

SECTION 26 32 13 16 – GAS-ENGINE-DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide a packaged natural gas fired engine generator in a weatherproof enclosure with all associated controls and required accessories as specified and shown on the Contract Drawings and as described herein.
- B. The systems shall include, but not be limited to: engine generator, concrete mounting pad, starting battery, battery charger, annunciator/controller, SCADA interface, conduit, wire, fittings, critical silencer, and enclosure attenuation required to provide a complete operating system.
- C. The Work also includes the furnishing of all labor, materials, equipment, installation, testing, and training to provide a complete and workable power system, including the generator set and generator set controls as shown on the Contract Drawings, shop drawings, and specified herein.
- D. 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 complete installation as shown on the Contract Drawings, shop drawings, and specified herein.
- E. Provide a generator with electrical characteristics to match that shown on Contract Drawings.
- F. The requirements of Section 26 05 00 – Electrical Work, General, Section 26 36 23 - Automatic Transfer Switches and Section 26 05 26 – Grounding apply to the work of this Section.
- G. Provide sound attenuated enclosure where noted on Contract Drawings.

1.2 REFERENCES

- 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. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 702.
10. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 2 systems. Level 2 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.
11. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

1.3 QUALITY ASSURANCE

- A. General: All materials shall be inspected for compliance with Section 26 05 00 – Electrical Work, General and shall be tested per Section 26 01 26 – Electrical Tests and the requirements herein.
- B. Factory Tests: As specified in this Section.

1.4 TYPE OF SYSTEM

- A. The system shall be classed as an optional standby power system and shall be natural gas fired.
- B. These specifications are based on equipment from **Kohler Power Systems**, to set a standard for quality. Alternative systems will be considered providing that sufficient documentation is provided to the Engineer to certify that the equipment meets the requirements of the specification.

1.5 SUBMITTALS

- A. General: Shop Drawings, Owner's Manual, and Record Drawings shall be submitted in conformance with the requirements of MASS Section 10.05 Article 5.6.
- B. Submit for approval:
 1. Manufacturer's catalog information with complete description of all equipment, schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number, each required interconnection between the generator set and the automatic transfer switch.
 2. Make and model of engine and generator.
 3. Make and models of all auxiliary equipment (vibration isolation, radiator, enclosure, etc.)

4. Manufacturer-published kilowatt output curve and published fuel consumption curve.
 5. Unit ventilation and combustion air requirements.
 6. Manufacturer-published transient response data of the complete engine generator set upon 50%, 75% and 100% block loads at 1.0 pf. Data shall include maximum voltage dips, maximum frequency dips, and recovery time periods.
 7. Submit motor/load starting calculations using the loads shown on the Contract Drawings, demonstrating that the engine generator will start the loads with no more than 20% voltage dip.
 8. Location and description of supplier's parts and service facilities within a 250 mile radius of the job site, including parts inventory and number of qualified generator set service personnel.
 9. Actual electrical diagram, including schematic diagrams and interconnection wiring diagrams for all equipment to be supplied.
 10. Prototype test certification and specification and catalog data sheets showing all standard and optional accessories to be supplied.
 11. Manufacturer warranty statements.
 12. Engine altitude duration curve.
 13. Generator motor starting curves showing the voltage dips versus starting kVA.
 14. Manufacturer-published service manuals for engine, generator and switchgear.
- C. Delete all superfluous information from the submittal data such as model numbers and options for equipment in the manufacturer's data sheet which are not used on this project.

1.6 OWNER'S MANUALS

- A. Submit Owner's Operation and Maintenance Manuals and other information necessary for the operation and maintenance of the system.

1.7 WARRANTY AND SERVICE

- A. A (5) five-year basic warranty for the generator set shall be included to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from date of start-up. Optional warranties shall be available upon request.
- B. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall be regularly engaged in a maintenance contract program 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, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and proper functioning of all systems.

1.8 MANUFACTURER

- A. The engine generator system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system.
- B. 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.
- C. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production, installation, and service of their complete product line.

1.9 SUPPLIER

- A. It is essential that the engine-generator supplier maintains a local parts and service facility within the State of Alaska. The supplier must carry sufficient inventory to cover no less than 80% parts service within 24 hours and 95% within 48 hours. Further, the supplier shall have factory-trained service representatives to furnish all installation, test, and start-up supervision necessary for final approval and acceptance as well as perform maintenance and repairs on all components as required.

