

DIVISON 16 ELECTRICAL**Section 16620A Diesel Engine Generator Set**

Note:

- All items shown in red require review, and possible input, for information required that is specific to the generator system being specified.
- The items shown with **{brackets like this}** are included for the purpose of establishing the levels of performance, quality and reliability required for the specified product, and ensuring the reputability of the product supplier.
- The brackets should be removed in any final specification.

Part: 1 GENERAL**1.1. DESCRIPTION OF SYSTEM**

- 1.1.1. Provide a Standby power system to supply electrical power in event of failure of normal supply, consisting of a liquid cooled engine, an AC alternator and system controls with all necessary accessories for a complete operating system, including but not limited to the items as specified hereinafter.

1.2. REQUIREMENTS OF REGULATORY AGENCIES

- 1.2.1. An electric generating system, consisting of a prime mover, generator, governor, coupling and all controls, must have been tested, as a complete unit, on a representative engineering prototype model of the equipment to be sold.
- 1.2.2. Conform to N.E.C. and applicable inspection authorities. NFPA 110

1.3. MANUFACTURER QUALIFICATIONS

- 1.3.1. This system shall be manufactured by GENERAC, Cummins, Caterpillar or approved equal who has been regularly engaged in the production of engine-alternator sets, and associated controls for a minimum of twenty years, thereby identifying one source of supply and responsibility.
- 1.3.2. The manufacturer shall have printed literature and brochures describing the standard series specified, not a one of a kind fabrication.

1.4 DEALER QUALIFICATIONS

- 1.4.1. The supplier of the generator set shall be the authorized dealer for the manufacturer and the installation of the generator set shall be within the authorized dealers assigned territory.

Part: 2 ENGINE-GENERATOR SET**2.1. Engine**

- 2.1.1. The diesel engine shall be a liquid cooled, four (4) cycle design. It shall have turbo-charging and after-cooling as required by the manufacturer to produce the required horsepower in the ambient conditions specified herein. The design may be in line or V type with a minimum displacement adequate to generate the specified kW at manufacturer's published rating. The nominal rating shall be ____ kW, at .80 power factor and operating speed of 1800 RPM. Standard published data sheets must be provided that describe derations applicable to site specific ambient conditions to allow determination of

acceptability of the unit proposed, Interpretation will be determined by the University of Arizona Electrical Engineer. Engine shall be lubricated with a positive displacement oil pump.

- 2.1.2. The engine is to be cooled with a unit mounted radiator, fan, water pump, and closed coolant recovery system providing visual diagnostic means to determine if the system is operating within a normal engine coolant level. The radiator shall be designed for operation in 115° Fahrenheit, ambient temperature.
- 2.1.3. The intake air filter, with replaceable element, must be mounted on the unit. Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter with internal bypass. Engine coolant and oil drain extensions must be provided to outside of the mounting base for cleaner and more convenient engine servicing. The fan and all rotating parts must have guards installed for personnel safety.
- 2.1.4. The engine shall have a battery charging DC alternator with a solid state voltage regulator. Remote 2-wire starting shall be by means of a solenoid shift, electric starter.
- 2.1.5. Engine speed shall be governed by electronic isochronous governor to maintain alternator frequency within $\pm .5\%$ from no load to full load alternator output. Steady state regulation is to be $\pm .25\%$.
- 2.1.6. The engine fuel system shall be designed for operation on No. 2 diesel fuel. A secondary fuel filter, water separator, manual fuel priming pump, fuel shutoff solenoid and all fuel lines must be installed at the point of manufacture.
- 2.1.7. Sensing elements to be located on the engine for low oil pressure shutdown, high coolant temperature shutdown, low coolant level shutdown, overspeed shutdown and overcrank shutdown. These sensors are to be connected to the control panel using a wiring harness with wire number labeling on each end of the wire run for easy identification. A molded rubber boot to cover the electrical connection on each sensor to prevent corrosion and all wiring to be run in flexible conduit for protection from the environment and external impact.
- 2.1.8. Provide the following items installed at the factory:
 - 2.1.8.1. A heavy duty, lead acid battery set shall be provided by the generator set manufacturer of adequate voltage and amperage capacity to start and operate the engine. Provide all inter-cell and connecting battery cables as required.
 - 2.1.8.2. Provide an automatic dual rate battery charger with an automatic equalizer system to monitor and limit the charge current to 10 amps. Provide an Ammeter and Voltmeter on the face of the charger, and a replaceable fuse accessible from the front of the automatic battery charger.
 - 2.1.8.3. Primary diesel fuel filter capable of removing contaminants of 10 microns or larger. Element shall be replaceable cartridge type.
 - 2.1.8.4. The manufacturer shall supply its recommended stainless steel, flexible connector to couple the engine exhaust to the exhaust system.
 - 2.1.8.5. The engine shall have a unit mounted, thermostatically controlled water jacket heater as an aid for quick starting. It will be of adequate wattage as recommended by the engine manufacturer. The contractor shall provide proper branch circuit from normal utility power source.
- 2.1.9. The fuel system shall include a double walled, UL approved, sub-base mounted fuel tank with electrical stub-up area. The fuel tank shall provide for a minimum of 24 hours run time at 100% of full load. It shall have the structural integrity to support the engine-generator set. Minimum features shall include all welded construction, fuel filler cap, fuel gauge, low fuel level alarm, tank rupture basin

