SECTION 26 32 13 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes engine generator set, emission control devices, fuel fittings and sub base tank, remote control panel, battery, and charger.

B. Locate all generators outdoors. Underground fuel tanks are NOT allowed at the airport.

1.2 SYSTEM DESCRIPTION

A. Description: Engine generator assembly and accessories to provide source of power for Level 1 and 2 applications in accordance with NFPA 110.

B. Capacity: As required with standby rating using specified engine cooling scheme.

C. Diesel generator muffler, flex and mounting hardware.

D. Main fuel supply shall be an aboveground tank with secondary containment capable of holding 110% of that main tank's capacity, also known as double wall tanks and/or sub-base tanks for emergency generators. A corrosion protection mechanism such a sacrificial anode shall be included. The main tank compartment shall be equipped with the proper level gage and vents. The secondary compartment shall be equipped with a leak detection sensor and vents. All sensors shall be continuously monitored to detect and report leaks or malfunctions. Please see Section 2.7 below for further details.

E. Provide engine generators approved by SCAQMD and CARB for use as emergency backup and meeting current emission standards at the time of installation.

1.3 SUBMITTALS

A. Shop Drawings: Indicate electrical characteristics and connection requirements. Include plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.

B. Product Data: Submit data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, transfer switch, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, and remote radiator.

C. Test Reports: Indicate results of performance testing.

D. Manufacturer's Field Reports: Indicate inspections, findings, and recommendations.

1.4 FACTORY PROTOTYPE TESTING

A. The system manufacturer must certify that engine, generator and controls have been tested as a complete system of representative engineering models (not on equipment sold). The manufacturer shall supply equipment that is a current factory standard production model.

B. Prototype testing shall include:

1. Fuel consumption at 1/4, 1/2, 3/4 and full load.
2. Exhaust emissions.
3. Mechanical and exhaust noise.
4. Governor speed regulation at 1/4, 1/2, 3/4 and full load; and during transients
5. Motor starting kVA.
6. Generator temperature rise in accordance with NEMA MG1-22.40 and 16.40
7. Harmonic analysis, voltage waveform deviation and telephone influence factor.
8. Generator short circuit capability.
9. Cooling system performance.
10. 3 phase short circuit tests.
11. Maximum power (kW)
12. Generator revolving field assembly for 2 hours at 2700 rpm (150% overspeed) and 70 degrees C and each production unit tested at 2250 rpm (125% overspeed) at room temperature.

1.5 WARRANTY

A. Five Year Manufacturer Warranty: The manufacturer's standard warranty shall in no event be for a period of less than five years form date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall not be a limiting factor for the system warranty by either the manufacturer or servicing distributor. An extended warranty for an additional five years shall be offered as an option. Submittals received without written warranties as specified will be rejected in their entirety.

1.6 MAINTENANCE SERVICE

A. Furnish service and maintenance of engine generators for five years from Date of Substantial Completion, inclusive of after-market emission devices (if any).

1.7 MAINTENANCE MATERIALS FOR EACH ENGINE GENERATOR

A. Furnish one set of tools required for preventative maintenance of engine generator system. Package tools in adequately sized metal tool box.

B. Furnish two of each fuel, oil and air filter element.

PART 2 - PRODUCTS

2.1 ENGINE

A. Manufacturers:

1. Caterpillar.

2. Kohler.

3. Cummins.

B. Product Description: Air-cooled in-line or V-type, four-stroke cycle, compression ignition Diesel internal combustion engine.

C. Rating: Standby rating in accordance with ISO-8528 and ISO-3046.

D. Fuel System: No. 2 fuel oil, low sulfur content compliant with CARB diesel regulation.

E. Engine speed: 1800 rpm.

F. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed and engine overcrank. Limits as selected by manufacturer.

G. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Furnish remote starting control circuit, with MANUALOFF-REMOTE selector switch on engine-generator control panel.

H. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F, and suitable for operation on 120 or 208 volts AC.

I. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F. Radiator air flow restriction 0.5 inches of water maximum.

J. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Furnish fuel pressure gage, water temperature gage, and lube oil pressure gage on engine/generator control panel.

