

SECTION 16620 - EMERGENCY STANDBY POWER SYSTEM

1.0 GENERAL

- 1.1 Standards - NEMA MG1
- 1.2 A complete emergency standby power system shall be provided including a diesel engine driven generator set and all auxiliary systems required for automatic operation.
- 1.3 Four sets of operating and maintenance instruction manuals shall be furnished. They shall cover the entire emergency standby power system including the transfer scheme. Framed operating instructions shall be mounted on or near the unit.
- 1.4 Instruction of Owner personnel in performance of routine maintenance and operation shall be provided.
- 1.5 Renewal parts and major maintenance shall be readily available through authorized manufacturers dealers located within 100 miles of job site.
- 1.6 A single manufacturer's dealer shall supply and warrant all equipment for the emergency standby power system. Warranty period shall be at least two years or 1500 hours of operation, whichever occurs first, and shall include all parts, labor, travel time and mileage.
- 1.7 Manufacturer of the engine generator set shall be Caterpillar or Onan. Equipment selections are based on Caterpillar. Equipment selections for the transfer switch are Asco 4000 series switches.
- 1.8 The generator set provided under these specifications shall be completely factory assembled and shall be listed and labeled per UL2200.
- 1.9 The engine generator set provided under these specifications shall comply with applicable EPA emissions requirements. At a minimum, the generator set shall meet EPA Tier 1 requirements. Diesel Engines manufactured after April 1, 2006, shall be certified as follows:

13 – 60 KW ----- EPA Tier II Certified
70 – 450 KW-----EPA Tier III Certified
500 – 2000 KW----EPA Tier II Certified
2250 KW ----- EPA Tier I Certified
2500 - 3000 KW -- EPA Tier II Certified

It shall be the responsibility of the engine generator supplier to comply with all applicable requirements of the Commonwealth of Virginia and or the municipality of county where the generator set will be installed.

2.0 PRODUCTS

2.1 The generator set shall have a minimum standby rating sufficient to start and run all equipment in the facility not designated as “Standby” or “Spare”. The engine shall have a maximum governed speed of 1800 rpm.

- A. Generator set shall be capable of producing rated output in an outside ambient temperature of 110°F at an altitude of 1000’.
- B. Certified copy of generator set standard factory tests shall be provided for the engineers and owners records.
- C. Voltage regulation shall be +/- 1.0 percent of rated voltage for any constant load between no load and rated load.
- D. The generator set shall be capable of starting the equipment in the facility in either one full step or in multiple steps (not to exceed four) as determined by the equipment supplier. Voltage dip shall not be greater than 20% at any point in the operating cycle. Factory approved voltage dip calculations based on data obtained with a light beam oscillograph shall be submitted for review and approval.
 - (1) Supplier shall define starting step 1. Facility lighting, receptacle, electric heat and air conditioning loads shall always be included in Step 1.
 - (2) Supplier shall define starting step 2 (15 second delay) if applicable.
 - (3) Supplier shall define starting step 3 (30 second delay) if applicable
 - (4) Supplier shall define starting step 4 (45 second delay) if applicable.
- E. All motors will have across the line starting unless otherwise noted.
- F. Readily accessible voltage droop, voltage level and voltage gain controls shall be provided. Voltage level adjustment shall be a minimum of plus or minus 5 percent.
- G. Generator insulation shall be Class H. Temperature rise shall not exceed 105°C over 40°C ambient for continuous operation at the standby rating.
- H. Frequency regulation from no load to full load shall be in accordance with governor specification. For any addition of load up to 90 percent of rated load, the frequency shall recover to steady state frequency band within fiveseconds.

- I. Voltage regulator shall be digital microprocessor based with fully programmable operating and protection characteristics. The regulator shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be capable of sensing true RMS in three phases of alternator output voltage, or operating in single phase sensing mode. The voltage regulator shall include a VAR/Pf control feature as standard. The regulator shall provide an adjustable dual slope regulation characteristic in order to optimize voltage and frequency response for site conditions. The voltage regulator shall include standard the capability to provide generator paralleling with reactive droop compensation and reactive differential compensation.
- J. Generator field for sets less than 40 KW shall be self excited.
- K. Generator field excitation, for sets 40 KW, and larger shall be permanent magnet.
- L. Equipment supplier shall furnish printed copy of equipment starting steps to Instrumentation/Controls equipment supplier to insure that the starting steps are included in the control systems.

