

SECTION 16620
Emergency Standby Generator

PART 1 - GENERAL

1.1 SUMMARY

- A. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production tested, and site-tested, together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
- B. Any and all exceptions to the published specifications shall be subject to the approval of the Owner.
- C. The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.

1.2 GENERAL REQUIREMENTS

- A. It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied and installed shall meet the requirements of the National Electrical Code, along with all applicable local codes and regulations.
- B. All equipment shall be new and of current production of a national firm that manufactures the generator set and controls, transfer switches, and switchgear, and assembles the generator sets as a complete and coordinated system. There will be one-source responsibility for warranty, parts, and service through a local representative with factory-trained servicemen.
- C. The equipment shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.
- D. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of their complete product line.

1.3 SUBMITTAL

- A. The submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number, each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.

1.4 TESTING

- A. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
- B. Design Prototype Tests. Components of the emergency system such as the engine/generator set, transfer switch, and accessories shall not be subjected to prototype tests, since the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
 - 1. Maximum power (kW).
 - 2. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
 - 3. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
 - 4. Governor speed regulation under steady-state and transient conditions.
 - 5. Voltage regulation and generator transient response.
 - 6. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
 - 7. Three-phase short circuit tests.
 - 8. Alternator cooling air flow.

9. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
 10. Endurance testing.
- C. Final Production Tests. Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
1. Single-step load pickup
 2. Transient and steady-state governing
 3. Safety shutdown device testing
 4. Voltage regulation
 5. Rated Power @ 0.8 PF
 6. Maximum power
 7. Upon request, a witness test, or a certified test record sent prior to shipment.
- D. **Site Tests.** The manufacturer's local representative shall perform an installation check, startup, and building load test shall be performed by the manufacturer's local representative. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
1. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
 2. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
 3. The generator set shall be started under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and frequency, and phase rotation.

1.5 QUALITY ASSURANCE

- A. The generator set shall conform to the requirements of the following codes and standards:
1. CSA C22.2, No. 14 - M91 Industrial Control Equipment.
 2. EN50082-2, Electromagnetic Compatibility - Generic Immunity Requirements, Part 2: Industrial.
 3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
 4. IEC8528 part 4, Control Systems for Generator Sets.
 5. IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
 6. IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
 7. Mil Std 461D -1993, Military Standard, Electromagnetic Interference Characteristics.
 8. Mil Std 462D - 1993, Military Standard, Measurement of Electromagnetic Interference Characteristics.
 9. NFPA 70, National Electrical Code, Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
 10. NFPA 99, Essential Electrical Systems for Health Care Facilities.
 11. NFPA 110, Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit. Component level type tests will not substitute for this requirement.
- B. Warranty and Maintenance
1. The generator set shall include a two year basic extended warranty to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from date of startup. Optional warranties shall be available upon request.
 2. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engaged in maintenance contract programs which perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and proper function tests performed on all systems.

1.6 STORAGE AND HANDLING

- A. Protect equipment during handling and storage prior to installation.

- B. Electrical equipment shall be protected from the elements prior to installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The generator set shall be a Kohler model 125RZG with a 4S11 alternator or pre-approved equal. Generator shall meet the following requirements:
 - 1. Provide 125kW/156.25 kVA when operating at 277/480 volts, 60 Hz, .8 power factor.
 - 2. Capable of this Standby 130°C rating while operating in an ambient condition of less than or equal to 77° F and a maximum elevation of 656 feet above sea level.
- B. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall meet the following requirements:
 - 1. Capable of supplying 460 LRKVA for starting motor loads, with a maximum instantaneous voltage dip of 35%.
 - 2. The maximum voltage dip shall be as measured by a digital RMS transient recorder in accordance with IEEE standard 115.
 - a. Motor starting performance and voltage dip determination that does not account for all components effecting total voltage dip (i.e. engine, alternator, voltage regulator and governor) will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.
- C. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Location. Outside; Cedar Rapids, IA
- B. Turbocharged engine shall deliver a minimum of 195 HP at a governed speed of 1800 rpm. The engine shall be equipped with the following:
 - 1. Electronic isochronous governor capable of 0.5% steady-state frequency regulation.
 - 2. 12 volt positive engagement solenoid shift-starting motor.
 - 3. 70 ampere 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 including fuel filter and electric solenoid fuel shut off valve capable of lifting fuel.
 - 7. The turbocharged engine shall be fueled with Natural Gas.
 - 8. The engine shall have a minimum of 8 cylinders, and be liquid-cooled by Unit Mounted Radiator 122°F/50°C.
- C. The alternator shall be salient-pole, brushless, 2/3 pitch, 12 lead, self-ventilated drip-proof construction with amortisseur rotor windings and skewed for smooth voltage waveform. The alternator shall meet the following requirements:
 - 1. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a fungus resistant epoxy.
 - 2. Temperature rise of the rotor and stator shall be limited to Standby 130°C.
 - 3. The excitation system shall be of brushless construction controlled by a solid- state voltage regulator capable of maintaining voltage within \pm 2.0% at any constant load from 0% to 100% of rating.
 - 4. The AVR must be capable of proper operation under severe non-linear loading and provide individual adjustments for voltage range, stability and volts-per-hertz operations; and be protected from the environment by conformal coating.
 - 5. 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.
 - 6. The alternator shall have a single maintenance-free bearing, designed for 4000 hour B10 life.
 - 7. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
 - 8. The generator shall be inherently capable of sustaining at least 250% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current support devices.