K. Mounting: Furnish unit with suitable spring-type vibration isolators and mount on structural steel base.

2.2 GENERATOR

A. Manufacturers:

1. As provided by engine generator manufacturer.

B. Product Description: NEMA MG1, three phase, four pole, reconnectable brushless synchronous generator with brushless exciter. Voltage, ampere and power factor ratings are as indicated on Drawings.

C. Insulation: The insulation material shall meet NEMA standards for Class H insulation and be vacuum impregnated with epoxy varnish to be fungus resistant. Temperature rise of the rotor and stator shall not exceed NEMA class F. The excitation system shall be of brushless construction.

D. Temperature Rise: 80 degrees C Standby, maximum as measured by resistance and based on 40 degrees C ambient temperature.

E. Enclosure: NEMA MG1, open drip proof

F. Total Harmonic Distortion (THD): Not to exceed three percent.

G. Telephone Influence: Below 50.

H. Exciter (Self-Excited): The self-excited, brushless exciter shall consist of a three-phase armature and a three-phase full wave bridge rectifier mounted on the rotor shaft. Surge suppressors shall be included to protect the diodes from voltage spikes.

I. Automatic Voltage Regulator: The digital automatic voltage regulator (DVR) shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be a totally solid state design, which includes electronic voltage buildup, volts per Hertz regulation, three-phase sensing, over excitation protection, loss of sensing protection, temperature compensation, shall limit voltage overshoot on startup, and shall be environmentally sealed.

2.3 GOVERNOR

A. Manufacturers:

1. As provided by engine generator manufacturer.

B. Product Description: Isochronous governor to maintain engine speed within 0.5 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Equip governor with means for manual operation and adjustment.

2.4 CIRCUIT BREAKER

A. Circuit Breaker Specifications: Provide a generator mounted circuit breaker, molded case or insulated case construction, rating as indicated. Breaker shall utilize a thermal magnetic

trip unit and 24VDC shunt trip. The breaker shall be UL listed with shunt trip device connected to engine/generator safety shutdowns. Breaker shall be set to protect the generator from short circuit damage. Breaker shall be housed in an extension terminal box mounted on the side of the generator. Mechanical type lugs, sized for the circuit breaker feeders, shall be supplied on the load side of breaker.

B. Provide an additional circuit breaker for the radiator mounted load bank.

2.5 CONTROL PANEL

A. Generator Mounted Control Panel: Provide a generator mounted control panel for complete control and monitoring of the engine and generator set functions. Panel shall include automatic start/stop operation; adjustable cycle cranking, digital AC metering (0.5% true rms accuracy) with phase selector switch, digital engine monitoring, shutdown sensors and alarms with horn and reset, adjustable cool down timer and emergency stop push-button. Panel shall incorporate self-diagnostics capabilities and fault logging. Critical components shall be environmentally sealed to protect against failure from moisture and dirt. Components shall be housed in a NEMA 1/IP22 enclosure with hinged lid.

B. Digital Readouts: Provide the following digital readouts:

1. Engine oil pressure
2. Coolant temperature
3. Engine RPM
4. System DC Volts
5. Non-resettable engine running hours
6. Generator AC volts
7. Generator AC amps
8. Generator frequency
9. KW meter
10. Percentage of rated Power
11. KVA meter
12. KVAr meter
13. Power Factor meter
14. KWHR meter

C. Alarm NFPA 110: Provide the following indications for protection and diagnostics according to NFPA 110 level 1:

1. Low oil pressure
2. High water temperature
3. Low coolant level
4. Overspeed
5. Overcrank

6. Emergency stop depressed
7. Approaching high coolant temperature
8. Approaching low oil pressure
9. Low coolant temperature
10. Low voltage in battery
11. Control switch not in auto position
12. Low fuel main tank
13. Battery charger ac failure
14. High battery voltage
15. EPS supplying load
16. Base-mounted tank low fuel level
17. Base-mounted tank high fuel level
18. Spare

D. Remote Annunciator NFPA 110: Provide one remote annunciator to meet the requirements of NFPA 110, Level 1. The annunciator will be installed by contractor. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn. Location shall be clearly identified on the electrical and architectural drawings.