1.10 TESTING--MANUFACTURER

- A. To assure 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 for the generator set: design prototype tests, final production tests, and shop tests.
- B. Generator Set Design Prototype Tests: Components of the emergency system such as the engine/generator set and accessories shall not be subjected to prototype tests since the tests are potentially damaging. Rather, similar design prototypes and pre-production models, which will not be sold, shall have been used for 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. Generator Set Production Tests

1. Final Production Tests: Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
 - a. Single-step load pickup.
 - b. Transient and steady—state governing.
 - c. Safety shutdown device testing.
 - d. Voltage regulation.
 - e. Rated Power @ 0.8 PF
 - f. Maximum Power.
2. Upon request, arrangements to either witness this test will be made, or a certified test record will be sent prior to shipment.

D. Site Tests

1. Site Tests: An installation check, start-up, and load test shall be performed by the manufacturer's local representative. The ENGINEER, regular operators, and the maintenance staff shall be notified a minimum of two weeks prior to the time and date of the site test. The tests shall include:
 - a. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
 - b. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery charger, generator strip heaters, remote annunciator, etc.
 - c. Start-up under test mode to check for exhaust leaks, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and frequency, and phase rotation.
 - d. Automatic start-up by means of 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 voltage, amperes, and frequency shall be monitored throughout the test. An external load bank shall be connected to the system to load the generator to the nameplate kW rating. Steploads of $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and full load shall be applied and the voltage dip, phase current, and frequency recorded. The generator shall be run at full load for a minimum of two hours and any parameters (voltage, frequency, temperature, etc.) that measure outside of manufacturer's specifications shall be investigated and corrected.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. The generator set shall be sized as indicated on the Contract Drawings and operate at the voltage and phase indicated on the Contract Drawings, 60Hz, 0.8 power factor for three phase units, 1.0 power factor for single phase units.

- B. Engine generator shall be housed in a weatherproof enclosure mounted on a concrete pad with isolators suitable to restrain unit under Seismic Design Category D forces.
- C. 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 500 feet above sea level.
- D. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying required KVA for starting motor loads with a maximum instantaneous voltage dip of 20%, 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.
- E. Vibration isolators shall be provided between the engine-generator and heavy-duty steel base.

2.2 ENGINE

- A. The engine shall deliver a minimum HP at a governed speed of 1800 rpm. The engine shall be equipped with the following:
 1. An electronic isochronous governor capable of +0.5% steady-state frequency regulation.
 2. 12 Volt positive engagement solenoid shift-starting motor.
 3. 70-Ampere minimum automatic battery charging alternator with solid-state voltage regulation.
 4. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.
 5. Dry-type replaceable air cleaner elements for normal applications.
 6. Electric solenoid fuel shut-off valve.
- B. The engine shall be fueled by Natural Gas.
- C. The engine shall be liquid-cooled by a unit-mounted radiator, blower fan, water pump, and thermostats. This system shall properly cool the engine with up to 0.5 inches H2O static pressure on the fan in an ambient temperature up to 88 degrees F. Fill the cooling system with 50%-50% water/ethylene glycol solution with corrosion inhibitors as recommended by the engine manufacturer.

2.3 ALTERNATOR

- A. 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 $\pm 2.0\%$ 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.

- B. 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.
- C. 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.

2.4 CONTROLLER

- A. Set-mounted controller capable of facing right, left, or rear, shall be vibration isolated in the generator enclosure. The controller shall be capable of being remote-mounted. The microprocessor control board shall be moisture proof and capable of operation from -30 F to 90 F. Relays will only be acceptable in high- current circuits.
- B. 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 the following features:
 - 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 systems 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 re-starting 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, low coolant level or overspeed is received.
 - 8. Engine cool down timer factory set at 5 minutes to permit unloaded running of the standby set after transfer of the load to normal.
 - 9. 3-position (Automatic-OFF-TEST) selector switch.
 - a. In the TEST position, the engine shall start and run regardless of the position of the remote starting contacts.

