

**SECTION 26 32 13.13****EMERGENCY GENERATOR****PART 1: GENERAL****1.01 SCOPE OF WORK**

- A. Provide complete factory assembled generator set equipment with digital (microprocessor-based) electronic generator set controls, digital governor, and digital voltage regulator.
- B. Provide factory testing.
- C. Provide field startup acceptance testing by a supplier authorized by the equipment manufacturer(s); include all required test equipment, load-bank, cabling and monitoring/recording equipment required to demonstrate operation and safety device(s) associated with the system.
- D. The generator set manufacturer shall warrant all equipment provided under this section in accordance with the Contract Documents for the Work.
- E. All installation and start-up services shall be provided by technicians specifically trained and certified by the manufacturer to support the products provided.

**1.02 REFERENCES**

- A. The generator set installation and on-site testing shall conform to the requirements of the latest codes and standards, as applicable. The generator set shall include necessary features to meet the requirements of these standards.
  - 1. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
  - 2. NECA/EGSA 404 – Recommended Practice for Installing Generator Sets; National Electrical Contractors Association;.
  - 3. NFPA 110 – Emergency and Standby Power Systems
  - 4. NFPA 70 – National Electrical Code
  - 5. NFPA 37 – Combustion Engines and Gas Turbines
  - 6. NEMA MG1 – Motors and Generators; National Electrical Manufacturers Association; latest edition.
  - 7. UL 142 – Sub-base Tanks

8. UL 2200 – The generator set shall be listed to UL 2200 or submit to an independent third party certification process to verify compliance as installed.
- B. The control system for the generator set shall comply with the following requirements.
1. EN 50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.
  2. FCC Part 15, Subpart B – Unintentional Radiators
  3. IEC8528 part 4 – Control Systems for Generator Sets
  4. IEC Std 801.2, 801.3, and 801.5 – Susceptibility, conducted, and radiated electromagnetic emissions.
  5. UL 508 – The entire control system of the generator set shall be UL508 listed and labeled.
  6. UL 1236 – Battery Chargers
- C. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

### 1.03 SUBMITTALS

- A. Shall conform to the requirements of Section– Submittals.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.
1. Manufacturer's product literature and performance data, sufficient to verify compliance to Specification requirements.
  2. Manufacturer's certification of prototype testing.
  3. Manufacturer's published warranty documents.
- C. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with certified overall dimensions, as well as wiring interconnection details. Provide fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.
1. Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.

- D. Test Reports: Indicate results of performance testing.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- F. Operation Data: Include instructions for normal operation.
- G. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

#### 1.04 FACTORY TESTING

- A. The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.
- B. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. All equipment and materials shall be delivered, stored and handled in strict accordance with the manufacturer's recommendations.

### **PART 2: PRODUCTS**

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Caterpillar. Alternate manufacturers will not be accepted. Contractor shall arrange purchase of generator with AW's Project Manager.

#### 2.02 GENERATOR SET

- A. System Capacity
  - 1. The generator capacity shall be as specified on the Contract Documents or as directed by the AW Project Manager.
  - 2. The generator set rating shall be based on emergency / standby service. Generator shall begin providing rated power not greater than 10 seconds after loss of utility power.

**B. Performance**

1. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.5%.
3. The diesel engine generator set shall accept a single step load of 100% nameplate kW and power factor, less applicable de-rating factors, with the engine generator set at operating temperature.
4. The generator set shall be capable of recovering to a minimum of 90% of rated no load voltage following the application of the specified kVA load at near zero power factor applied to the generator set. Maximum voltage dip on application of this load, considering both alternator performance and engine speed changes shall not exceed 25%.
5. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3rd order harmonics or their multiples. Telephone influence factor shall be less than 40.
6. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning.
7. The generator shall be compatible with VFD's on equipment motors.
8. Transient Frequency Performance: Less than 2-Hz variation for 50% step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.

**C. Construction**

1. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.
2. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3R enclosure. There shall be no exposed points in the control (with the door open) that operate in excess of 50 V.

#### D. Connections

1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the Drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the Drawings.
2. Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.
3. Generator set control interfaces to other system components shall be made on a permanently labeled terminal block assembly. Labels describing connection point functions shall be provided.

### 2.03 ENGINE AND ENGINE EQUIPMENT

- A. The engine shall be diesel, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable.
- B. Engine protection devices shall have sensing elements located on the engine to initiate preliminary alarms and engine shutdowns as per manufacturer's recommendation.
- C. Engine shall be radiator cooled by engine mounted radiator system including belt driven pusher fan, cooling pump, and thermostat temperature control. Performance of components shall be as required by set manufacturer. Radiator shall be provided with a duct adapter flange permitting the attachment of air discharge duct directing the discharge of radiator air through the wall.
- D. Contractor shall provide the generator set with suitable spring / pad type vibration isolators and mount on structural steel base.

### 2.04 STARTING AND CONTROL BATTERIES

- A. Starting and control batteries shall be calcium/lead antimony type, 24 V DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors. The batteries shall be capable of a minimum of three complete 15-second cranking cycles at 40°F ambient temperature when fully charged.

### 2.05 EXHAUST SYSTEM

- A. Provide critical grade exhaust muffler(s) for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. Muffler shall be constructed from stainless steel unless specifically noted otherwise. The average noise emission shall be less than 85 dB(A) at 3 ft distance measured at 5 ft above grade, during full load operation.

