

SECTION 26 32 12.12

PACKAGED DIESEL ENGINE GENERATOR SYSTEM FOR EXTERIOR INSTALLATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Proposed KD900KW Diesel Generator.
- B. This packaged diesel engine generator system meeting EPA non-road Tier 2 emission requirements.
- C. This generator is to be installed inside an exterior weatherproof sound enclosure (Level 2) 75 dB(A) sound level at full load) with fixed dampers and louvers.
- D. The concrete base shall be 24 inches wider and 24 inches longer than the generator to accommodate the enclosure. The sub base fuel tank shall be mounted to the concrete base using ¾ inch diameter x 10 inch long stainless steel concrete anchors and hardware manufactured by Hilti or approved equal manufacturer.
- E. Steel exhaust silencer and fittings.
- F. Fuel dispense system, fuel tank with rupture basin and required State of Wisconsin UL listed tank, venting and fittings and exterior mounted fuel fill alarm control panel.
- G. Provide sufficient fuel for the required testing and a full tank of fuel after all testing and operation is complete.
- H. Batteries, battery charger and battery tray.
- I. Generator main circuit breaker.
- J. Generator Control Panel as specified within.
- K. The Electrical Contractor shall provide all excavation, fill around generator pad, backfill, compaction and the concrete generator concrete base as shown on the plans. See Electrical Plans for additional information.

1.02 REFERENCES

- A. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. ANSI/NEMA MG 1 - Motors and Generators.
- C. ANSI/NFPA 70 - National Electrical Code.
- D. ANSI/NFPA 99 - Health Care Facilities.
- E. ANSI/NEMA AB 1 - Molded Case Circuit Breakers.

1.03 SYSTEM DESCRIPTION

- A. Engine generator system to provide source of standby power.
- B. System Capacity: The engine generator set shall be rated for 900 KW/1125KVA @ 0.8 PF, 60 Hz, 3 phase, 4 wire, 277/480 volt and Standby rating at 130 degrees C rise. Peak motor starting KVA rating

shall be 3136 amps at 60 Hz and a 12.75% voltage dip. Note the design requires ratings with not more than 6.63% frequency dip and 78.24% KW used.

- C. Operation: In accordance with ANSI/NFPA 99.
- D. The generator with the specified enclosure, block heater, muffler system, batteries, battery charger battery, enclosure, fuel tank and fill system, and louvers shall be provided by the manufacturer and Electrical Contractor as specified within and shown on the plans

The automatic transfer is specified in Specification Section 26 36 23 "Automatic Transfer Switches" for this project.

1.04 SUBMITTALS

- A. Submit six sets of shop drawings showing plans and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
- B. Submit product data showing all equipment dimensions, weights, ratings, enclosure size, interconnection points, and internal wiring diagrams for engine/generator, block heater, batteries, battery trays, internal wiring, fuel system, fuel tank with sizes and position under generator, UL venting requirements and layout, generator, control panel, fixed louvers, exhaust silencer and layout and vibration isolators.

1.05 PROJECT RECORD DOCUMENTS

- A. Accurately record location of engine generator and mechanical and electrical connections.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include instructions for normal operation, routine maintenance requirements, service manuals for engine and fuel tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in packaged engine generator system with minimum ten (10) years of supplying and service experience.
- B. Supplier: Authorized distributor of engine generator manufacturer with service facilities within 150 miles of project site.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Accept packaged engine generator set and accessories on site in crates and verify damage.
- B. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

1.09 WARRANTY

- A. Provide five year warranty. (Warranty shall not begin until Owner has provided written acceptance to the Contractor).

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of packaged engine generator system for one year from date that Owner has provided written acceptance to the Electrical Contractor.

1.11 EXTRA MATERIALS

- A. Provide two additional sets of each fuel, oil, and air filter elements and enough oil for two (2) complete oil changes required for the engine generator system.

1.12 GENERATOR INSTALLATION

- A. The Electrical Contractor is responsible for the complete installation of the emergency generator system as shown on the electrical drawings including the concrete base.
- B. The Electrical Contractor shall furnish and install, but not limited to; the generator, exhaust system, plumbing for fuel system and venting, sub-base fuel tank with fuel monitoring for leakage, generator enclosure, automatic transfer switch (specified separately), and all conduit and wiring required to provide a complete and fully operational system as shown on the plans and as specified in the specifications.
- C. The concrete pad for the generator is shown on the plans.
- D. Once the generator has been tested, it is the Electrical Contractor's responsibility to provide the Owner with a full tank of fuel.