- b. In the Automatic position, the engine shall start when contacts in the remote control circuit close and stop 5 minutes after those contacts open.
 - c. 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. Alarm horn with silencer switch per NFPA 110.
- C. Standard indicating lights to signal the following shall be included:
 - 1. Not-in-Auto (flashing red)
 - 2. Overcrank (red)
 - 3. Emergency Stop (red)
 - 4. High Engine Temperature (red)
 - 5. Overspeed (red)
 - 6. Low Oil Pressure (red)
 - 7. Battery Charger Malfunction (red)
 - 8. Low Battery Voltage (red)
 - 9. Auxiliary Pre-alarm (yellow)
 - 10. Auxiliary Fault (red)
 - 11. System Ready (green)
- D. Test button for indicating lights.
- E. Terminals shall be provided for each indicating light above, plus additional terminals for common fault and common pre-alarm.

2.5 INSTRUMENT PANEL

- A. The instrument panel shall include the following:
 - 1. Voltmeter, +/- 2% accuracy
 - 2. Ammeter, +/- 2% accuracy.
 - 3. Voltmeter-ammeter phase selector.
 - 4. Frequency meter, 0.5% accuracy, 45 to 65 Hz scale.
 - 5. Panel-illuminating lights.
 - 6. Battery charging voltmeter.
 - 7. Coolant temperature gauge.
 - 8. Oil pressure gauge.
 - 9. Running-time meter.
 - 10. Voltage adjustment-minimum +/- 5%.

2.6 ACCESSORIES

- A. A UL 1077 listed, 80% rated line circuit breaker sized as indicated on the Contract Drawings, amperes, molded-case type, generator-mounted with load side lugs.

- B. Engine block heater. Thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature in an ambient of -30 degrees F to meet the start-up requirements of NFPA-99 and NFPA-110, Level 2.
- C. Generator Enclosure 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.
- D. Thermostatically controlled battery heater to maintain a battery temperature of 32 degrees F in an ambient of -30 degrees F.
- E. A re-settable line current sensing circuit breaker with inverse time versus current response shall be furnished which protects the generator from damage due to its own high current capability. This breaker shall not trip within the 10 seconds specified above 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 performed. A field current-sensing breaker will not be acceptable.
- F. Enclosure shall be as follows:
 - 1. Enclosures shall be constructed from G60 galvanized high strength, low alloy steel. Wind rated to 150 mph.
 - 2. The enclosure shall be primed with BASF urethane and finish coated with BASF Superl System paint. Enclosures will be finished in the manufacturer's standard color.
 - 3. The enclosures must allow the generator set to operate at full load in an ambient of 90 F with no additional derating of the electrical output.
 - 4. The enclosures must meet all of the requirements of UL-2200.
 - 5. 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.
 - 6. Doors must be hinged with stainless steel hinges and hardware and be removable.
 - 7. Doors must be equipped with lockable latches. Locks must be keyed alike.
 - 8. Enclosures must be mounted to the generator set skid.
 - 9. The enclosure roof must be pitched to prevent accumulation of water
 - 10. A duct between the radiator and air outlet must be provided to prevent re-circulation of hot air.
 - 11. The complete exhaust system shall be internal to the enclosure. Enclosures with roof mounted or externally exposed silencers are not acceptable.
 - 12. The silencer shall be an insulated critical silencer with a tail pipe and rain cap.
 - 13. All acoustical foam must be fixed to the mounting surface with pressure sensitive adhesive. In addition, all acoustical foam mounted in a horizontal plane must be mechanically fastened. The acoustical foam must have a protective film facing to act as a barrier for liquids.