alarm, supply line check valve, fuel supply connection, fuel return connection, main tank vent, rupture basin vent and tank drain fitting. Tank must be pressure tested to 5 PSI during manufacturing. Appropriately sized flexible fuel supply and return lines shall be provided and installed.

- 2.1.10. Appropriate vibration isolation (elastomeric or springs as required) is to be provided between the generator set and the fuel tank base. Additionally, cork/rubber type vibration isolation pads shall be provided for field installation between the fuel tank base mounting rails, and the concrete mounting pad.
- 2.1.11. LUBRICATION SYSTEM
- A. The lubrication oil pump shall be a positive displacement type that is integral with the engine and gear driven from the engine gear train. The system shall incorporate full flow filtration with bypass valve to continue lubrication in the event of filter clogging.
 - B. The bypass valve must be integral with the engine filter base of receptacle. Systems where bypass valves are located in the replaceable oil filter are not acceptable. Pistons shall be oil cooled by continuous jet spray to the underside or inside of the crown and piston pin.
 - C. System shall utilize synthetic lubricants with compatible filtration, and compatible engine seals, approved by the engine manufacturer.
- 2.1.12. GOVERNOR
- A. The engine governor shall control engine speed and transient load response within commercial and ISO 8528 tolerances. It will be selected, installed, and tested by the generator set manufacture.

2.8 GOVERNOR, ELECTRONIC-SPEED CONTROL

- A. The engine governor shall be a Woodward 2301 Electronic Speed Control with EG Electro-Hydraulic Actuator or Barber Coleman Equal. Speed drop shall be externally adjustable from 0 (isochronous) to 10% from no load to full rated load. Steady state frequency regulation shall be +/-0.25 percent

2.2. ALTERNATOR

- 2.2.1. The alternator shall be a 4-pole revolving field type, 12 lead, wired for ____/____ VAC, 3Ø, 60 Hz, brushless with PMG excitation. The stator shall be direct connected to the engine to insure permanent alignment. The generator shall meet temperature rise standards for Class "H" insulation, and operate within Class "F" standards for extended life. All leads must be extended into an AC connection panel. The alternator shall be protected by internal thermal overload protection and an automatic reset field circuit breaker. Maximum temperature rise at the required kW shall not exceed 130° C above 50° C ambient.
- 2.2.2. One step load acceptance shall be 100% of nameplate rating and meet the requirements of NFPA 110 paragraph 5-13.2.6. The generator set and regulator must sustain 300% short circuit current for a minimum of 10 seconds.
- 2.2.3. A solid state digital voltage regulator must be used to control output voltage by varying the exciter magnetic field to provide $\pm 1\%$ regulation during stable load conditions. True RMS sensing shall be utilized. Should an extremely heavy load drop the output frequency, the regulator shall have a Volts/Hertz capability to maximize motor starting ability. The frequency at which drop operation begins must be adjustable, allowing the generator set to be properly matched to the site specific load characteristics insuring optimum system performance. The voltage regulator shall meet MIL-STD-461C Part 9 for radiated and conducted emissions susceptibility when mounted within the alternator standard connection box. The voltage regulator shall be fully encapsulated for protection against moisture or abrasive contamination. It shall be tested to MIL-STD-705 Method 711.1C and salt fog tested to ASTM B117-73

