correct assembly and installation of the equipment, appurtenances, and accessories.
3. The manufacturer shall inspect and approve the equipment pad or foundation, the equipment enclosure, and required clearances.
4. The manufacturer's representative shall make periodic visits to the site as the work proceeds as necessary for consultation and for expediting the work in the most practical manner.

**END OF SECTION 26 32 13**