

SECTION
SPECIFICATIONS: GENERATOR SET

1. Scope of Work

- 1.1. 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 specified herein. The generator supplier shall be responsible to provide the generator system equipment to the County completely installed and tested to be properly operational.

The supplier shall arrange with properly capable and licensed contractors to determine how to install and connect the new generator to the building electrical system to provide emergency power to the entire Lando Fire Department building, Edgemoor Station, 4487 Edgeland Rd. This includes installation of the automatic transfer switch inside the building and distribution to the required circuits.

- 400 Amp Transfer Switch will be installed at Meter Location.
- Installing 2 Parallel 2" Conduits from location of generator to ceiling of fire house and extend to location of Transfer Switch.
- Install (1) ¾ conduit location of generator to ceiling of fire house and extend to location of Transfer Switch.
- Installation of 3/0 conductors required for installation.
- Ground generator and transfer switch per code.
- Electrically connect all control conductors from generator to transfer switch

The county will provide access to the building for review of the existing electrical system. Please contact Eddie Murphy at 803-377-4632 for an appointment.

Concrete Work: Concrete pad for new generator set has been provided by the County.

- 1.2. Any and all exceptions to the published specifications shall be subject to the approval of the Emergency Management Director.
- 1.3. 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 with the generator supplier's close assistance to ensure a complete and properly operating system.
- 1.4. The equipment shall be produced by The Kohler Company or an approved manufacturer who has produced this type of equipment for a period of at least 20 years and who maintains a service organization available twenty-four hours a day throughout the year. Generator sizing and load carrying characteristics for this project are based on the Kohler generator model described in the specification. See "Equipment" 7.1 below. References to Kohler products are a basis for description. Similar products from Caterpillar or Cummins are acceptable.
- 1.5. The equipment shall be produced by a manufacturer who is ISO 9001 certified

for the design, development, production and service of its complete product line.

2. General Requirements

- 2.1. 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 shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
- 2.2. All equipment shall be new and of current production by a national firm that manufactures the generator sets 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.

3. Submittal

- 3.1. 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.

4. Codes and Standards

- 4.1. The generator set shall be listed to UL 2200 or submitted to an independent third party certification process to verify compliance as installed.
- 4.2. The generator set shall conform to the requirements of the following codes and standards:
 - 4.2.1. CSA C22.2, No. 14-M91 Industrial Control Equipment.
 - 4.2.2. EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.
 - 4.2.3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
 - 4.2.4. IEC8528 part 4, Control Systems for Generator Sets.
 - 4.2.5. IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and

conducted electromagnetic emissions.

- 4.2.6. IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
- 4.2.7. NFPA 70, National Electrical Code, Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
- 4.2.8. NFPA 99, Essential Electrical Systems for Health Care Facilities.
- 4.2.9. 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.

5. Testing

- 5.1. 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.
- 5.2. **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 because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
 - 5.2.1. Maximum power (kW).
 - 5.2.2. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
 - 5.2.3. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
 - 5.2.4. Governor speed regulation under steady-state and transient conditions.
 - 5.2.5. Voltage regulation and generator transient response.
 - 5.2.6. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
 - 5.2.7. Three-phase short circuit tests.
 - 5.2.8. Alternator cooling air flow.

- 5.2.9. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
- 5.2.10. Endurance testing.
- 5.3. **Final Production Tests.** Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
 - 5.3.1. Single-step load pickup
 - 5.3.2. Safety shutdown device testing
 - 5.3.3. Rated Power @ 0.8 PF
 - 5.3.4. Maximum power
 - 5.3.5. Upon request, a witness test, or a certified test record sent prior to shipment.
- 5.4. **Site Tests.** The manufacturer's distribution representative shall perform an installation check, startup, and load test. The Emergency Management Director, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
 - 5.4.1. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
 - 5.4.2. 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, remote annunciators, etc.
 - 5.4.3. Generator set startup 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 operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
 - 5.4.4. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.

6. Warranty and Maintenance

- 6.1. The generator set shall include a standard one year 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.
- 6.2. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to 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 functional tests performed on all systems.

7. Equipment

- 7.1. The generator set shall be a Kohler model 125REZGC with a 4R13X alternator or equivalent. It shall provide 128kW/160 kVA on natural gas fuel when operating at 120/208 volts, 60 Hz, .8 power factor. The generator set shall be capable of a Standby 130°C rating while operating in an ambient condition of less than or equal to 77° F and a maximum elevation of 8200 feet above sea level. Equal systems manufactured by Caterpillar or Cummins are acceptable. Factory certified documents shall be provided and the equipment shall be site tested to certify it performs to this specification.
7. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 540 peak kVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting 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.
- 7.3. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.