E. Programmable Control Panel: Provide programmable protective relay functions inside the control panel to include the following:

1. Undervoltage
2. Overvoltage
3. Over frequency
4. Under frequency
5. Reverse power
6. Overcurrent (phase and total)
7. KW level (overload)
8. Three spare LED's
9. Four spare inputs

2.6 FUEL SYSTEM

A. Fuel Filter: Filter/Separator - In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine.

B. Fuel Piping: All supply and return fuel piping shall be double-shell rated for diesel fuel service. Steel piping, including vent piping, (except stainless) shall be epoxy-coated (primer plus epoxy or equivalent).

C. Fuel Line Rating: Flexible fuel lines rated 300 degrees F and 100 PSI.

2.7 SUB-BASE FUEL TANK

A. Manufacturers:

1. IBI.

2. International Supply Co.

3. Tramont.

B. Provide a sub-base steel dual wall fuel tank for the generator set, sized to allow 8 hours of operation.

1. All Protected Base Tanks are UL Secondary Containment list and labeled. It is comprised of a UL142 steel tank, enclosed by a UL142 steel containment basin. All steel tanks are tightness tested at the manufacturer's facility, in accordance with testing procedures specified by UL142 for AST's, and meet UL requirements for standard and emergency venting. The interior of the primary tank has been cleaned and free of any loose material, mill scale, or debris. Sub base tanks are UL 2085 listed for the UL 2 hour fire burn test. Tanks must be ballistic and impact rated per UL 2085 specification.
2. The base tank shall be furnished as a complete, factory assembled and tested assembly and listed as an assembly by Underwriters Laboratories, to UL 142 and UL 2085 factory installed.
3. Primary tanks shall be of minimum thickness per UL 142. Inner tanks will be of rectangular configuration per UL standard 142. All welds must comply with AWS, and ASME IX and ASME B31.1.
4. Secondary containment consists of UL 142 primary tank, completely enclosed by a UL 142 secondary containment tank, which is 110% of the primary. Primary and secondary tank will be Rectangular in configuration. Both tanks are pressure tested to between 3 PSI and 5 PSI per UL requirements. The exterior of the tank will be steel.
5. All tank systems and sub-assemblies shall be installed in strict accordance with the manufacturer's recommendations and applicable fire and environmental codes.
6. All tanks are primed with a Rust-Oleum Shop Coat Enamel. Top coat is Alkyd High Gloss Enamel paint (Sherwin WilliamsSW6004 Mink.)
7. All tanks to be installed on reinforced engineered concrete slab. Protective barriers shall be installed as required by state and local codes.
8. Tanks shall be marked on a visible side with "Flammable", "Combustible", and "No Smoking", product identification, and other signs as required by state and local codes.
9. The system installation (end user) shall be inspected and approved by the system installer or its certified contractor. The system installer shall submit a comprehensive checklist of quality and safety items associated with the installation of the system and its sub-assemblies to verify that the installation is in compliance with applicable local fire and environmental codes.

C. Features

1. Emergency tank and basin vents.
2. Mechanical level gauge.
3. Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by the engine manufacturer and in compliance to UL2200 and NFPA requirements.
4. Leak detection provisions, wired to the generator set control for local and remote alarm indication.
5. High and low level float switches to indicate fuel level. Wire switches to generator control for local and remote indication of fuel level.
6. Basin drain.
7. Integral lifting provisions

2.8 EMISSION CONTROL DEVICES

A. Provide and install as per manufacturer recommendations.

B. Diesel Particulate Filter - The engine shall be equipped with an active diesel particulate filter compliant with current SCAQMD and CARB emissions standards for a major source facility.

C. Install emission control devices that meet SCAQMD, CARB and EPA emission tier standards for the engine at the time of installation.

2.9 STARTING SYSTEM

A. Starting Motor: The engine shall be started by two 24 V DC electric starting motors. Crank termination switch and 24 V DC fuel solenoid valve shall be provided for remote automatic start/stop capability.

B. Jacket Water Heater: A unit mounted forced circulation type water heater. The heater Watt rating shall be sized by the manufacturer to maintain jacket water temperature at 90 degrees F, and shall be a 480 volt, three phase, 60 hertz.

C. Batteries: Lead acid batteries of sufficient capacity for four 15 second crank periods with 10 second rest intervals shall be furnished. Battery voltage of 24 V DC shall be derived from four 12 V DC, 205 amp hour high performance batteries, dry charged. Two battery interconnection cables and four battery-to-starter cables.