2.29 VOLTAGE REGULATOR - SEALED

- A. The automatic voltage regulator shall be manufactured by the manufacturer of the engine - generator set. The volts/hertz regulator shall sense line-to-line three phases of generator output voltage and exhibit the following characteristics:
1. Generator output voltage maintained within +/- 1% of rated value for any load variation between no load variation and full load variation.
 2. Generator output voltage drift no more than +/- 1/2% of rated value at constant temperature.
 3. Generator output voltage drift no more than +/- 1% of rated value within a 40° change over ambient temperature range of -40° C to 70° C.
 4. Generator frequency change not over ¼ cycle no load to full load and back.
 5. Response time less than 20 milliseconds.
 6. Telephone Influence Factor (TIF) of less than 50.
 7. Electronic Interference/Radio Frequency Interference (EMI/RFI) suppressed to commercial standards.
 8. The regulator shall include the following features:
 - a. Voltage level rheostat to provide generator output voltage adjustment of 25% to +10% of nominal.
 - b. Gain adjustment to provide output voltage compensation for changes in load or frequency.
- 2.2.4. It is the responsibility of the generator set supplier to verify that the motor starting ability of the generator set being proposed is capable of handling the maximum starting load as shown on the plans. The maximum voltage dip during any sequence shall not exceed 30%. Mathematical confirmation in writing shall be included with the bid to assure that the generator set proposed is sized appropriately for the specific application. This confirmation shall be performed utilizing the computerized sizing program from the alternator manufacturer.
- 2.2.5. A NEMA 1 panel that is an integral part of the generator set must be provided to allow the installer a convenient location in which to make electrical output connections. An isolated neutral lug must be included by the generator set manufacturer to insure proper sizing.
- 2.2.6. The electric plant shall be mounted with vibration isolators on a welded steel base that shall permit suitable mounting to any level surface. Note: If fuel tank type base is included the spring isolators are to be installed between the generator set rails and the fuel tank. (see 2.1.11.)
- 2.2.7. A fully electronic main line circuit breaker 100% rated with long time, short time adjustments and as shown on the drawings, must be mounted in the AC connection panel. The line side connections are to be made at the factory. A system utilizing a manual reset field circuit breaker and current transformers is unacceptable. Circuit breakers of 1000 amps and above require ground fault. Breaker shall be adjustable for 110% load testing. Refer to Section 2.4.6.
- 2.2.8. Thermal Class 200 magnet wire as described by NEMA Magnet Wire Standard MW 1000, Section MW35-C, shall be used for rotor and stator windings. The windings shall consist of copper magnet wire. All winding insulation materials shall be Class H.