8. Engine

- 8.1. The 537-cubic-inch displacement engine shall deliver a minimum of 190 HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:
 - 8.1.1. Electronic isochronous governor capable of 0.25% steady-state frequency regulation.

- 8.1.2. 12-volt positive-engagement solenoid shift-starting motor.
- 8.1.3. 65-ampere automatic battery charging alternator with a solid-state voltage regulation.
- 8.1.4. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.
- 8.1.5. Dry-type replaceable air cleaner elements for normal applications.
- 8.2. The turbocharged, air-cooled engine shall be fueled by Natural Gas..
- 8.3. The engine shall have a minimum of 8 cylinders and be liquid-cooled by Unit Mounted Radiator 122°F/50°C.
- 8.4. The engine shall be EPA certified from the factory.

9. Alternator

- 9.1. The alternator shall be salient-pole, brushless, 2/3-pitch, 12 lead, self-ventilated with drip-proof construction and amortisseur rotor windings and skewed for smooth voltage waveform. 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. Temperature rise of the rotor and stator shall be limited to Standby 130°C. The excitation system shall be of brushless construction controlled by a solid- state voltage regulator capable of maintaining voltage within $\pm 5\%$ at any constant load from 0% to 100% of rating. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. 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.
- 9.2. The alternator shall have a single maintenance-free bearing, designed for 40000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
- 9.3. 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.

10. Controller

10.1. Decision Maker® 3000 Generator Set Controller

- 10.1.1. The generator set controller shall be a microprocessor based control system that will provide automatic starting, system monitoring and protection. The controller system shall also provide local monitoring and remote monitoring. The control system shall be capable of PC based updating of all necessary parameters, firmware and software. .
- 10.1.2. The controller shall be mounted on the generator set and shall have integral vibration isolation. The controller shall be prototype and reliability tested to ensure operation in the conditions encountered.

10.2. Controller Buttons, Display and Components

The generator set controller shall include the following features and functions:

- 10.2.1. Push button Master Control buttons. The buttons shall be tactile-feel membrane with an indicator light to initiate the following functions:
 - Run Mode: When in the run mode the generator set shall start as directed by the operator.
 - Off/Reset Mode: When in the Off/Reset mode the generator set shall stop, the reset shall reset all faults, allowing for the restarting of the generator set after a shutdown.
 - Auto Mode: When in Auto the mode the generator set shall be ready to accept a signal from a remote device.
- 10.2.2. Emergency Stop Switch. The remote stop switch shall be red in color with a "mushroom" type head. Depressing the stop button will immediately stop the generator set and lockout the generator set for any automatic remote starting.
- 10.2.3. Push Button/Rotary Selector dial. This dial shall be used for selection of all Menus and sub-menus. Rotating the dial moves you through the menus, pushing the dial selects the menu and function/features in that menu. Pushing the button selects the feature/function and sub-menus.
- 10.2.4. Digital Display. The digital display shall be alphanumeric, with 2 lines of data and approximately 24 characters. The display shall have back lighting for ease of operator use in high and low light conditions. The display shall display status of all faults and warnings. The display shall also display any engine faults. While the generator set is running the display shall scroll all important information across the screen for ease of operator use. The scroll can be stopped by pushing the rotary dial. The display shall fall asleep when the generator set is not running and will

wake-up when the generator set starts or the rotary dial is depressed.

- 10.2.5. Fault Light. The controller shall have an annunciator fault light that glows red for faults and yellow for warnings. These faults and warnings shall be displayed in the digital display. The fault light will also glow yellow when not in AUTO.
- 10.2.6. Alarm Horn. The controller shall provide an alarm horn that sounds when any faults or warnings are present. The horn shall also sound when the controller is not in the AUTO mode.
- 10.2.7. Alarm Silence/Lamp Test Button. When this button is depressed it shall test all controller lamps. This button will also silence the alarm horn when the unit is not AUTO.
- 10.2.8. USB Connection. The controller shall have a USB connection on the face of the controller. This connection shall allow for updating of all software and firmware. This port shall also allow for all servicing of generator set parameters, fault diagnostics and viewing of all controller information via use a laptop computer.
- 10.2.9. Dedicated user inputs. The controller shall have dedicated inputs for remote emergency stop switch, remote 2 wire star for transfer switch and auxiliary shutdown.
- 10.2.10. The controller shall have auto resettable circuit protection integral on the circuit board.

