

PROJECT:

SECTION 16620
PACKAGED ENGINE GENERATOR SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY:

- A. This Section includes packaged engine-generator systems for emergency power supply with the following features:
 - 1. Diesel Engine
 - 2. Unit-mounted cooling system
 - 3. Double Wall Base Mounted Fuel Tank
 - 4. Generator
 - 5. Engine Generator Set Controller
 - 6. Engine Generator Set Accessories
 - 7. Weatherproof Enclosure

1.2 SUBMITTALS:

- A. Shop Drawings: Indicate electrical characteristics and connection requirements. Show 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: Provide data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, and radiator.
- C. Test Reports: Indicate results of performance testing.

FACTORY TESTING:

The generator set shall be tested and validated with a completed factory test report which shall be completed at the factory on the unit. The test metering shall have an accuracy of 1% or better, and the metering used in testing shall be regularly calibrated and traceable to the National Bureau of Standards. The certified test of the engine-generator performance shall be provided. All tests shall be performed in accordance with the following test methods: IEEE 115 or MIL STD 705.

Factory tests shall include but not be limited to the following:

1. Full rated load at rated PF and maximum load, to verify engine power, overload and maximum capability.
2. kVA, kilowatts, amperes, voltage, frequency at: no load, full load rated and maximum output.
3. Regulator range (adjust), phase sequence, phase voltage balance.
4. Stator and exciter field resistance.
5. Insulation test, generator field, exciter armature, exciter field, generator armature or stator.
6. Dielectric test, generator field, exciter armature, exciter field, generator armature or stator.
7. All safety shutdown and automatic controls.
8. Standard testing includes portions of MIL-STD-705:

MIL-STD-705 Methods:

301.1b Insulation Resistance Test	510.1c Rheostat Range Test
302.1a High Potential Test	511.1c Regulator Range Test
401.1a Winding Resistance Test	511.2b Frequency Adjustment Range Test
410.1a Open Circuit Saturation Curve Test	513.2 Indicating Instrument Test (Electrical)
503.1b Start and Stop Test	515.1a Low Oil Pressure Protective Device Test
505.2a Overspeed Protective Device Test	515.2a Over temperature Protective Device Test
507.1c Phase Sequence Test (Rotation)	516.1 Controls, Direction of Rotation
508.1c Phase Balance Test (Voltage)	640.1c Maximum Power Test

- 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. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate procedures and findings.

1.3 OPERATION AND MAINTENANCE DATA:

- A. Operation Data: Include instructions for normal operation.
- B. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine, oil sampling and analysis for engine wear, and emergency maintenance procedures. Provide Operation and Maintenance Manuals.

1.4 QUALITY ASSURANCE:

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with a minimum of three years documented experience, and with service facilities within miles of project.

- B. Supplier: Authorized distributor of specified manufacturer with a minimum of three years documented experience.
- C. Comply with NFPA 70.
- D. Comply with NFPA 110 requirements for Level 1 emergency power supply systems.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver, store, protect and handle products to site under provisions of Section 01600.
- B. Accept unit on site on skids. Inspect for damage.
- C. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

1.6 WARRANTY:

- A. The standby electric generating system components, complete engine-generator and instrumentation panel shall be warranted by the manufacturer against defective materials and factory workmanship for a period of _____ years or 1500 hours. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge. The warranty period shall commence when the standby system is invoiced by the factory. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided.

1.7 MAINTENANCE SERVICE:

- A. Beginning at Substantial Completion, the Engine Generator Set supplier shall provide a _____ year maintenance service program including annual engine lube oil and filter change and fuel filter change. Maintenance shall be performed by skilled employees of manufacture's designated service organization. Include routine preventive maintenance as recommended by manufacture and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.8 EXTRA MATERIALS: (OPTIONAL)

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identification with labels describing contents.
 - 1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
 - 2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
 - 3. Filters: One set each of Lubricating, fuel, and combustion-air intake.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Only approved bidders shall supply equipment provided under this contract. Equipment specifications for this project are based on Engine Generator Sets manufactured by Blue Star Power Systems.
- B. Substitutions: Subject to compliance with requirements, equipment by other manufactures are acceptable, if approved not less than two weeks prior to scheduled bid date. Proposals must include a line-by-line compliance statement based on this specification.