2.3. CONTROLS

- 2.3.1. All engine alternator controls and instrumentation shall be designed, built, wired, tested and shock mounted in a NEMA 1 enclosure to the engine-generator set by the manufacturer. It shall contain panel lighting, a fused DC circuit to protect the controls and a +/-5% voltage adjusting control. This panel must be able to be rotated 90 degrees in either direction for correct installation as the site may require.
- 2.3.2. The engine-generator set shall contain a complete 2 wire automatic engine start-stop control which starts the engine on closing contacts and stop the engine on opening contacts. A programmable cyclic cranking limiter shall be provided to open the starting circuit after five attempts if the engine has not started within that time. Engine control modules must be solid state plug-in type for high reliability and easy service.
- 2.3.3. The panel shall include; analog meters to monitor AC voltage, AC current and AC frequency with a phase selector switch, a mushroom style emergency stop switch, an audible alarm, battery charger fuse, and a programmable engine control and monitoring module.
- 2.3.4. The programmable module shall include: a manual, off, auto switch; four LEDs to indicate 1) Not In Auto, 2) Alarm Active, 3) Generator Running, 4) Generator Ready; a data entry keypad and a digital display panel.
- 2.3.5. The module will store and display all pertinent unit parameters including:
1. Generator Status
 - Current unit status in real time
 2. Instrumentation
 - Real time readouts of the engine and alternator analog values
 - * Oil pressure
 - * Coolant temperature
 - * Fuel level
 - * DC battery voltage
 - * Run time hours
 3. Generator Commands
 - Current engine start/stop status
 4. Alarm Status- Provide Audio Visual Alarm Panel.
 - Current alarm(s) condition
 - * High or low AC voltage
 - * High or low battery voltage
 - * High or low frequency
 - * Low or pre-low oil pressure
 - * Low water level
 - * Low water temperature
 - * High and pre-high engine temperature
 - * High, low and critical low fuel levels (where applicable)
 - * Overcrank
 - * Overspeed
 - * Unit not in "Automatic Mode"
 - * 8 user programmable digital channels
 - * 4 user programmable analog channels
 5. Alarm Log
 - Memory of last fifty alarm events
 6. Operating parameters
 - Access to and manipulation of the current operating parameters and alarm limits
 7. Software Information
 - Version information and module display test function
 8. Overvoltage and undervoltage protection.

2.3.6. The panel must be accessible by PC based software via either standard RS232, RS485 or modem. The software must display the module face, be updated in real time and allow for complete access to all module functions. Communication output and its software must be fully compatible and allow for incorporation into an existing control program.

2.3.7. The following equipment is to be installed at the engine-generator set manufacturer's facility:

2.3.7.1. The panel mounted voltage adjuster must have a shaft locking device to avoid unintentional adjustment.

2.3.8. The following equipment is to be provided by the engine-generator set manufacturer and shipped loose with the unit:

2.3.8.1. Provide an alarm annunciator panel for remote mounting with the following signals indicating status and possible malfunction. The annunciator must have the capability of programming the audible alarms as follows:

LAMP LEGEND	LIGHT	AUDIBLE
Pre-Alarm High Water Temperature	Yellow	Selectable
Pre-alarm Low Oil Pressure	Yellow	Selectable
High Coolant Temp/Low Coolant Level	Red	Yes
Low Oil Pressure	Red	Yes
Low Coolant Temperature	Yellow	Selectable
Low Fuel	Yellow	Selectable
High Battery Voltage	Yellow	No
Not In Auto	Red	Yes
RPM Sensor Loss	Red	Yes
Over Speed	Red	Yes
Low Battery Voltage	Yellow	Yes
Overcrank	Red	Yes
Generator Power	Yellow	No
Normal Utility Power	Green	No
System Ready	Green	No
Alarm Switch Off	Red	No
Generator Running	Yellow	No
Battery Charger Failure	Yellow	Selectable
Emergency Stop	Red	Yes
Communications OK	Green	Yes

The panel shall have an ALARM switch that when moved to the OFF position silences the audible alarm. A TEST/RESET switch must be included to verify the lights are functional and reset any condition after it has cleared inside enclosure.

2.3.9. Engine Start Stop Control- Mushroom Switch

2.3.10. Engine run monitor, simplex CZAM/ZAM, connected into fire alarm loop. Refer to single line diagrams for the project.

2.4. UNIT ACCESSORIES AND MISC.

2.4.1. Weather protective sound attenuating enclosure: The engine-generator set shall be factory enclosed in a 12 gauge steel enclosure constructed with corner posts, uprights and headers. The roof shall aid in the runoff of water and include a drip edge. The enclosure shall be coated with electrostatically applied paint, baked and finished to manufacturers' specifications. The enclosure shall be completely lined with 1" thick, UL 94 HF-1 listed, sound deadening material. This material must be of a self-extinguishing design. The enclosure is to have large, hinged, removable doors to allow access to the engine, alternator and control panel. Hinges and all exposed fasteners will be stainless steel. Each

door will have lockable hardware with identical keys. Padlocks do not meet this specification. The critical silencer shall be included to further reduce the unit sound level. The overall design must be such that sound level is 75dbA at 7 meters (23 feet) or less.