PART 2 PRODUCTS

2.01 FUEL SYSTEM

- A. The sub-base fuel tank and fuel system fill system shall be provided by the generator manufacturer/distributor. The tank shall be manufactured by Global Power Components or Engineer approved equal manufacturer. Coordinate exact equipment as required by the specified generator manufacturers. The tank dimensions are shown on the plans.
- B. The UL venting installation, fuel system and fuel fill monitoring control panel, and all internal wiring of equipment shall be provided by the manufacturer and coordinated by the Electrical Contractor.
- C. The Electrical Contractor shall install and complete the wiring of the unit on site ready for start-up and testing. The Electrical Contractor is responsible for providing the required fuel for both testing and final acceptance.

2.02 GENERATOR MANUFACTURERS

- A. Kohler; Model KD900, with KH03450T alternator. Maximum voltage dip shall be 12.75% using a 100 degrees C ambient temperature, 1,000 feet elevation and 130 degrees C rise with class H insulation and No.2 diesel fuel.
- B. Caterpillar. Provide load calculations at shop drawing review that generator meets the requirements of the project. Maximum voltage dip shall be approximately 12.75% using a 100 degrees C ambient temperature, 1,000 feet elevation and 130 degrees C rise with class H insulation and No.2 diesel fuel. See the Electrical One-Line Diagrams for the required generator steps for each load shown. Provide generator calculations and data sheets for approval by the Engineer before the generator prior to bidding. Any generator submittal after that period will not be reviewed or accepted.
- C. Onan. Provide load calculations at shop drawing review that generator meets the requirements of the project. Maximum voltage dip shall be approximately 12.75% using a 100 degrees C ambient temperature, 1,000 feet elevation and 130 degrees C rise with class H insulation and No.2 diesel fuel. See the Electrical One-Line Diagrams for the required generator steps for each load shown. Provide generator calculations and generator data sheets for approval by the Engineer prior to bidding. Any generator submittal after that period will not be reviewed or accepted.

- D. No substitutes.

2.03 ENGINE

- A. Type: Liquid-cooled, 12-cylinder V, four stroke cycle, direct injection diesel engine, turbo charged and intercooled.
- B. Fuel System: Appropriate for use of No. 2 fuel oil. The maximum fuel usage shall be approximately 64.7 gallons per hour at 100% speed or approximately 27.68 hours of run-time on 1791 gallons of fuel.
- C. Engine Speed: 1800 rpm.
- D. Electronic governing system to control generator frequency regulation from no-load to full load (isochronous) and steady state of +/-0.25%.
- E. Engine Protection Devices: Low coolant temperature alarm, low lubrication oil pressure alarm, high coolant temperature alarm, low lubrication oil pressure shutdown, high coolant temperature shutdown, over-speed shutdown and over-crank lockout.
- F. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.
- G. Ignition: 24V battery ignition system with radio suppression, negative ground. (Includes two (2) 1150 CCA batteries) A 12VDC starting system and a single starting battery are not acceptable.
- H. Engine Jacket Heater: Thermal circulation type 9000 watt water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F, and suitable for operation on 208 VAC single phase from the generator Panelboard L4.
- I. Engine Accessories: Fuel filter, replaceable oil filter with bypass, reusable element, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Include water temperature gauge, and lube oil pressure gauge on engine-generator control panel.
- J. Mounting: Provide unit with suitable spring-type vibration isolators and mount on structural steel base. (See sub-base fuel tank for additional requirements).
- K. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F. Radiator Air Flow Restriction: 0.5 inches of water (9.34 mm of mercury), maximum.

2.04 GENERATOR

- A. The generator shall be salient-pole, brushless, 12-lead reconnectable, self-ventilated of drip proof construction with amortisseur rotor windings and skewed stator. The insulation shall meet NEMA standard (MG-1-22.40 and 16.40) for class H and be insulated epoxy varnish to be fungus resistant per MIL 1-24092. Temperature rise of the rotor and stator shall be limited to NEMA Class H ratings. The excitation system shall be brushless controlled by a solid-state voltage regulator capable of maintaining voltage within +/- 2% at constant load from 0 to 100% of rating. The regulator shall be isolated to prevent tracking when connected to SCR loads, and provide individual adjustments for voltage range, stability and volts-per-hertz operations and be protected from the environment by conformal coating. The generator shall upon a one-step application of any load up to 90% of the rated load of 0.8 power factor, the voltage dip shall not exceed 25% and shall recover to 2% of rated voltage within one second. The generator shall be capable of sustaining at least 300% of rated current for a minimum of 10 seconds under a 3 phase symmetrical short.
- B. Rating: 900kW/1125kVA as specified at 0.8 power factor, 1354 amps, 480Y/277 volts, 60 Hz at 1800 rpm.