1. Battery Trays: A battery tray shall be provided for the batteries and shall conform to NEC 480-7(b). It shall be treated to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil-over battery electrolyte shall be contained within the tray to prevent a direct path to ground.
2. Battery Charger: A current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and

equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. Ac input voltage shall be 120 volts, single phase. Charger shall have LED annunciation for low DC volts, rectifier failure, loss of AC power, high DC volts. Amperage output shall be no less than ten (10) amperes. Charger shall be wall-mounting type in NEMA 1 enclosure.

2.10 RADIATOR MOUNTED LOAD BANK

A. Furnish a continuous duty load bank, complying with UL 508A, mounted directly on the skid base, on the exhaust side of the radiator, complete with all necessary pilot and power control, wiring and devices to furnish a functional system for the intended use. Load bank shall comply with all applicable NEMA, NEC and ANSI Standards. Load bus configuration and load terminations shall be clearly identified.

B. The load bank shall have the capability of maintaining a constraint load for the Emergency Power Supply Source (EPSS), during both exercising and actual use condition. Rating shall be a minimum of 50% of the generator output rating and matched to the EPSS voltage. Load steps at a minimum of three (3) incremental loads, manually controlled.

C. Enclosure shall be suitable for installation on the exhaust side of the engine radiator. It shall match dimensionally the radiator's duct flange height and width without adaptive duct work. The control section shall have a hinged and gasketed access door(s).

D. Manufacturer shall be Avtron load bank K-711 Series, or equal.

E. Construction shall be aluminum or galvanized steel. All fasteners shall be stainless steel. Load elements shall be helically wound and rated to operate at 50% of the maximum continuous wire rating. Each 50 kW element shall have current limiting fuses. (Furnish three (3) sets of three (3) fuses as spares.)

2.11 VIBRATION ISOLATORS FOR EACH ENGINE GENERATOR

A. For unit to base provide spring type with neoprene acoustical pads, leveling devices and vertical limit stops. Minimum static deflection shall be 1 inch.

B. For base to concrete pad spring mountings, provide adjustable type to provide minimum clearance of 4 inches between structural base and floor, with alignment and lift off restraints.

C. Provide for engine-generator set base, engine-generator set base and remote radiator and silencer and exhaust pipe.

2.12 ENCLOSURE

A. Weatherproof Enclosure: Reinforced steel housing allowing access to control panel and service points, with lockable doors and panels. Provide fixed louvers, battery rack and silencer. Provide sound attenuated enclosure and critical area silencer for noise attenuation.

2.13 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Make completed engine-generator assembly available for inspection at manufacturer's factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install engraved plastic nameplates.

B. Ground and bond generator and other electrical system components.

3.2 START-UP AND TESTING

A. Coordinate all start-up and testing activities with LAWA.

B. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:

1. Verify that the equipment is installed properly.
2. Check all auxiliary devices for proper operation, including battery charger, jacket water heater(s), generator space heater, remote annunciator, etc.
3. Test all alarms and safety shutdown devices for proper operation and annunciation.
4. Check all fluid levels.
5. Start engine and check for exhaust, oil, fuel leaks, vibrations, etc.
6. Verify proper voltage and phase rotation at the transfer switch before connecting to the load.
7. Perform a 4-hour load bank test at 0.80 power factor at full nameplate load using a reactive load bank and cables supplied with the generator. Observe and record the following data at 15-minute intervals:
    a. Service meter hours
    b. Volts AC - All phases
    c. Amps AC - All phases
    d. Frequency
    e. Power factor or VARs
    f. Jacket water temperature

g. Oil Pressure

h. Fuel pressure

i. Ambient temperature

8. Connect the generator to building load and verify that the generator will start and run all designated loads in the building.

3.3 TRAINING

A. Furnish eight hours of instruction to be conducted at project site with manufacturer's representative to LAWA choice of staff to be trained. Provide training session for each of 3 shifts.

B. Describe loads connected to emergency and standby system and restrictions for future load additions.

C. Simulate power outage by interrupting normal source, and demonstrate system operates to provide emergency and standby power.

D. Provide manuals for attendees.

END OF SECTION 26 32 13