10.3. **System Controller Monitoring and Status Features and Functions**

The generator controller shall display and monitor the following engine and alternator functions and allow adjustments of certain parameters at the controller:

- 10.3.1. Overview menu
 - 1. Active shutdowns and warnings shall be displayed if present and without the need of operator interface.
 - 2. Engine runtime with total hours
 - 3. Average line to line voltage
 - 4. Coolant temperature
 - 5. Fuel level or pressure
 - 6. Oil pressure
 - 7. Battery voltage
 - 8. Software version
 - 9. Frequency
 - 10. Average current

- 10.3.2. Engine metering menu
 - 1. Engine speed
 - 2. Oil pressure
 - 3. Coolant temperature
 - 4. Battery voltage

- 10.3.3. Generator metering menu
 - 1. Total power in VA
 - 2. Total power in W
 - 3. Rated power % used
 - 4. Voltage L-L and L-N for all phases
 - 5. Current L1, L2, L3
 - 6. Frequency

- 10.3.4. Generator set information
 - 1. Generator set model number
 - 2. Generator set serial number
 - 3. Controller set number

- 10.3.5. Generator set run time
 - 1. Engine run time total hours
 - 2. Engine loaded total hours
 - 3. Number of engine starts
 - 4. Total energy in kW

- 10.3.6. Generator set system
 - 1. System voltage
 - 2. System frequency 50/60Hz
 - 3. System phase, single/three phase
 - 4. Power rating kW
 - 5. Amperage rating
 - 6. Power type standby/prime
 - 7. Measurement units, metric/English units adjustable
 - 8. Alarm silence, always or auto only

- 10.3.7. Generator set Calibration, the following are adjustable at the controller
 - 1. Voltage L-L and L-N all phases
 - 2. Current L1, L2, L3
 - 3. Reset all calibrations

- 10.3.8. Voltage regulation, +/-0.5% regulation, the following is adjustable at the controller
 - 1. Voltage Adjustable +/- 10%

- 10.3.9. Digital and Analog Inputs and outputs

1. Displays settings and status

10.3.10. Event Log

1. Stores event history, up to 1000 events

10.4. **Controller Engine control features and functions**

- 10.4.1. Automatic restart - the controller has automatic restart feature which initiates the start routine and re-crank after a failed start attempt.
- 10.4.2. Cyclic cranking - the controller shall have programmable cyclic cranking
- 10.4.3. Engine starting aid - the controller shall have the capability of providing control for an optional engine starting aid.
- 10.4.4. The control system shall include time delays for engine start and cool down.
- 10.4.5. The control system shall interface with the engine ECM and display engine fault codes and warnings. The ECM shall also include sender failure monitoring to help distinguish between failed senders and actual failure conditions.
- 10.4.6. The controller shall monitor and display engine governor functions with include steady state and transient frequency monitoring.

10.5. **Controller Alternator control features and functions**

- 10.5.1. Integrated hybrid voltage regulator. The system shall have integral microprocessor based voltage regulator system that provides +/- 5% voltage regulation, no-load to full load with three phase sensing. The system is prototype tested and control variation of voltage to frequency. The voltage regulator shall be adjustable at the controller with maximum +/- 10% adjustable of of nominal voltage.
- 10.5.2. AC output voltage regulator adjustment. The system shall allow for adjustment of the integral voltage regulator with maximum of +/- 10% adjustment of the system voltage.
- 10.5.3. Alternator thermal overload protection. The system shall have integral alternator overload and short circuit protection matched to each alternator for the particular voltage and phase configuration.
- 10.5.4. Power metering. The controller digitally displays power metering of kW and kVA.

10.6. Other control features and functions

- 10.6.1. Event logging. The controller keeps a record of up to 1000 events, for warning and shutdown faults. This fault information becomes a stored record of systems events and can be reset.
- 10.6.2. Historical data logging. The controller's total number of generator set successful start shall be recorded and displayed.
- 10.6.3. Programmable access. The control system shall include a USB port that gives service technicians the ability to provide software and firmware upgrades. The system shall also be capable of allowing setting of all critical parameters using the service software and a laptop computer. All parameters and setting should be capable to being stored on a laptop for future upgrades of printing for analysis.

10.7. Generator Set Warning, Shutdown Alarm and Status

The generator set shall have alarms and status indication lamps that show non-automatic status and warning and shutdown conditions. The controller shall indicate with a warning lamp and or alarm and on the digital display screen any shutdown, warning or engine fault condition that exists in the generator set system. The following alarms and shutdowns shall exist as a minimum:

- 10.7.1. Engine functions
 - 1. Critical high fuel level (alarm)
 - 2. ECM communication loss (shutdown)
 - 3. ECM diagnostics (alarm & shutdown)
 - 4. Engine overspeed (shutdown)
 - 5. Engine start aid active
 - 6. Engine under speed (shutdown)
 - 7. Fuel tank leak (alarm & shutdown)
 - 8. High DC battery voltage (alarm)
 - 9. High coolant temperature (alarm & shutdown)
 - 10. High fuel level (alarm)
 - 11. Low DC battery voltage (alarm)
 - 12. Low coolant level (shutdown)
 - 13. Low coolant temperature (alarm)
 - 14. Low cranking voltage (alarm)
 - 15. Low engine oil level (alarm & shutdown)
 - 16. Low fuel level (alarm & shutdown)
 - 17. Low fuel pressure (alarm)
 - 18. Low oil pressure (alarm & shutdown)
 - 19. No coolant temperature signal (shutdown)
 - 20. No oil pressure signal (shutdown)
 - 21. Overcrank (shutdown)
 - 22. Speed sensor fault (alarm)