- C. Insulation: ANSI/NEMA MG 1, Class H, synthetic, nonhygroscopic.
- D. Temperature Rise: 130 degrees C continuous. 150 degrees C standby.
- E. Enclosure: ANSI/NEMA MG 1; open drip proof.
- F. Voltage Regulation: Solid state type, include torque-matched generator-mounted volts per Hertz exciter-regulator to match engine and generator characteristics, with voltage regulation +/- 0.25 percent from no load to full load. Include manual controls to adjust voltage drop +/- 5 percent voltage level, and voltage gain.

2.05 ACCESSORIES

- A. Exhaust Silencer: Critical type silencer, steel with flexible steel exhaust fitting and exhaust pipe, sized in accordance with engine manufacturer's instructions located within the generator enclosure.
- B. State Code Sub Base Fuel Tank:
 1. Tank shall be sub base type mounted beneath the engine generator. Tank shall be constructed of ¼ inch steel with primed and finished painted exterior. Interior shall be baffled and shall be epoxy coated for rust prevention.
 2. Tank shall be of approximately 1791-gallon capacity providing an approximate runtime of approximately 27.68 hours at 100% continuous load, UL 142 listed, and NFPA 30 and 37 standards.
 3. The fuel tank shall be supplied with an intrinsically safe overfill alarm panel and sensors as manufactured by Aggressive Systems, Inc, model ATA-1 or approved equal. The alarm panel shall be mounted on a fixed panel located on the generator enclosure at about 48 inches AFG, directly in line with the fill point. The wiring from the High Level sensor to the panel shall be installed in schedule 80 PVC conduit. The conduit shall be secured to the fixed generator panel with two hole straps and stainless screws. The panel shall provide a "High" fill alarm signal to the SCADA Control Panel SCP-31 routed through the generator controller. The panel shall provide LED light indication and an audible alarm of the high level.
 4. Tank shall have the following connections:
 - a. 2" NPT fuel return.
 - b. 2" NPT fuel supply dip tube.
 - c. 2" Fuel fill with lockable cap.
 - d. 3" NPT normal vent.
 - e. (2) 3" NPT NFPA 30 emergency vents.
 - f. 2" NPT containment area vent.
 - g. 2" fitting for fuel level gauge, verify size with Manufacturer.
 - h. 2" fitting for "Low" fuel level alarm.
 - i. 1/2" NPT for interstitial space alarm switch.
 - j. 1/2" NPT for basin drain.
 - k. 2" spare NPT.
 - l. The electrical contractor shall verify these pipe sizes and make any adjustments as required by the NFPA or the State of Wisconsin.
 5. Provide rupture basin sized to hold a minimum of 150 percent of tank capacity. Provide fuel in basin alarm float with a minimum 50-watt switch wired to an indicating lamp as shown on the plans.
 6. Provide fuel level gauge and a low fuel level float with a minimum 50-watt switch wired to generator controller and then onto the proposed SCADA Control Panel SCP-31. See plans for additional inputs required from the generator to the proposed SCADA Control Panel SCP-31.
 7. Upon completion of all testing, tank shall be filled to capacity with appropriate diesel fuel. The Electrical Contractor shall coordinate the fuel tank installation to meet all State of Wisconsin requirements.
- C. The enclosure shall come complete with a 120/208 volt, 3 phase 125 amp panelboard with main circuit breaker and branch circuit breakers to power the loads within the generator including but not limited to; battery charger, block heater, fuel fill control panel, interior lights and interior GFCI receptacles.