2.2 Diesel Engine shall be Four Cycle

- A. All engine ratings shall be shown in manufacturer's literature published at least six months prior to bid opening and engine shall be of a design that has been successfully used for at least three years.
- B. Generator shall be driven by a single engine without the use of gearing.
- C. Provide an engine instrument panel which contains water temperature gauge, lubricating oil pressure gauge and fuel pressure gauge.

2.3 Engine lubrication shall include a forced feed lubricating oil system with wet sump.

- A. Provide water cooled lube oil cooler.
- B. Provide full flow replaceable oil filters with spring loaded bypass valve to insure oil flow if filter clogs.

2.4 Engine combustion air cleaner shall be dry replaceable element type cleaner.

2.5 Engine fuel system shall be fuel injection type capable of performance on commercial Grade No. 2 fuel oil. Provide primary and secondary fuel filters of replaceable cartridge type. A positive displacement engine mounted fuel pump capable of 12' minimum suction shall be provided. All fuel lines shall have flexible connections and a check valve shall be provided ahead of the fuel pump.

- 2.6** Engine exhaust system shall include a minimum 18" long flexible steel exhaust connection for each exhaust outlet to muffler. For outdoor units with mufflers bolted to engine or engine housing, flex connection may be omitted.
- A. Provide a muffler which shall reduce noise to not more than 75 db at 23' from the end of the exhaust pipe.
 - B. For indoor units, mufflers and rigid exhaust pipe shall be insulated with calcium silicate suitable for temperatures up to 1000°F. Flexible connection shall have screen guard for protection of operating personnel. For outdoor units, mufflers mounted on top of the weatherproof enclosure shall be shielded with formed expanded metal guards for protection of operating personnel.
 - C. Provide a threaded drain hole for generator sets larger than 200 KW.
 - D. Diesel exhaust system piping shall be extra heavy black steel (schedule 80). Fitting shall be standard weight forged steel with beveled ends.
- 2.7** Engine governor shall be Electronic Isochronous type which shall control the frequency within 4 pct of rated frequency from no load to full load. The frequency at any constant load shall remain within a steady state band width of plus or minus .25 pct of rated frequency.
- 2.8** Provide a thermostatically controlled jacket water heater to maintain jacket water at 40°F with ambient of -20°F. Heater voltage shall be suitable for circuit voltage shown on Contract Drawings.
- 2.9** Radiator shall be engine mounted and cooled by blower fan. Fan belts if used shall be "V" type and have tension adjustment. The radiator shall be capable of cooling the engine at its standby load ratings and 110°F ambient air temperature. The radiator shall be filled with ethylene glycol and water solution to protect to -20°F and shall include a cooling system rust inhibitor. All cooling system gaskets shall be suitable for use with ethylene glycol.
- 2.10** Provide engine driven centrifugal type water circulating pump and thermostatic valve to maintain engine at recommended temperature level.
- 2.11** For generator sets, 200 KW and larger, provide a thermostatically controlled heater in the generator to prevent condensation. Heater shall be suitable for circuit voltage shown on Contract Drawings.
- 2.12** Generator controls and main output circuit breaker shall be mounted on the generator.
- A. The controls shall include the following meters and relays:

- (1) A.C. voltmeter
 - (2) A.C. ammeter
 - (3) Frequency meter
 - (4) Running time meter
 - (5) S.P.D.T. contacts that operate on failure of engine to run when "called for."
- B. The controls shall include the following alarms which shall light an individual indicating lamp for each alarm condition and shall stop and lockout the unit. Lockout shall require manual reset.
- (1) Over-crank
 - (2) Low oil pressure
 - (3) High water temperature
 - (4) Low Coolant Water Level
 - (5) Over-speed
 - (6) "Not In Automatic" alarm light
 - (7) Low fuel oil level
 - (8) Auxiliary S.P.D.T. contact to indicate alarm condition (for use with plant annunciator system).
 - (9) Indicator/Display lamp test switch to permit checking indicator and display lamps.
- C. Starting and stopping controls shall be activated by switch on generator control panel.
- D. Controls shall include means to cause fuel tank anti-siphon valve to open during engine starting and running periods. Valve shall be closed when engine is not running. Valve coil voltage shall be same as engine battery voltage.
- E. Output circuit breaker shall be installed inside of the weatherproof housing. The breaker shall be rated for generator full load amps.