- 2.4.2. Exhaust silencer(s) shall be provided of the size as recommended by the manufacturer and shall be of critical grade to attenuate the sound to the level noted above. It shall be supplied with a flexible, seamless, stainless steel exhaust connection. A rain cap will be supplied to terminate the exhaust pipe. These components must be properly sized to assure operation without excessive back pressure when installed. Maximum back pressure is 6.7 kPa. Pitch piping to drain.
- 2.4.3 Jacket water heater(s) shall be provided to maintain coolant temperature of 32 C (90F) while the engine is idle. Heaters shall accept 208 volt AC single phase power and include adjustable thermostats.
- 2.4.4 ISOLATOR-SPRING TYPE
- A. Steel spring isolators shall be installed between the generator set base and the mounting surface. The isolators shall bolt to the base, and have a waffled or ribbed pad on their bottom surface. The pads shall be resistant to heat and age, and impervious to oil, water, antifreeze, diesel fuel, and cleaning compounds.
- 2.4.5 ENCLOSURE – STANDBY PACKAGE, FULL
- A. The enclosure shall offer protection as specified by OSHA from all moving and hot parts of the engine, generator and radiator. It shall be constructed to allow full access to the engine for maintenance without exposing personnel to any moving machinery. Radiator and radiator fan assembly shall be totally enclosed with lockable door over the radiator cap. The radiator shall be sized to accommodate any resulting air flow restriction. Provision shall be made for a duct flange or perforated metal grill to protect the radiator core. Doors shall be the lift off hingeless type with lockable stainless steel security latches
- B. Louvers shall allow sufficient air flow to allow full load operation of the generator set. The louvers shall be twisted to deflect water and direct noise downward. The enclosure shall satisfy IEC 1P22 requirements for drip proof construction acceptable for outside installation when doors are in place.
- C. The enclosure shall be fitted to the generator set base and isolated from engine vibration. Corners shall be formed and welded to assure strength and rigidity. Sheet metal with minimum thickness of 2.0 mm for enclosure and 1.2 mm for doors shall have no burrs or sharp edges. Inside and outside surfaces shall be finished with a baked high performance enamel. Exposed fasteners shall be minimized with all hardware stainless steel.
- D. Outdoor generator enclosures shall be sage green, Federal standard 595b, 14449.
- 2.4.6 CIRCUIT BREAKER-GENERATOR SET MOUNTED
- A. The circuit breaker shall be mounted and connected in a guarded drip-proof enclosure. Cable lugs shall be provided for customer connections.
- B. One molded case electronic circuit breaker, three pole, single-throw, stationary- mounted with manual operating handle, overload and short circuit trips, complete with cable lugs. Overcurrent trip shall be 100% rated and sized to provide enclosed and ambient temperature compensation. The breaker shall be qualified for 600 volt operation and tested in accordance with UL Standard 489, LSI / LSIg. Breaker shall be adjustable to allow for 110 % output test.
- C. One shunt trip, 24 volt DC, on circuit breaker wired to terminal board.
- D. Three current transformer, 5 ampere secondaries.
- E. One ground connection point.

2.4.7 REMOTE ANNUNCIATOR PANEL

- A. NFPA-99 requirements for remote annunciation shall be satisfied by a remote mounted electro-mechanical panel which includes red and yellow indicating lights and silenceable alarm horn for low oil pressure shutdown, low coolant temperature alarm, high coolant temperature, shutdown, overcrank, overspeed shutdown, battery charger malfunction (via charger switch), generator on load (via customer switch). Install where directed by the University.