- D. Batteries: Heavy duty, diesel starting type lead-acid storage batteries, two (2) 1150 CCA minimum capacity or as specified by the manufacturer. Match battery voltage to starting system. Include necessary cables and clamps and battery.
- E. Battery Tray: Plastic coated metal treated for electrolyte resistance, constructed to contain spillage of electrolyte.
- F. Battery Charger: 10 ampere automatic float and equalize battery charger with $\pm 1\%$ constant voltage regulation from no load to full load over $\pm 10\%$ AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambient from -40 to +60 degrees C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected. Provide the optional alarm circuit board to meet the requirements of NFPA 110 for low battery voltage, high battery voltage, and battery charger malfunction. Route alarm circuit wiring to generator control panel for remote monitoring at the proposed SCADA panel.
- G. Line Circuit Breaker: rated as shown, 3-pole NEMA AB 1 molded case circuit breaker on generator output with an 2000 AF/2000 amp, 3 pole, 480 volt, 100% rated integral thermal, instantaneous magnetic trip in each pole, with GFP. Include battery-voltage operated shunt trip, connection to open circuit breaker on engine failure. Mount unit in enclosure to meet ANSI/NEMA 250, Type 1 requirements. The size is shown on the plans.
- H. Engine Generator Control Panel with the following equipment and features:
1. Controller shall include two lines of 12 characters digital display with pushbutton/rotary selector dial for menu navigation for access of all functions.
 2. Measurements in English or metric.
 3. Scrolling display for critical data.
 4. Integrated hybrid voltage regulator providing $-/+0.25\%$ regulation.
 5. Built-in alternator thermal overload protection.
 6. Emergency stop button and alarm horn.
 7. Environmentally sealed membrane keypad with master control buttons for Off-Reset/Auto/Run with lights. Off/Reset with red light, Auto in green and run in yellow.
 8. Alarm Silence/Lamp test button with light.
 9. Annunciator fault light, with red for shutdown and yellow for warning.
 10. USB Connection for software upgrades and communications access for diagnostics.
 11. User inputs for remote emergency stop switch (not used), remote 2 wire start for transfer switch and future SCADA and auxiliary shutdown.
 12. Frequency Digital Meter: 45-65 Hz range.
 13. Auto-resettable circuit protection.
 14. Digital display of power monitoring including kW and kVA.
 15. AC Digital Output Voltmeter.
 16. AC Digital Output Ammeter.
 17. Rated power in percentage.
 18. Output voltage adjustment.
 19. Push to test indicator lamps, one each for low oil pressure, high water temperature, over-speed and over-crank.
 20. Engine start/stop selector switch for manual operation.
 21. Engine running time meter.
 22. Oil pressure gauge.
 23. Water temperature gauge.
 24. Auxiliary Run Relay: 3PDT, operates when engine runs, with contact terminals pre-wired to terminal strip.
 25. Input/Output Module.
- I. Controller:
1. Set-mounted controller shall be vibration isolated on the generator enclosure. The microprocessor control board shall be moisture proof and capable of operation from -40 degrees C to 70 degrees C with a humidity range of 5% to 95% noncondensing.
 2. AC output voltage regulator adjustment of $\pm 10\%$ Maximum of system voltage.
 3. Alternator short circuit protection.

4. Cyclic cranking.
 5. Event logging up to 1000 entries for warning and shutdown faults, fully resettable.
 6. Historical data logging capabilities.
 7. Integrated hybrid voltage regulator.
 8. Lamp test.
 9. Power metering.
 10. Programming access via USB port.
 11. Run time hour meter.
 12. Time delay engine cooldown (TDEC) feature.
 13. Time delay engine start (TDES) feature.
 14. Controller shall meet the following standard:
 - A. CE Directive
 - B. NFPA 99
 - C. NFPA 110, Level 1
 - D. UL 508
 - E. ASTM B117 (Salt spray test).
- J. NFPA 110 Requirements: Indicating Display, Front Panel Mounted with the following:
1. Overcrank.
 2. Emergency Stop
 3. High Engine Speed
 4. Low Coolant Level
 5. Low Fuel level or Pressure
 6. Low Oil Pressure Warning
 7. Low Oil Pressure Shut down
 8. High Battery Voltage
 9. Low Battery Voltage
 10. EPS Supplying Load
 11. High Coolant Temperature Warning
 12. High Coolant Temperature Shut down
 13. Low Coolant Temperature Warning
 14. Master Switch for "Not In Auto" Position
 15. Battery Charger Fault
 16. Lamp test
 17. Audible Alarm Silence Button
 18. Remote Emergency Stop
 19. Contacts for Local and Remote Common Alarm
- K. Display Indicators
1. Not-in-Auto (flashing red)
 2. Over-crank (red)
 3. Emergency Stop (red)
 4. High Engine Temperature (red)
 5. Over-speed (red)
 6. Low Oil Pressure (red)
 7. Battery Charger Malfunction (red)
 8. Low Battery Voltage (red)
 9. Low Fuel (red)
 10. Auxiliary (yellow)
 11. Auxiliary Fault (red)
 12. System Ready (green)
 13. Pre-alarm High Engine Temperature (yellow)
 14. Pre-alarm Low Oil Pressure (yellow)
 15. Low Coolant Temperature (red)
 16. Test button for indicating lights