- D. The controller shall be a Decision-Maker® 3 Plus Controller or preapproved equal. Circuitry shall be of plug-in design for quick replacement. Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall include:
1. Fused DC circuit.
 2. Complete 2-wire start/stop control, which shall operate on closure of a remote contact.
 3. Speed sensing and a second independent starter motor disengagement system shall protect against starter engagement with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.
 4. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.
 5. Cranking cyler with 15-second ON and OFF cranking periods.
 6. Overcrank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.
 7. Circuitry to shut down the engine when signal for high coolant temperature, low oil pressure, overspeed, low coolant level, or low coolant level is received.
 8. Engine cooldown timer factory set at 5 minutes to permit unloaded running of the generator set after transfer of the load to normal.
 9. Three-position (Automatic-OFF-TEST) selector switch. In the TEST position, the engine shall start and run regardless of the position of the remote starting contacts. In the Automatic position, the engine shall start when contacts in the remote control circuit close and stop 5 minutes after those contacts open. In the OFF position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault shall also be accomplished by putting the switch to the OFF position.
 10. Indicating lights to signal:
 - Master switch Not-in-Auto (flashing red)
 - Overcrank (red)
 - Emergency Stop (red)
 - High Engine Temperature (red)
 - Overspeed (red)
 - Low Oil Pressure (red)
 - Battery Charger Malfunction (red)*
 - Low Battery Voltage (red)*
 - Low Fuel (red)*
 - Auxiliary Prealarm (yellow)*
 - Auxiliary Fault (red)*
 - System Ready (green)*
 - Prealarm High Engine Temperature (yellow)*
 - Prealarm Low Oil Pressure (yellow)*
 - Low Coolant Temperature (red)*

*Required to meet NFPA 99 standard for Health Care Facilities.
 11. Test button for indicating lights.
 12. Alarm horn with silencer switch per NFPA 110.
 13. Terminals shall be provided for each signal, plus additional terminals for common fault and common prealarm.
 14. Provide module to allow network communication supporting Modbus protocol.

2.3 SOUND ENCLOSURE

- A. All enclosures are to be constructed from high strength aluminum.
- B. The enclosure shall be finish coated with powder baked paint for superior finish, durability and appearance. Enclosures will be finished in the manufacturer's standard color.
- C. The enclosures must allow the generator set to operate at full load in an ambient of 40°C - 45°C with no additional de-rating of the electrical output.
- D. Enclosures must be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit breaker must meet the requirements of the National Electric Code.

- E. Doors must be hinged with stainless steel hinges and hardware and be removable.
- F. Doors must be equipped with lockable latches. Locks must be keyed alike.
- G. The enclosure roof must be pitched to prevent accumulation of water.
- H. A duct between the radiator and air outlet must be provided to prevent re-circulation of hot air.
- I. The complete exhaust system shall be internal to the enclosure.
- J. The silencer shall be an insulated critical or hospital silencer with a tailpipe and rain cap.
- K. All acoustical insulation must be fixed to the mounting surface with pressure sensitive adhesive or mechanically fastened. In addition, all acoustical insulation mounted on a horizontal plane must be mechanically fastened. The acoustical insulation must be flame retardant.
- L. The enclosures must include an exhaust scoop to direct the cooling air in a vertical direction.