2.4.8 WEATHERPROOF SOUND ATTENUATION ENCLOSURE

- A. Enclosure shall be sound attenuating enclosure: the engine-generator set shall be factory enclosed in not less than a 12 gauge steel enclosure constructed with corner posts, uprights and headers. The roof shall aid in the runoff of waste and include a drip edge. The enclosure shall be coated with electrostatically applied paint, baked and finished to manufacturers specifications. The enclosure shall be completely lined with not less than 1: thick, UL 94 HF-1 listed, sound deadening material. This material must be of a self extinguishing design. The critical silencer shall be included to further reduce the unit sound level. The overall design must be such that sound level is 75dbA at 7 meters (23 feet) or less.
- B. Exhaust silencer(s) shall be provided of the size as recommended by the manufacturer and shall be of critical grade to attenuate the sound to the level noted above. It shall be supplied with a flexible, seamless, stainless steel exhaust connection. A rain cap will be supplied to terminate the exhaust pipe. These components must be properly sized to assure operation without excessive back pressure when installed.

Part: 3 AUTOMATIC TRANSFER SWITCH- refer to specific specification for this apparatus.

Part 4 SUBMITTALS

1.12 SUBMITTALS

- A. Submittals shall include but not be limited to:
 - 1. Component List - A breakdown of all components and options including switch gear.
 - 2. Technical Data - Manufacturer produced generator set specification or data sheet identifying make and model of engine and generator, and including relevant component design and performance data.
 - a. Engine:
 - Type, aspiration, compression ratio, and combustion cycle.
 - Bore, stroke, displacement, and number of cylinders.
 - Engine lubricating oil capacity.
 - Engine coolant capacity without radiator.
 - Engine coolant capacity with radiator.
 - Coolant pump external resistance (maximum). Where remote radiator is specified
 - 3. Generator: Model
 - Model
 - Frame
 - Insulation class
 - Number of Leads
 - Weight, total
 - Weight, rotor
 - Air Flow

At rated voltage:
 Efficiency at 0.8 power factor for: 50% load, 75% load, 100% load
 Fault current, 3 phase symmetrical
 Decrement curve

- 4. Radiator: (High Ambient, Brass)
 Model
 Type
 Coolant capacity, radiator
 Coolant capacity, radiator and engine
 Weight: Dry, Wet

- 5. System:
 Dimensions: Length, Width, Height
 Weight: Dry, Wet

- Performance in 115°F air, 2400 MSL.

Continuous power rating at 0.8 power factor (KW) kVA rating
 Fuel consumption at standard conditions for:
 50%, 75% and 100% load heat rejection to:
 coolant, after-cooler, exhaust, atmosphere from engine, and atmosphere from
 generator
 Exhaust gas stack temperature
 Exhaust gas components; % NOX, % SO
 Tons particulate/yr/mo at 50%, 100% load
 Verification of 10% overload capability

- B. Transient response of frequency and voltage for the generator set:
- C. Auxiliary Equipment - Specification or data sheets, including switchgear, spring type vibration isolators.
- D. Drawings - General dimensions drawings showing overall generator set measurements, mounting location, and interconnect points for load leads, fuel, exhaust, cooling and drain lines.
- E. Wiring Diagrams - Wiring diagrams, schematics and control panel outline drawings published by the manufacturer in Joint Industrial Council (JIC) format for controls and switchgear showing interconnected points and logic diagrams for use by contractor and owner.
- F. Warranty Statements - Warranty verification published by the manufacturer.
- G. Service - Location and description of supplier's parts and service facility including parts inventory and number of qualified generator set service personnel.

PART 5 EXECUTION

5.1 EXECUTION

- A. The following articles and paragraphs are intended to define acceptable procedures and practices of inspecting, installing, and testing the generator set and associated equipment.

5.2 PREDELIVERY INSPECTION

- A. A pre-delivery inspection must be performed by the system manufacturers' local dealer at the dealer's facility to insure no damage occurred in transit and all genset components, controls, and

switchgear are included as specified herein.