- L. Controller:
1. Set-mounted controller capable of facing right, left or rear of the generator shall be vibration isolated on the generator enclosure. The microprocessor control board shall be moisture proof and capable of operation from -40 degrees C to 85 degrees C.
 2. Circuitry shall be plug-in type and shall be capable of testing without operating the engine.
 3. Speed sensing with a second independent starter motor disengagement system for protection against starter engagement with the moving flywheel without the use of battery charging alternator voltage.
 4. The starting system shall be designed for restarting in the event of a false engine start, by allowing the engine to completely stop and then re-start again.
 5. Cranking cycle with 15 second ON and OFF cranking periods.
 6. Over crank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.
 7. Internal circuitry shall be provided to shut down the engine when signal for high coolant temperature, low oil pressure or over speed is received.
 8. Engine cool down timer set to 5 minutes to permit unloaded running of the generator 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, i.e. transfer switch contact close and stop five minutes after they open. In the Off position the generator shall not start, even if the transfer switch contacts close or if it is operating it shall immediately shutdown. Reset of any fault shall also be extinguished by selecting the off position.
- M. An outdoor enclosure shall be provided as described below:
1. Provide an outdoor weatherproof enclosure to enclose the Generator and exhaust system as outlined in this specification. The Level 1 enclosure shall be installed onto generator's concrete base. The enclosure shall be insulated and constructed to provide the required sound attenuation at full speed measured from 7 meters using an 8 point test at each end of the generator enclosure.
 2. The enclosure and complete generator installation shall be made rodent proof.
 3. The sound attenuated enclosure shall be made from 14 gauge aluminum for both the side walls and roof. The walls and roof shall be power coat painted.
 4. The roof shall be tapered to allow water run-off. All doors shall be lockable using steel welded hinges with stainless steel hardware and chrome plated door handles.
 5. All seams shall be caulked with body sealer and shall be primed and final color provided.
 6. Double doors shall be located on each side of the engine and single doors located on each side of the generator to access the control panel.
 7. All doors shall be lockable and the Owner shall be provided with six sets of keys. All doors shall be keyed alike.
 8. The exhaust system shall be contained within the enclosure. The silencer shall be a critical grade muffler that is inside the enclosure. Mufflers located above the enclosure will no be acceptable.
 9. The enclosure shall be provided with fixed louvers and dampers.
 10. The enclosure shall include the panelboard, as specified within, two (2) GFCI receptacles, interior lighting with wall switch, all AC power distribution installed in accordance with NEC using incandescent lights, Ceiling mounted 5KW wall heater, 800 cfm Ventilation Fan, battery charger and block heater wiring.
 11. The color shall be the manufacturer's standard.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work and field dimensions are as shown on Drawings.
- B. Verify that required utilities are available in proper location and ready for use.

- C. Beginning of installation means installer accepts existing conditions.
- D. Provide a circuit breaker directory for the panelboard.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.03 FIELD QUALITY CONTROL

- A. Provide full load test utilizing portable load bank, for (4) four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown, and return to normal.
- B. During test, record the following at 20-minute intervals and submit report to engineer:
 - 1. Kilowatts.
 - 2. Amperes.
 - 3. Voltage.
 - 4. Coolant temperature.
 - 5. Room temperature.
 - 6. Frequency.
 - 7. Oil pressure.
- C. Test alarm and shutdown circuits by simulating conditions.

3.04 MANUFACTURER'S FIELD SERVICES

- A. Prepare, start, test, and adjust systems according to the generator's manufacturer's recommendations.

3.05 ADJUSTING

- A. Adjust generator output voltage and engine speed.

3.06 CLEANING

- A. Clean engine and generator surfaces.

3.07 DEMONSTRATION

- A. Describe loads connected to standby system and restrictions for future load additions. Also see Specification 26 36 23 "Automatic Transfer Switches" for additional information.
- B. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide standby power, minimum of (4) four operations with the Engineer present.
- C. Provide a (4) four hour load bank test on the generator after installation and provide written test results to Engineer documenting the testing. After all testing is complete provide a full tank of fuel to the Owner.

END OF SECTION

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