2.2 PACKAGE ENGINE GENERATOR SYSTEM:

GENERATOR RATING:

KW: _____
KVA: _____
Volts: _____
Phase: _____
Power Factor: _____
Hertz: 60
RPM: 1800

Provide Blue Star Power Systems Model: _____ as provided by: _____ (xxx-xxx-xxxx), or approved equal.

(OPTIONAL)

Provide Blue Star Power Systems Model: _____ with over-sized generator end _____ as provided by: _____ (xxx-xxx-xxxx), or approved equal. The Generator shall be able to provide _____ SKVA at _____% instantaneous voltage dip.

2.3 ENGINE:

- A. Fuel: No. 2 Diesel
- B. Rated Engine Speed: 1800 RPM
- C. The _____ cubic-inch-displacement engine shall deliver a minimum of _____ bhp at a governed speed of 1800 rpm. The engine shall be equipped with the following:
 - 1. Governor: _____
 - 2. 24 Volt positive engagement solenoid shift-starting motor.
 - 3. 37-Ampere minimum automatic battery charging alternator with solid-state voltage regulation.
 - 4. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.
 - 5. Dry-type replaceable air cleaner elements for normal applications.

6. Engine-driven or electric fuel transfer pump capable of lifting fuel 6 feet, fuel filters, and electric solenoid fuel shut-off valve.
 7. The turbocharged engine shall be fueled with No. 2 diesel
 8. The engine shall have a minimum of [redacted] cylinders, and be liquid-cooled by a unit-mounted radiator, blower fan, water pump, and thermostats. This system shall properly cool the engine with up to 0.5 inches H₂O static pressure on the fan in an ambient temperature up to 118°F/48°C.
- D. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator set mounting frame and integral engine driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacture.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used.
 4. Temperature control: Self-contained thermostatic control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacture.
 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging, ultraviolet, and abrasion resistant material.
 - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 degree F (82 degree C), and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

2.4 FUEL SUPPLY SYSTEM:

- A. Comply with Flammable and Combustible Liquids Code—NFPA 30, the Standard for Installation and Use of Stationary Combustible Engine and Gas Turbines—NFPA 37, and Emergency and Standby Power Systems—NFPA 110.
- B. Base-Mounted [redacted] gallon Double Wall Secondary Containment Fuel Oil Tank: Factory installed and piped, complying with UL142 fuel oil tank. Features include the following:
 1. Fuel Level: A direct reading, UL listed, magnetic fuel level gauge with a hermetically-sealed vacuum tested dial shall be provided to eliminate fogging.
 2. Capacity: Fuel for [redacted] hour's continuous operation at 100 percent of rated load.
 3. Containment Provisions: Comply with requirements of authorities having jurisdiction.
 4. Low Fuel Level Switch: Consists of a 50 watt float switch for remote or local annunciation of an adjustable (25% standard) low fuel level condition.