5.3 PREDELIVERY TESTING

- A. Prior to delivery and acceptance, the generator set shall be tested to show it is free of any defects and will start automatically and carry full load with all parasitic and external loads. This testing shall be performed at the facility of the system manufacturer's authorized local dealer.
- B. The testing shall be done on dry type, resistive load banks.
- C. The load banks shall not be dependent on the generator control instruments to read current and voltage on each phase. Rather, the test instrumentation will serve as a check of the generator set meters.
- D. Load bank testing shall be done in the presence of the owner's engineer or his appointed representative. After manufacturers approved break-in procedure, sample oil, change oil and performance testing, forward oil test results to U of A Engineer. Testing shall be for a minimum of 1 hour at 80% load, 1 hr. at 100% load, 2 hrs. at 110% load, 1.0 pf. Demonstrate voltage dips and frequency dips with block loading. Bypass output circuit breaker for 110% testing. Use 125% rated conductors into load bank.
- E. All consumables necessary for testing shall be furnished by the bidder. Any defects which become evident during the test shall be corrected by the bidder at his own expense prior to shipment to the jobsite.

5.4 SHIPMENT TO JOBSITE

- A. Delivery shall be FOB to the jobsite by the system manufacturer's authorized dealer.

5.5 INSTALLATION

- A. The installation shall be performed in accordance with shop drawings, specifications, and the manufacturer's instructions.

5.6 FIELD QUALITY CONTROL

- A. The complete installation shall be checked for procedural and operational compliance by a representative of the system manufacturer's authorized local dealer. The engine lubricating oil and antifreeze, as recommended by the system manufacturer, shall be provided by the generator set dealer. If switchgear and generator sets are furnished by different manufacturers, technical representatives of both manufacturers' authorized dealers shall verify the installation meets requirements. Any deficiencies shall be noted and corrected by the Contractor.
- B. The system manufacturer's dealer representative shall be present to assist the Contractor during start-up, systems check, adjusting, and site testing required after the installation is complete. Re run the pre delivery test and then test the oil. (Do not change the oil.)

5.7 POST-INSTALLATION TESTING

- A. Following installation, the following tests shall be performed by the system manufacturer's local dealer representative(s) in the presence of the owner's engineer or designated appointee.

5.8 PRESTART CHECKS

- Oil level
- Water level
- Day tank fuel level

Battery connection and charge condition
Air start supply pressure (if so equipped)
Engine to control interconnects
Engine generator intake/exhaust obstructions
Removal of all packing materials

5.9 OPERATION

- A. Load - two hours operation at 80% of full load rating. One hour operation at 100% of full load rating and one hour at 110°C. After the first half-hour stabilization period at full load, the following shall be recorded at fifteen minute intervals (starting at time equals "zero"):
1. Voltage, amperage, frequency
 2. Fuel pressure, oil pressure and water temperature
 3. Exhaust gas temperature at engine exhaust outlet
 4. Ambient temperature
- B. If equipped with appropriate instrumentation:
1. Kilowatts
 2. Power Factor
 3. KVARs
 4. Generator Temperature
- C. Proper operation of controls, engine shutdown, and safety devices shall be demonstrated.

5.10 ORIENTATION

- A. The system manufacturer's authorized dealer shall provide a complete orientation for the owner's engineering and maintenance personnel. Orientation shall include both classroom and hands-on instruction. Topics covered shall include control operation, schematics, wiring and diagrams, meters, indicators, warning lights, shutdown system and routine maintenance.

5.11 SERVICE MANUALS AND PARTS BOOKS

- A. The system manufacturer's authorized local dealer shall furnish three copies each of the manuals and books listed below for each unit under this contract:
1. OPERATING INSTRUCTIONS - with description and illustration of all switchgear controls and indicators and engine and generator controls.
 2. PARTS BOOKS - that illustrate and list all assemblies, subassemblies and components, except standard fastening hardware (nuts, bolts, washers, etc.).
 3. PREVENTATIVE MAINTENANCE INSTRUCTIONS - on the complete system that cover daily, weekly, monthly, biannual, and annual maintenance requirements and include a complete lubrication chart.
 4. ROUTINE TEST PROCEDURES - for all electronic and electrical circuits and for the main AC generator.

5. TROUBLESHOOTING CHART - covering the complete generator set showing description of trouble, probable cause and suggested remedy.
 6. RECOMMENDED SPARE PARTS LIST - showing all consumables anticipated to be required during routine maintenance and test.
 7. WIRING DIAGRAMS AND SCHEMATICS - showing function of all electrical components.
- B. All manuals and books described above shall be contained in rigid plastic pouches.