2.4 ACCESSORIES

- A. **Air Restriction Indicator.** The air cleaner restriction indicator shall indicate the need for maintenance of the air cleaners.
- B. **Battery Charger.** A 6-ampere automatic float to equalize battery charger with the following features:
 - 12 VDC output
 - 1% steady-state voltage regulation from no load to full load over 10% AC input line voltage variation
 - LED lamps for charge state indication
 - Temperature compensated for ambient temperatures for -40°C to 70°C
 - Potting for durability
 - Short-circuit and reverse polarity protection
 - UL 1236 listed
- C. **Battery Rack and Cables.** Battery rack and battery cables, capable of holding the manufacturer's recommended batteries, shall be supplied.
- D. **Block Heater.** An engine block heater that can be connected to a power source that is energized when the generator set is not running. The block heater shall be 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.
- E. **Circuit Breaker.** A UL2200 listed, 80% rated line circuit breaker of 250 amperes, molded-case type, generator-mounted with load side lugs. The breaker shall be available with the following:
 - Bus bar kits shall be available for connection to the generator set when breakers are not ordered. Bus bar kits shall offer a convenient way to connect load leads to the generator set when the breaker is not present.
 - Auxiliary switch shall indicate the position of the circuit breaker contacts. This shall be a single pole, double-throw switch operated by a movable contact assembly. It shall be used to remotely indicate the position of the main circuit breaker contacts, whether open or closed.
 - Alarm switches shall indicate that the circuit breaker has tripped due to an over load, short circuit or ground fault, the operation of the shunt trip or under-voltage trip, or the "push-to-trip" pushbutton
 - Shunt trip shall provide 12- or 24-VDC solenoid within the circuit breaker case that, when momentarily energized from a remote location, activates the trip mechanism.
 - Under voltage trip shall trip the circuit breaker when the control voltage drops below the preset threshold of 35%-70% of the rated voltage.
 - Over-current trip switch shall indicate that the circuit breaker has tripped due to overload, ground fault or short circuit and returns to the de-energized state when the circuit breaker is reset.
 - Lock-out device shall field installable handle padlock attachment that is available for manually - operated circuit breakers.

- F. Critical Silencer. The engine exhaust silencer shall be temperature and rust resistant, and rated for critical applications. The silencer will reduce total engine exhaust noise by 25-35 db(A).
- G. Dry Contact Kits. The 10 Dry Contact Kit shall provide normally open and normally closed, gold-plated contacts in a form C configuration to activate warning devices and other customer-provided accessories allowing remote monitoring of the generator set. Typically, lamps, audible alarms, or other devices signal faults or status conditions.
- H. Failure Relay. The common failure relay shall remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, overcrank, and overspeed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts.
 - 1. The relay contacts shall be gold flashed to allow use of low current draw devices (100ma @ 28VDC min.).
 - 2. Once energized the relay shall remain latched until the system is reset by the main controller switch.
- I. Flex Exhaust Tube. The exhaust piping shall be gas proof, seamless, stainless steel, flexible exhaust bellows with threaded NPT connection.
- J. Generator Heater. The generator heater shall prevent the accumulation of moisture and dampness in the generator windings. The heater shall be wired on at all times.
- K. Prealarm Senders. The generator prealarm senders shall provide signals for local and/or remote annunciation for engine conditions approaching critical/shutdown parameters required in NFPA 110. Pre-alarms warn of low water (engine) temperature, approaching low oil pressure, and approaching high engine temperature.
- L. Run Relay. The run relay shall provide a three-pole, double-throw relay with 10 amp/ 250 VAC contacts for indicating that the generator is running. The relay provides three sets of dry contacts for energizing or de-energizing customer devices while the generator is running (e.g. louvers, indicator lamps, etc.).
- M. Safeguard Breaker. A resettable line current breaker with inverse-time shall be furnished to protect the generator from damage due to its own high current capability. This breaker shall have a time delay up to 10 seconds to allow selective tripping of downstream fuses or circuit breakers under a fault condition. This breaker shall not automatically reset, preventing restoration of voltage if maintenance is being preformed.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Generator and all equipment shall be carefully examined for defects immediately before unloading.
- B. All defective equipment shall be rejected and removed from the site.

3.2 DELIVERY

- A. The equipment shall be delivered, F.O.B. to Cedar Rapids Hoosier Lift Station.
- B. Delivery of the equipment shall be coordinated by the Contractor.
- C. The contractor will provide the labor and equipment necessary to unload the equipment in the field. Proper rigging equipment shall be used in an effort to protect the coating from damage.

3.3 INSTALLATION OF EQUIPMENT

- A. The equipment shall be installed as outlined in Section 01060.

END OF SECTION