- 2.13** Engine-generator set shall be provided with spring type vibration isolator secured to a common steel channel or H-beam type engine generator base and bolted to the foundation.
- 2.14** Engine starting shall be electrically powered from lead-acid storage batteries, having voltage rating and ampere hour minimum capacity ratings recommended by the manufacturer to provide 120 seconds of cranking at an ambient temperature of 40°F. Provide batteries, battery rack, cables and a U/L listed automatic battery charger with automatic two rate charging that will provide recharge from 0 volts to full charge in 8 hours. Charger shall have 120 volt single phase input, ammeter, voltmeter and suitable enclosure. Provide 280W, 120V battery heater, under the battery, as recommended by the equipment supplier.
- A. In addition to battery charger, an engine driven battery charging alternator shall be factory installed with required guards. Alternator shall be rated minimum of 24 volts and 45 amperes.
- 2.15** Provide 75W, 120V battery heater under the battery as recommended by the equipment supplier.
- 2.16** Finish paint coat of engine generator set, accessories and auxiliary equipment shall be standard factory color.
- 2.17** Fuel system shall include fuel storage and piping equipment for a complete system as follows:
- A. Day tank with accessory equipment shall be equipped with and have threaded pipe connections for inlet, suction, return, overflow, vent, drain, float switch and fuel gauge. Provide a ¼ full low level alarm light at generator control unit. Tank shall be mounted on housekeeping pad. Auxiliary fuel transfer pump shall be provided. Provide day tank when required by generator set supplier.
- B. Provide above ground, stand alone type fuel tank with double wall construction consisting of a UL listed rectangular steel tank with secondary containment. Tank shall:
- (1) Comply with the requirements of UL 2085, including fire resistive, vehicle impact and ballistics protection listings, and shall be so labeled.
 - (2) Be of a type that has been in production for at least five years and shall carry a minimum 30-year warranty.
 - (3) Be constructed in accordance with UL-142 Standard for Steel Above Ground Tanks for Flammable and Combustible Liquids.

- (4) Shall have the space between the inner (primary) and outer (secondary) tank walls filled with a lightweight thermal insulation to provide a minimum two-hour fire wall rating as tested by UL 2085.
- (5) Have capacity to run the generator for a period of 72 hours at $\frac{3}{4}$ load plus and additional 15% capacity to allow for 10% overfill and 5% below the suction pipe.
- (6) Have threaded openings for fill, supply, return, atmospheric vent, emergency vents and gauge lines. Supply and return openings shall be as recommended by generator-set supplier. Coordinate location of openings with tank facilities shown on Contract Drawings.
- (7) Provide sight glass fuel level indicator showing fuel level in $\frac{1}{4}$ increments.
- (8) Have dip stick type monitoring.
- (9) Have lockable fill cap, atmospheric vent, and emergency vent.
- (10) Have a high level fuel alarm contact, a low level fuel alarm contact and leak detection alarm contact.
- (11) Have grounding lug.
- (12) Have UL listed seven gallon spill/overflow container with drain valve that drains back into tank.
- (13) Have overfill prevention valve rated for pressurized delivery. Valve shall close automatically at 90% full level.
- (14) Have alarm panel in NEMA 4 enclosure attached to the tank. Alarm shall consist of horn and light to signal when tank has dropped to 20% of its capacity or has developed a leak. Panel shall be complete with alarm reset switch and with test switch to permit testing alarm devices.
- (15) Have one coat epoxy paint and one coat polyurethane finish coat. Color shall be selected by generator set supplier and approved by owner.
- (16) If tank height exceeds 36", have galvanized steps and handrails of sufficient height to allow fuel supplier to fill tank without supplementary ladders or lifts. Steps and handrails shall be of a design allowable under all pertinent OSHA platform regulations.
- (17) Have fuel tank piping as indicated.