Exhaust system shall be installed according to the engine manufacturer's recommendations and applicable codes and standards

## 2.06 BATTERY CHARGER

- A. Provide a minimum 10 amp battery charger for each generator set battery bank. Generator sets incorporating two battery banks shall be provided with two chargers connected together and operating in parallel, with alarm output(s) connected in parallel. The charger(s) shall include the following capabilities:
  - 1. Chargers shall be UL 1236-BBHH listed and CSA or C-UL certified for use in emergency applications.
  - 2. The charger shall be compliant with UL 991 requirements for vibration resistance.
  - 3. The charger shall comply with the requirements of EN 61000-4-5 for voltage surge resistance; EN 50082-2 for immunity; EN 61000-4-2 for ESD; EN 61000-4-3 for radiated immunity; ANSI/IEEE C62.41 category B and IN61000-4-4 for electrically fast transient; EN61000-4-6 for conducted emissions; and FCC Part 15 Class A for radiated emissions.

## 2.07 ENGINE FUEL SYSTEM

- A. Each generator set fuel tank shall be provided as specified in the Contract Document or as directed by the AW Project Manager.
- B. The fuel tank shall have adequate capacity in compliance with all national and local regulations.
- C. The sub-base fuel tank shall be double wall, constructed of corrosion resistant steel and shall comply with NFPA 37.
- D. The fuel tank shall be UL listed.
- E. Where required, the indoor day tank and in-skid fuel transfer tank shall be double wall, made of aluminized steel with welded construction, and pressure tested to 3 PSI.

## 2.08 AC GENERATOR

- A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system and shall be UL 1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 125°C.

- B. The generator shall be capable of delivering rated output (KVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.
- C. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.
- D. For generator set rated 600 V ac and lower: the sub-transient reactance of the alternator shall not exceed 15 percent, based on the standby rating of the generator set.
- E. For generator set rated higher than 600 V ac up to 15,000 V ac:
  - 1. Provide two embedded resistance temperature detectors per phase and temperature indication equipment. The control system shall annunciate high alternator temperature as a fault condition.
  - 2. Provide anti-condensation heater for the alternator.
  - 3. The sub-transient reactance of the alternator shall not exceed 12 percent, based on the standby rating of the generator set.

## 2.09 GENERATOR CONTROLS

- A. Provide a lighted, unit mounted control panel with NEMA 250, Type 1 enclosure with engine and generator controls and indicators. The control console shall be factory built, wired, tested, and shock-mounted.
- B. For outdoor applications, unit mounted control panel shall be provided with a NEMA 250 Type 3R enclosure.
- C. The generator set mounted control panel shall include the following features and functions:
  - 1. Control switches including emergency stop switch, reset switch, and panel lamp switch
  - 2. Generator set AC output metering
  - 3. Generator set alarm status display including alarm and status indication lamps
  - 4. Engine status monitoring including a digital status panel on generator set control for engine oil pressure, engine coolant temperature, engine oil temperature, engine speed, number of hours of operations, number of start attempts, battery voltage, etc
  - 5. Engine control functions
  - 6. Alternator control functions

- D. The control panel shall include provision for padlock and shall have standard manufacturer recommended features or as directed by the AW Project Manager.
- E. Where the height of the sub-base fuel tank is such that the level of the control panel is above the normal reach of site personnel. Contractor shall provide fixed access stairs with walking platform and handrails to all operating features.

#### 2.10 MAIN LINE CIRCUIT BREAKER (FOR LOW VOLTAGE)

- A. The generator set shall be provided with a mounted main line circuit breaker, sized to carry the rated output current of the generator set. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all over-current conditions, or a thermal-magnetic trip with other over-current protection devices that positively protect the alternator under over-current conditions. The supplier shall submit time over-current characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

### **PART 3: EXECUTION**

#### 3.01 PREPARATION

- A. Verify site conditions and equipment mounting bases are ready for installation of the unit.

#### 3.02 INSTALLATION

- A. Equipment shall be installed by the Contractor in compliance with applicable State and local codes accordance with manufacturer's instructions.
- B. Equipment shall be installed in accordance with requirements of local utility provider, where applicable.
- C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The Contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
- D. Equipment shall be installed on poured-in-place concrete housekeeping pad that extend 1 feet on all sides. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.
- E. Equipment shall be initially started and operated by representatives of the manufacturer.
- F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment



shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

### 3.03 ON-SITE ACCEPTANCE TEST:

- A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The AW Project Manager shall be notified in advance and shall have the option to witness the tests.
- B. Installation acceptance testing shall be coordinated with AW and the local electrical power provider as required.
- C. Installation acceptance tests to be conducted on-site shall include the use of a resistive load bank provided under this Contract; make all temporary connections for the testing outlined below.
- D. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel. Testing of the assembly shall include applying load steps in 25% increments to the generator for 15 minutes each before sustained 100% load for the 2 hour duration indicated. Upon completion of these tests, and engine cool-down, the testing shall include a "cold start" test; applying a one step 100% rated load pickup test in accordance with NFPA 110.

### 3.04 TRAINING:

- A. Contractor shall provide training for the facility operating personnel covering operation and maintenance of the generator set. Training date shall be coordinated with AW.

### 3.05 WARRANTY

- A. The generator set and associated equipment shall be warranted for a period of not less than 2 years or standard manufacturer warranty period from the date of commissioning against defects in materials and workmanship.
- B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

**END OF SECTION 26 32 13.13**