5. Fuel Leak Detection Switch: Consists of a 50 watt float switch for remote or local annunciation of fuel in the containment area of the double wall fuel tank.
 6. Fuel Fill: There shall be a Vandal-resistant 2" NPT opening within the primary tank with an 8" raised fill pipe and lockable manual fill cap.
 7. Sub base fuel tank shall have an electrical conduit stub-up area
- C. Exterior Finish: The exterior coating has been tested to withstand continuous salt spray testing at 100 percent exposure for 244 hours to a 5 percent salt solution at 92-97° F. The coating has been subjected to full exposure humidity testing to 100 percent humidity at 100° F for 24 hours. Tests are to be conducted in accordance with The American Standard Testing Methods Society.
 - D. Venting: Normal venting shall be sized in accordance with the American Petroleum Institute Standard No 2000, Venting Atmospheric and Low Pressure Storage Tanks not less than 1-1/4" (3 cm.) nominal inside diameter. A 1-1/4" atmospheric mushroom cap shall be furnished and the installing contractor shall pipe above the highest fill point as a minimum
 - E. Emergency Venting: The emergency vent opening shall be sized to accommodate the total capacity of both normal and emergency venting and shall be not less than that derived from NFPA 30, table 2-8, and based on the wetted surface area of the tank. The wetted area of the tank shall be calculated on the basis of 100 percent of the primary tank. A brass plated 4 inch emergency pressure relief vent cap shall be furnished for the primary tank. The vent is spring-pressure operated: opening pressure is 0.5/psig and full opening pressure is 2.5 psig. Limits are stamp marked on top of each vent. The emergency relief vent is sized to accommodate the total venting capacity of both normal and emergency vents.

2.5 GENERATOR

- A. The alternator shall be salient-pole, brushless, 12-lead reconnect able, self-ventilated of drip-proof construction with amortizes rotor windings and skewed stator for smooth voltage waveform. The insulation shall meet the NEMA standard (MG1-22.40 and 16.40) for Class H and be insulated with epoxy varnish to be fungus resistant per MIL 1-24092. Temperature rise of the rotor and stator shall be limited to NEMA Class F ratings. The excitation system shall be capable of maintaining voltage within +/- _____% at any constant load from 0% to 100% of rating. The unit shall be encapsulated for humidity and abrasion protection. The regulator shall include volts per hertz operation, over excitation shutdown, stability adjust and built in voltage adjustment. The waveform harmonic distortion shall not exceed 5% total RMS measured line to line at full rated load. The TIF factor shall not exceed 50.
- B. The generator, having a single maintenance-free bearing, shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
- C. The Generator shall be able to provide _____ SKVA at _____% instantaneous voltage dip.
- D. The voltage regulator shall be a static-type using non-aging silicone controlled rectifiers, with electromagnetic interference suppression to commercial standards. If a permanent magnet excitation systems is specified, provide the DVR2000E digital voltage regulator.
- E. Provide Permanent Magnet Generator PMG. (OPTIONAL)

2.6 CONTROL AND MONITORING PANEL:

- A. Functional Description: When the mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of the generator set. When the mode-selector switch is switched to the on position, the generator manually starts. The off position of the same switch initiates generator shut-down. When the generator is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote Emergency-Stop switch also shuts down the generator set.
- B. Configuration: Operating and safety indications, protective devices, basic system controls and engine gages are grouped on a common control and monitoring panel mounted on the generator set. Mounting method isolates the control panel from generator set vibration.
- C. Indicating and Protective Devices and Controls: Include those required by NFPA-110 for level 1 systems, and the following:
1. AC Voltmeter
 2. AC Ammeter
 3. AC Frequency meter
 4. Battery Charging DC Ammeter
 5. Engine Coolant temperature gage
 6. Engine Lubricating oil pressure gage
 7. Running time meter
 8. Ammeter / Voltmeter, phase-selector switch (es)
 9. Alarm buzzer with silencing switch
 10. LED - Low Battery Voltage
 11. LED - Charger Malfunction
 12. LED - High Engine Temperature
 13. LED - Low Oil Pressure Pre-Alarm
 14. LED - Engine Over-Speed
 15. LED - Engine Over-Crank
 16. LED - EPS Supplying Load
 17. LED - Low Water Temperature
 18. LED - High Engine Temperature (Pre-Alarm)
 19. LED - Low Oil Pressure (Pre-Alarm)
 20. LED - Low Fuel Level
 21. LED - Unit Not in Auto
- D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support specified items. Locate sensors and other supporting items on engine, generator, or elsewhere as indicated. Where not indicated, locate to suit manufacturer's standard.
- E. Remote Alarm Annunciator: A repetitive alarm annunciator panel will be supplied complying with the NFPA-110 requirements. The NFPA requires audible and visual signal drives, powered by an electrical storage battery, be provided to give warning of derangement or alarm conditions in the alternate electric power source. (Standby Electric Generator Set) In accordance with NFPA-110, the alarm annunciator audible system allows for a first alarm to be silenced and if a second alarm occurs, the alarm system will again sound the alarm. The annunciator panel will include the following features:

1. Low battery voltage
2. Charger malfunction
3. High cycle temperature
4. Low oil pressure
5. Engine overspeed
6. Engine overcrank
7. (EPS) Emergency generator supplying load
8. Low Coolant temperature
9. High engine temperature - pre-alarm
10. Low oil pressure - pre-alarm
11. Low fuel
12. Unit not in Auto
13. Fuel Leak Detection
14. Low Coolant level

F. Remote Break-Glass Emergency Stop Switch: Surface mounted, unless otherwise indicated, and labeled. Push button shall be protected from accidental operation.
(OPTIONAL)

2.7 ENGINE GENERATOR SET ACCESSORIES:

- A. Line Circuit Breaker: _____ ampere Frame, _____ amps sensor, 3 poles, _____ volt Thermal Magnetic, 80% rated, UL molded case type, generator mounted.
- B. Coolant Jacket Heater: Thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA-99 and NFPA-110, Level 1. Provide _____ watt, _____ volt, single-phase coolant jacket heater, factory mounted and wired.
 - 1 Coolant Jacket Heater will be installed with ball valves as to permit maintenance to heater without draining entire cooling system.
- C. Battery: _____-volt lead-antimony battery (ies) capable of delivering the manufacturer's recommended minimum cold-cranking Amps required at 0°F, per SAE Standard J-537, shall be supplied.
- D. Battery Tray: Factory fabricated of metal with climate resistant finish.
- E. Battery Cable: Size as recommended by engine manufacture. Include required interconnecting conductors and connection accessories.
- F. Battery Charger: The charger shall employ a ferroresonant magnetic circuit to provide continuous taper charging and shall be completely automatic in operation. The __ AMP DC output shall be voltage regulated and current limited. The DC output shall be isolated from the AC input. AC line compensation shall be automatic. Current limiting shall be magnetic. The battery shall not be discharged through the charger.

The charger shall have constant voltage, current limited, 4-rate automatic equalization. A DC ammeter and voltmeter shall be supplied. Automatic meter alternately displays output volts, amps on charger case front.

Sealed silicon diode, full-wave rectifiers shall be used. The charger shall be equipped with an AC circuit breaker. The housing shall be convection cooled 304 stainless steel. The charger shall be warranted for three years and be UL listed.

Safety Functions: Include sensing of abnormally low battery voltage arranged to close contacts providing low battery voltage indication on the control and monitoring panel. Also include sensing of high battery voltage and loss of AC input or DC output of the battery charger. Either condition closes contacts that provide a battery charger malfunction indication at the system control and monitoring panel.

The battery charger shall be a BLUE STAR POWER SYSTEMS: [REDACTED]. The charger shall be mounted and wired (DC to the starter and AC to the Terminal Block) at the Gen-Set skid.

- G. Muffler / Silencer: The engine exhaust silencer shall be coated to be temperature and rust resistance, rated for critical application. The silencer will reduce total engine exhaust noise by 25-35 dBA.

(FOR OUTDOOR APPLICATIONS CHOOSE ONE OF THE FOLLOWING ENCLOSURES: Weather Protective - OR – Level 1 (Weather Proof) - OR – Level 2 (Weather Proof with Foam) - OR – Level 3 (Weather Proof with Foam and Scoop) - OR – Level 4 (Sound Attenuated Enclosure)