- (18) Be installed where indicated and shall be as manufactured by General Industries Inc., Tramont or Superior Systems and Technologies.
- (19) Contractor shall assist the Owner in obtaining necessary permits and certificates of use.

2.18 Fuel System Piping

- A. Engine return fuel oil line shall be returned to main supply tank.
- B. Above ground piping shall be:
 - (1) Schedule 40 A53, Grade B black steel pipe.
 - (2) ASTM Black Malleable Iron, 150 class threaded fittings and 300 lb. Malleable Iron Unions.
 - (3) Verify pipe sizes with generator manufacturer to provide required fuel flow. Design line size is 1".
 - (4) Above ground pipe shall be threaded.

2.19 Generator set shall be installed in a sound attenuated weatherproof housing with muffler installed inside of the enclosure. The enclosure shall reduce the noise level of the generator operating at 100% load to no more than 62 dBA at 50 feet. The enclosure shall be equipped with one access door on each side that permits full access to the engine generator set inside. One door shall have a plexiglass window installed in it that allows full view of the generator control panel with the door shut. Housing shall be finished with manufacturer's standard finish.

2.20 A remote "Emergency Off/Lockout" station shall be installed on the exterior of the housing. Station shall be red, 2.25 inch mushroom head push for "Off" and pull for "On" type with D.P.D.T. contact block and NEMA 4X stainless steel enclosure.

2.21 The Automatic By-Pass Isolation Transfer Switch shall be of the pause in neutral, double throw type with integral By-Pass Isolation switch in a common NEMA 1 or NEMA 3R enclosure as required. The switch shall have a contact to contact transfer time greater than 0.5 seconds. Operation of the By-Pass Isolation switch shall not interrupt power to the load. Switch shall be three pole with ampere rating as indicated.

- A. The transfer switch operation shall be accomplished as follows:
 - (1) The transfer shall be initiated by a drop of any phase of normal supply voltage below 75% of rated voltage.

- (2) Provide adjustable time delay for transfer operation, in order to over-ride momentary power outages or fluctuations. Time delay shall be adjustable from 0.5 to 300 seconds and shall be set at 20 seconds.
 - (3) Load transfer to the alternate source shall occur only if the alternate source has at least 90% of rated voltage and 95% of rated frequency.
 - (4) The load shall be transferred back to the normal supply when the voltage of each phase of the normal supply has continuously remained above 90% of rated voltage for 300 seconds, and the phase rotation of the two sources is identical. Time delay shall be adjustable from 0 to 60 minutes, and set at 5 minutes.
- B. Following re-transfer of the load to the normal voltage supply, the engine shall continue to run for a cool down period to be specified by the engine manufacturer. Time delay shall be adjustable from 0 to 60 minutes.
- C. The ATS shall be equipped with the following isolated, dry, auxiliary contacts:
- (1) A1TD - SPDT timed open, timed close contacts to indicate Normal Power Available. Timing range shall be 3 to 300 seconds and shall be set at 30 seconds.
 - (2) A1E - SPDT instantaneous contacts to indicate Emergency Power Available
 - (3) A4DT - SPDT instantaneous contacts to indicate ATS in Normal Position
 - (4) A3DT - SPDT instantaneous contacts to indicate ATS in Emergency Position
 - (5) A1LTD - SPDT timed open, timed close contacts to indicate Load Energized. Timing range shall be adjustable 1 to 300 seconds set at 5 seconds.
- D. The ATS shall be equipped with a time clock to exercise power system. The exerciser shall be switchable for Load/No Load operation, and shall permit exercising the generator on a weekly basis for periods adjustable from 1 minute to 24 hours. Exerciser shall be programmed as requested by site personnel at start-up.
- E. The ampere rating of the complete By-Pass Isolation ATS shall be a continuous rating with the switch installed in a non-ventilated enclosure. The thermal capacity of the main contacts shall not be less than 20 times the continuous rating.