- 10.7.2. Generator functions
 - 1. AC sensing loss over & under current (alarm & shutdown)
 - 2. Alternator protection (shutdown)
 - 3. Ground fault input (alarm)
 - 4. kW overload (shutdown)
 - 5. Locked rotor (shutdown)
 - 6. Over-frequency (shutdown)
 - 7. Over AC voltage (shutdown)
 - 8. Under-frequency (shutdown)
 - 9. Under AC voltage (shutdown)
 - 10. Emergency stop (shutdown)

- 10.7.3. Other General functions
 - 1. Battery charger fault (alarm)
 - 2. Common fault (shutdown)
 - 3. Common warning (alarm)
 - 4. Master switch not in auto (alarm)
 - 5. Generator running
 - 6. Input/Output fault (alarm)

- 10.7.4. The generator set controller shall also be capable of meeting all necessary NFPA 110 level 1 requirements which include several of the above along with; EPS supplying load, Master switch no in auto and contacts for local and remote common alarm.

11. Accessories

- 1.1. BATTERY CHARGER. A 6-AMPERE AUTOMATIC FLOAT TO EQUALIZE BATTERY CHARGER WITH THE FOLLOWING FEATURES SHALL BE PROVIDED FOR INSTALLATION INSIDE THE GENERATOR ENCLOSURE:
 - 1. 12 VDC output
 - 2. 1% steady-state voltage regulation from no load to full load over 10% AC input line voltage variation
 - 3. LED lamps for charge state indication
 - 4. Temperature compensated for ambient temperatures for -40°C to 70°C
 - 5. Potting for durability
 - 6. Short-circuit and reverse polarity protection
 - 7. UL 1236 listed

- 11.1. **Battery Rack and Cables.** Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.

- 11.2. **Block Heater.** 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.

- 11.3. **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).
- 11.4. **Circuit Breaker.** The generator shall come with a primary, factory installed, 80% rated thermal magnetic line circuit breaker of 400 amperes that is UL2200 listed. Load side lugs shall be provided from the factory. Load side breaker connections made at the factory shall be separated from field connections. When GFI breakers are required, additional neutrals shall be factory installed.
- 11.5. **Flexible Fuel Lines.** Provide flexible fuel line for natural gas connection at the engine.
- 11.8. **Air Cleaner.** The air cleaner shall provide engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.
- 11.9. **2 Input/5 Output Module.** The 2 Input/5 Output Module kit provides two additional analog inputs and 5 additional dry contact outputs. The analog inputs can be used for analog or digital input functions. They can be set up for 0-5VDC, ± 3 VDC resistive or relay contact sensor devices. The dry contact outputs are arranged as two 120VAC or 28VDC, 10A from C contacts and three 28VDC, 2A from C contacts. Input and output functions are user defined using Site Tech software.

12. Generator shall be fueled by Natural Gas:

- 12.1. Installing contractor shall coordinate fuel line sizing to provide correct fuel volume and pressure for 100% load operation with the generator provider.

13. Sound Enclosure

- 13.1. All enclosures are to be constructed from high strength, low alloy steel, aluminum or galvanized steel. Sound level shall be approximately 73 dba at 23 feet.
- 13.2. 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.
- 13.3. The enclosures shall allow the generator set to operate at full load in an ambient of 40°C - 45°C with no additional derating of the electrical output.
- 13.4. Enclosures shall 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.

- 13.5. Doors must be hinged with stainless steel hinges and hardware and be removable.
- 13.6. Doors shall be equipped with lockable latches. Locks must be keyed alike.
- 13.7. The enclosure roof shall be pitched to prevent accumulation of water.
- 13.8. A duct between the radiator and air outlet shall be provided to prevent re-circulation of hot air.
- 13.9. The complete exhaust system shall be internal to the enclosure or optional with external mounted silencer.
- 13.10. All acoustical insulation shall be fixed to the mounting surface with pressure sensitive adhesive or mechanically fastened. In addition, all acoustical insulation mounted on a horizontal plane shall be mechanically fastened. The acoustical insulation shall be flame retardant.
- 13.12. The enclosures shall include an exhaust scoop to direct the cooling air in a vertical direction.

14. Service Representation

The manufacturer shall maintain a national service organization of employing personnel located throughout the contiguous United States. The local factory authorized service center shall be located no further than 50 miles from the installation site, center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.