2.8 GENERATOR SET ENCLOSURE:

- A. Reinforced weather protective or weather proof enclosure, allowing access to control panel and service points, with lockable doors and panels. The enclosure shall have hinged doors with key locking provisions. The enclosure shall be designed to provide adequate ventilation for the generator set to operate in the ambient temperature specified without de-rating the generator output capability. The exhaust silencer shall be internally insulated and mounted in the enclosure. Factory paint the enclosure with powder coating. Paint shall be manufacturer's standard color.
- B. Blue Star Power Systems [REDACTED] enclosure dimensions with [REDACTED] gallon double wall sub-base fuel tank shall be [REDACTED]"L X [REDACTED]"W X [REDACTED]"H.
- C. Sound Level shall not exceed [REDACTED] dBA measured at 23 FT (7 meters) at 100% load, as per test method SAE J1074.
- D. The exhaust silencer shall be internally insulated and mounted within the enclosure (500 kW and below). (OPTIONAL)

2.8 SAE ENCLOSURE:

- A. Reinforced Blue Star Power Systems Sound Attenuated Enclosure model: [REDACTED], allowing access to control panel and service points, with lockable doors and panels. The enclosure shall have sound attenuation insulation consisting of 1-1/2 inch polyether polyurethane sound attenuating material. The enclosure shall have hinged doors with key locking provisions. The enclosure shall be designed to provide adequate ventilation for the generator set to operate in the ambient temperature specified without de-rating the generator output capability. The exhaust silencer shall be internally insulated and

mounted in the exhaust chamber. Radiator discharge air shall be directed to exit the top of the enclosure. Factory paint the enclosure with powder coating. Paint shall be manufacturer's standard color.

- B. Blue Star Power Systems Sound Attenuated Enclosure dimensions with _____ gallon double wall sub-base fuel tank shall measure _____"L X _____"W X _____"H.
- C. Sound Level shall not exceed _____ dBA measured at 23 FT (7 meters) at 100% load, as per test method SAE J1074.
- D. The exhaust silencer shall be insulated and mounted within the enclosures exhaust chamber.

(OPTIONAL)

2.9 LOAD BANK:

- A. Permanent, radiator mounted, weatherproof, forced-air-cooled, resistive load bank, with controls capable of providing a balanced 3-Phase load to the generator set at 50% of the rated system capacity, at 1.0 power factor. Unit is capable of selective control of load in 25% steps. Load Bank Control panel may be preset for adjustable single-step loading of generator set during automatic exercising. In the event of a utility power outage during the exercise cycle, the controls will remove the load applied by the radiator mounted load bank, and allow the generator set to pick up the transferred building load.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions.
- B. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The engine generator set shall be installed on a concrete pad. The engine generator set shall be permanently fastened to the pad in accordance with the manufacturer's instructions and seismic requirements of the site.
- C. The on-site power system shall be initially started and operated by a representative of the manufacturer.
- D. All equipment shall be 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.

3.2 START UP AND WARRANTY VALIDATION:

- A. The complete installation shall be tested for compliance with the specification following completion of all site work. All start-up procedures and testing of engine generator set and

automatic transfer switch will be performed by an authorized service center of the manufacturer. The fuel required for test purposes shall be provided by the contractor.

- B. The following start-up procedures shall be performed by the manufactures authorized service center, factory trained technician:

- Verification of fluid levels (coolant, lubricating oil, battery electrolyte, fuel)
- Inspection to identify any loose or broken equipment
- Verification of proper jacket water heater operation
- Verification of proper battery charger operation
- Static verification of control panel alarms and shutdowns
- Exhaust system inspection to verify proper installation including rain cap
- Verification of manual starting from local control panel
- Verification that no fluid leaks exist
- Verification of proper control panel gauge operation
- Perform any necessary adjustments (output voltage, engine speed)
- Verification of proper interface with the Automatic Transfer Switch(s)
- Verification that the remote annunciator panel is operating properly

3.3 ON-SITE ACCEPTANCE TEST: (OPTIONAL)

- A. Installation acceptance tests to be conducted on-site shall include a “cold start” test, a two hour full load test, and a one step rated load pick up test in accordance with NFPA-110. Provide a resistive load bank and make temporary connections for full load test.

3.3 DEMONSTRATION:

- A. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide emergency and standby power.
- B. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. Training shall be coordinated with the facility owner.

END OF SECTION