F. ATS/BPS combined shall be equipped with the following indicator lights:

- (1) L2 - Normal Position
- (2) L1 - Emergency Position
- (3) L4 - Normal Power Available
- (4) L3 - Emergency Power Available
- (5) ATS in Test Position
- (6) ATS Isolated
- (7) ATS Inhibited
- (8) ATS Operator Disconnect Switch in "Off"
- (9) By-Pass Switch in Normal Position
- (10) By-Pass Switch in Emergency Position

G. When coordinated with molded case circuit breakers, the minimum withstand and closing rating (WCR) shall be as follows, for a minimum of 3 electrical cycles. WCR rating of the By-Pass Isolation switch shall be equal to the ATS.

<u>Amperage</u>	<u>3 Cycle Rating (UL1008)</u>
0-100A	22,000 Symmetrical
101-399A	30,000
400-599A	35,000
600-1599A	50,000
1600-3000A	100,000

ATS/BPS shall also be rated for 200,000 WCR when coordinated with current limiting fuses, regardless of ampere rating.

- H. Transfer switch and all accessories and terminations may require front and side access. Provide adapter bay, where required, to permit cables to enter at bottom of switch.
- I. The ATS shall be equipped with Pause-in-Neutral feature. Pause time shall be adjustable 0 to 10 minutes and shall be set at five (5) seconds.

- J. The ATS shall be equipped with a maintained contact test switch.
- K. The ATS shall be equipped with one set of meters to monitor the load. The set of meters shall consist of an ammeter with selector switch to permit monitoring current in each phase and a voltmeter with a seven position selector switch to permit monitoring phase to phase and phase to neutral voltages for each phase.
- L. The ATS/BPS combination shall be rated as indicated on the drawings, shall be Zenith Controls ZBTSD series or approved equal, and shall include the following accessories:

- (1) CDP Load / No Load Exerciser
- (2) DS Selector switch to permit automatic (auto) operation or non automatic (inhibit) operation of the transfer switch.
- (3) S5P Auto/Semi Manual selector switch. In semi manual mode, retransfer to source 1 shall be automatic if source 2 fails.
- (4) E Engine Start Contacts
- (5) P2 Time Delay, Engine Start – Extended
- (6) T Time Delay, Re-Transfer to Normal
- (7) U Time Delay, Engine Cool Down
- (8) W Time Delay, Transfer to Emergency
- (9) M2 Ammeter with 3 position selector switch
- (10) M4-7 pos. Voltmeter with 7 position selector switch
- (11) A-62 Programmed/Sequenced motor control contacts to be closed with ATS in normal position and timed to close when switch moves to emergency position. Contacts shall be provided when motors are to be started in steps that are not provided by system motor control schemes. Contact timing shall be:

15 seconds – Starting step #2 (if applicable)

30 seconds – Starting step #3 (if applicable)

45 seconds – Starting step #4 (if applicable)

Contacts shall be rated 10 amps at 480 volts.

(12) UMD SPST contact to open prior to transfer in either direction. Time of operation shall be adjustable from 0 to 60 seconds prior to transfer and shall be set at 15 seconds to permit orderly shutdown of the system prior to transfer.

2.22 An ATS installed outdoors shall be equipped with a keyed locking device to prevent unauthorized access to, or operation of, the microprocessor based keypad or the meter selector switches. The cover shall have a clear Plexiglas window to permit viewing the keypad and selector switches without opening the cover. Enclosure and cover shall be rated NEMA 3R.

2.23 Generator set shall be tested at the factory or on site, at full rated KVA load for a minimum period of 2½ hours with the use of resistive and reactive load banks furnished by the generator set supplier.

A. Data shall be tabulated at 30 minute intervals for the following:

- (1) Voltage - each phase
- (2) Amperage - each phase
- (3) Frequency
- (4) Power factor
- (5) Cooling water temperature
- (6) Exhaust gas temperature
- (7) Oil pressure
- (8) Ambient temperature

B. Results of this test shall be submitted to the Engineer for approval prior to final acceptance of the equipment and installation.

C. All fuel and other consumables required for this test when performed on site shall be provided by the Contractor. Fuel tank shall be filled to capacity prior to acceptance of installation by Owner.

3.0 EXECUTION

3.1 Oil tanks shall be installed and tested according to current installation instructions provided with the tank.

END OF SECTION