5.12 WARRANTY NAMEPLATE

- A. A warranty nameplate of not less than 152 mm x 203 mm (6 in x 8 in) must be affixed to the generator set with the following data:

Warranty Period:
Start-up Date:
Termination Date:
Supplier Name:
Supplier Address:
24-Hour Emergency Number:
Preventive maintenance to be performed by:

5.13 OIL SAMPLING SERVICE

- A. The generator set supplier shall provide a scheduled oil sampling service to monitor engine condition on an ongoing basis. The sampling method shall be of the atomic absorption spectrophotometry method.

Immediate notification of critical results shall be provided to the owner's representative.

Part: 6 UNIT OPTIONS

61. FACTORY TESTING

- 6.1.1. Before shipment of the equipment, the engine-generator set shall be tested under rated load for performance and proper functioning of control and interfacing circuits. Tests shall include:

- 6.1.1.1. Verifying all safety shutdowns are functioning properly.
- 6.1.1.2. Single step load pick-up per NFPA 110-1996, Paragraph 5-13.2.6.
- 6.1.1.3. Transient and voltage dip responses and steady state voltage and speed (frequency) checks.

6.2. OWNER'S MANUALS

- 6.2.1 Three (3) sets of owner's manuals specific to the product supplied must accompany delivery of the equipment. General operating instruction, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included. Also include a copy of the manual on CD.

6.3. INSTALLATION

- 6.3.1 Contractor shall install the complete electrical generating system including all fuel connections in accordance with the manufacturer's recommendations as reviewed by the Engineer.

6.4. SERVICE

- 6.4.1. Supplier of the electric plant and associated items shall have permanent service facilities in this trade area. These facilities shall comprise a permanent force of factory trained service personnel on 24 hour call, experienced in servicing this type of equipment, providing warranty and routine maintenance service to afford the owner maximum protection. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications.
- 6.4.2. The supplier of the generator set shall include a maintenance contract in a form that is ready for execution by the owner if the owner should choose. The maintenance contract may not be intended for execution by a third party in any form thus ensuring and maintaining sole source and responsibility for all items supplied.

6.5. WARRANTY

- 6.5.1. 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 5 years. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge for travel and labor. The warranty period shall commence when the standby power system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

The execution of all warranty shall be conducted by the generator set supplier thus assuring a single source of responsibility.

The manufacturer shall include the option for any extended warranties that may be available in the bid. Any added cost and conditions for this option shall be clearly stated.

6.6. STARTUP AND CHECKOUT

- 6.6.1. At the jobsite.
- 6.6.1.1. Ensuring the engine starts within the specified time.
 - 6.6.1.2. Verification of engine parameters within specification.
 - 6.6.1.3. Set no load frequency and voltage.
 - 6.6.1.4. Test all automatic shutdowns of the engine-generator.
 - 6.6.1.5. Perform a load test of the electric plant, ensuring full load frequency and voltage are within specification by using building load.
 - 6.6.1.6. After the above tests are completed satisfactorily a four hour full load test utilizing resistive load banks shall be conducted. Logging of pertinent data every fifteen minutes shall be included. The load test format shall be approved by the engineer before the test commenced. Initial fuel fill and fuel for testing shall be provided by the owner.

6.7. SUBMITTALS

- 6.7.1. Provide seven complete sets of Engineering Submittal for approval, prior to production release, showing all components, in addition to the engine and generator. Submittals shall include a statement of compliance with these specifications.

6.8. SUBSTITUTIONS

- 6.8.1. The Standby power system has been designed to the specified manufacturer's electrical and physical characteristics. The equipment sizing, spacing, amounts, electrical wiring, ventilation equipment, fuel and exhaust components have all been sized and designed around the basis of design Engine Generator. Should any substitutions be made, the contractor shall bear responsibility for the installation, coordination and operation of the system as well as any engineering and redesign costs which may result from such substitutions. Alternate equipment suppliers shall furnish equipment submittals 14 days prior to bid date for approval to bid. As part of the submittals, the substitute manufacturer shall supply as a minimum engine, alternator and control panel wiring diagrams and schematics.

End of Appendix Section 16620A