14. The enclosures must include an exhaust scoop to direct the cooling air in a vertical direction.
 15. Provide a 120 volt, 20 amp duplex receptacle in the enclosure for maintenance purposes.
- G. 12-volt lead-antimony batteries capable of delivering the manufacturer's recommended minimum cold-cranking Amps required at 0 F, per SAE Standard J-537, shall be supplied.
- H. 10-Ampere, UL 1236 listed, automatic float and equalize battery charger. The charger shall be designed for heavy-duty industrial service and be capable of full-rated output indefinitely at temperatures between 14 F and 90 F. The charger shall be capable of recharging a fully discharged battery of the maintenance-free lead acid, conventional (wet) lead acid or nickel-cadmium type. The charger shall maintain the battery automatically and minimize the need for battery electrolyte replenishment. Conservatively rated SCRs and diodes in full-wave bridge shall be used. A crank disconnect relay shall not be required to protect the charger from overload. The charger shall be mounted in the enclosure and natural convection cooled. The housing shall be constructed of rustproof metal (e.g., aluminum) and treated with a protective coating.
1. Battery Charger Input: The charger shall operate from: 120 V \pm 10%, 60Hz \pm 3% AC mains. The charger shall incorporate a soft-start feature in which the output is gradually increased from zero to full required output within 5 to 10 seconds. Input protection shall consist of fuses or circuit breakers. Proven surge suppression devices shall be fitted.
 2. Battery Charger Output: Output voltage shall be 12 volts nominal. Float voltage shall be adjustable from 100% to 120% of nominal. Equalize voltage shall be adjustable up to 15% above float voltage. Output voltage adjustments shall be on separate potentiometers in the charger. The charger shall incorporate automatic current limiting with a rectangular current limit characteristic, and shall be capable of operating into a short circuit or dead battery indefinitely without damage or overheating. The charger shall be equipped with output fuses or circuit breakers.
 3. Regulation and Temperature Compensation:
 - a. Voltage regulation shall be within \pm 1 of the correct temperature compensated value from no load to full load with simultaneous variations of \pm 10% input voltage and \pm 5% input frequency. The DC output shall be constant voltage and current limited. The charger's current limit shall be fixed between 100% and 110%. Input transient protection shall be provided. The charger shall be protected against damage by reverse connection of the battery.
 - b. The charger shall be equipped with an automatic high rate (equalize) charge facility operating in response to the battery's state of charge. The charger shall operate at the high rate until the battery is fully charged, then revert to float voltage to prevent overcharging. High rate operation shall be governed by the requirement of the battery. Mechanical or electronic timers shall not be used.

- c. The charger shall incorporate automatic ambient temperature compensation to maximize battery performance and life. Temperature coefficient shall be (-0.18%) per degree C to assure correct charging in all temperatures.
 - d. The charger shall automatically compensate for voltage drop in the charging leads to prevent charging errors due to long cable runs.
4. Float/Equalize Control: The charger shall include an automatic equalize feature that is activated when the battery's state of charge is reduced. Individual adjustment potentiometers shall be provided for float voltage, boost voltage and alarm voltages.
5. Indicators and Optional Alarms:
- a. Meters for output amperes and voltage shall be provided.
 - b. The battery charger shall incorporate an alarm system providing indication of charger and battery status by LED displays and form C contacts. Separate contacts for low-battery voltage and charger fail shall be provided. An LED shall indicate input power ON.
6. Standard Nameplate Data: A standard permanent adhesive nameplate is to contain the following data:
- a. Supplier name, city and state
 - b. Product description
 - c. Model number
 - d. Serial number/date code
 - e. Input voltage rating
 - f. Input frequency rating
 - g. Input current rating
 - h. Nominal output voltage rating
 - i. Output current rating
7. Drawings And Documents:
- a. A final test report is to be supplied with each charger. In addition, one user manual per charger is to be supplied that contains the information described below. Drawings and documents are to reflect the manufacturer's standard, cataloged product.
 - b. Documents and drawings are to be created to good commercial practice, and are to be supplied on standard 11" x 17" paper, or on 8.5" x 11" paper.
 - c. The user manual is to provide:
 - 1) Safety instructions
 - 2) Product description
 - 3) Mechanical installation instructions, with drawings
 - 4) AC input ratings and terminal configurations
 - 5) Electrical connections
 - 6) Operation instructions with explanation of operating modes and controls
 - 7) Output adjustments, along with standard factory settings and description and chart of temperature compensation operation
 - 8) Troubleshooting table
 - 9) Component diagnostic tests
 - 10) Detailed theories of operation for all circuits
 - d. The following drawings are to be appended to user manual:

- 1) Detailed dimensional drawing
 - 2) Connections drawing, with maximum wire sizes shown
 - 3) Power circuit schematic
 - 4) Control board schematic, with component values
 - 5) Alarm board schematic, with component values
8. Quality Assurance, Inspection And Test
- a. Quality Assurance: The following quality assurance steps are to be included in the manufacturer's standard procedure:
 - 1) Source control documents are maintained on all purchased parts
 - 2) A master list of all approved purchased components and vendors is maintained
 - 3) All assembly personnel are trained in the manufacture of the product
 - 4) Bills of material, drawings, procedures, photographs, visual method sheets and other documents affecting the manufacture and test of the product are controlled so that engineering changes are immediately incorporated.
 - 5) Inspection is performed at every step of the assembly process. (Quality is "built-in" rather than "inspected in.")
 - b. Standard Factory Assembly and Test Procedure: The standard assembly process is to prescribe the tests and calibration that are to be performed on the product. These activities are to include, but are not limited to, the following:
 - 1) Insulation breakdown test using a "hipot" device to the standards prescribed in UL 1012.
 - 2) Performance testing to insure that critical performance specifications are met. These are to include operation at low and high AC line voltage, output ripple and regulation.
 - 3) Calibration to the correct output, alarm and shutdown voltages
9. Warranty: The manufacturer is to warrant its products to be free of defects in material or workmanship for a period of two years from date of shipment.
10. Manufacturers, Or Equal: Compact: **SENS model FCA12-10-2411U**, or equal.
- I. The engine exhaust silencer shall be coated to be temperature and rust resistance, rated for critical application. The silencer will reduce total engine exhaust noise as required to meet dB(A) requirements.
- J. Gas-proof, seamless, stainless steel, flexible exhaust bellows with threaded NPT connection.
- K. Two flexible fuel lines rated 257 F and 100 psi ending in pipe thread.
- L. Air cleaner restriction indicator to indicate the need for maintenance of the air cleaners.
- M. Engine crankcase emission controls.

- N. The 10 relay dry contact kit provides normally open and normally closed 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. At a minimum, a generator 'Not-in-Auto' signal shall be provided.
- O. Run Relay to provide a three-pole, double-throw relay with 10 amps at 250VAC contacts for indicating that the generator is running.
- P. A radiator duct flange to provide a convenient connection to duct work for the radiator discharge air.
- Q. Common Failure relay to 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. The relay contacts shall be gold flashed to allow use of low current draw devices (100ma @ 28VDC min.). Once energized the relay shall remain latched until the system is reset by the main controller switch.
- R. Provide a DeviceNet Auxiliary Starter (DSA) module, Allen Bradley Cat # 100-DNY42R with the generator control panel. The DSA module shall be wired to monitor generator 'Running', 'Fault' and 'Not-in-Auto' dry contacts and report back to the Booster Station's SCADA system.
- S. Generator controller 'Monitor' software and all required cables and connectors as required allowing Owner to connect a laptop to the generator's control panel and make any necessary controller adjustments.

PART 3 - EXECUTION

3.1 MANUFACTURER

- A. Engine-generator shall be of a single manufacturer's products, factory assembled, dynamically balanced and fully load tested with specified coolant protection as a complete system prior to shipment as a complete assembly from the factory.
- B. Submit copy of factory test report.

3.2 INSTALLATION

- A. Install engine-generator in the weatherproof enclosure on a concrete pad as shown on the plans.
- B. Mount engine-generator on vibration isolators per manufacturer's requirements.
- C. Provide the necessary electrical connections for proper operation of the engine intake and exhaust dampers.

- D. Mount batteries adjacent to engine. Make all connections to starter and battery charger.
- E. All wiring shall comply with NEC Article 700.
- F. Make all fuel line connections between the engine-generator and the natural gas service.
- G. Make all ducting connections between the engine-generator and enclosure dampers.

3.3 STARTUP AND INSTRUCTION

- A. After delivery of the unit to the site, secure the unit to the site foundation and make all necessary fuel line and electrical connections to the unit. Once all connections have been made, coordinate with the ENGINEER to provide start-up of the system.
 - 1. Provide all engine fluids (oil, coolant, etc.) necessary prior to start-up and testing.
 - 2. Simulate two power failures with load transfer with normal cool-down cycle.
 - 3. Demonstrate all automatic features as directed by the OWNER's representative.
 - 4. Record voltage, amperage, and frequency during each test. Note any required adjustments.
 - 5. Furnish record of tests to the OWNER.
- B. Furnish maintenance records for OWNER's use.
- C. Parts books covering the engine, generator, and major auxiliary equipment shall be provided to the OWNER.
- D. Procedures on operating and maintenance of the standby power system shall be explained to operating personnel at this time. Provide a minimum of 4 hours of training.

3.4 SCHEDULED SERVICE

- A. Include in Operations & Maintenance Manual the manufacturer's recommended maintenance procedures for standard routine maintenance.

END OF SECTION 26 32 13.16