

**SECTION 9 - GENERATOR & ATS SYSTEM**

A standby generator system complete with diesel engine, alternator, battery charger, weather-protected housing, integral fuel tank, generator disconnect, automatic transfer switch (ATS), and all appurtenances shall be provided by the contractor. The major equipment and components shall include the following:

**9.1 GENERATOR**

**A. REFERENCES**

1. ANS/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. ANS/NEMA MG 1 - Motors and Generators.
3. ANS/NFPA 70 - National Electrical Code.
4. ANS/NFPA 99 - Health Care Facilities.
5. ANS/NEMA AB 1 - Molded Case Circuit Breakers.
6. NFPA 37 - Installation and Use of Stationary Combustion Engines and Gas Turbines.
7. NFPA 110 - Emergency and Standby Power Systems.

**B. SYSTEM DESCRIPTION:**

1. Engine generator system shall provide a source of emergency and standby power.
2. System Capacity: Minimum 50 KW at an elevation of 1,000 feet above sea level, and ambient temperature between -20°F and 110°F; standby rating using engine-mounted radiator. **(This generator rating is based on a pump station with 20 hp pumps that are duplexed and alternated and using a 480 volt, 3 phase, 100 amp service or less. Each project shall determine the correct size of generator, automatic transfer switch, and utility service based on the pump station configuration and size. The Engineer shall run Generator Sizing software and enter all simultaneous loads and starting sequences to determine the necessary size of the engine-generator set.)**
3. Operation: In accordance with ANS/NFPA 99.Functional Description.
4. Subject to compliance with requirements, provide completely assembled and tested engine-generator units by one of the following engine generator set manufacturers:
  - a. Cummins Power Generation
  - b. Caterpillar, Inc.

**C. SUBMITTALS**

1. General: Submit the following according to Conditions of Contract and Division 01 Specification Sections.
2. To be Submitted before Equipment Order:
  - a. Product data for products specified in this Section. Include data on features, components, ratings, and performance. Data shall include weights, fuel consumption rates, ventilation and combustion air requirements, exhaust flow data, cooling system data and engine and generator data. Include dimensioned outline plan and elevation drawings of engine generator set and other system components.

52

- b. Shop Drawings: Detail fabrication, piping, wiring, and installation of the field-installed portions of the system. Include general arrangement drawings showing locations of auxiliary components in relation to the engine generator set and duct, piping, and wiring connections between the generator set and the auxiliary equipment. Show connections, mounting, and support provisions and access and working space requirements. Submit all pertinent construction details for weatherproof enclosures.
- c. Wiring Diagrams for System: Show power and control connections and distinguish between factory-installed and field-installed wiring. Terminals for field wiring the system controls and between equipment shall be labeled in a consistent point to point manner by the manufacturer.

**D. MANUFACTURER SEISMIC QUALIFICATION CERTIFICATION:** Submit certification that engine-generator set, batteries, battery racks, accessories, weatherproof enclosure and components will withstand seismic forces as defined for the pump station site. Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

**E. CERTIFIED SUMMARY OF PROTOTYPE UNIT TEST REPORT:**

1. Submit certified copies of actual prototype unit test report.

**F. EMISSIONS**

1. Submit certificates for compliance with EPA Emissions Standards for Compressed Ignition Engines.

**G. ENGINE GENERATOR SET**

1. Type: Water-cooled in-line or V-type, compression ignition diesel electric ignition internal combustion engine.
2. Rating: Sufficient to operate at 100 percent load for two hours at specified elevation and ambient limits.
3. Fuel: No. 2 fuel oil
4. Rated Engine Speed: 1800 rpm.
5. Lubrication System: The following items shall be mounted on engine or skid:
  - a. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
  - b. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
  - c. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
6. Engine Fuel System:
  - a. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow

53

- under starting and load conditions.
- b. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- c. Engine Fuel Supply System: Comply with UL 142 fuel oil tank.
- d. Base-Mounted Fuel Tank: UL listed fuel tank with at least 48 hours of full load operation capacity. Integral rupture basin with leak detection. Provide fueling port with an overflow prevention type receptacle and lockable cap for exterior units. The tank shall include structural steel supports for top mounted engine generator set. Furnish complete with flexible fuel line connectors, lockable cover, and analog level gauge. Furnish complete with float switches to indicate low fuel level 25%, 50%, and 75%. The footprint of the base-mounted fuel tank shall not exceed the footprint of the enclosure for exterior installations.

7. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90°F, and suitable for operation on 120 volts if rated at 1200 watts or less or 480 volts if rated at greater than 1200 watts. Provide electrical circuiting and protection to the heater based on the load requirements. The minimum wattage of the heater shall be as recommended by the manufacturer
8. Governor: Adjustable isochronous, with speed sensing.
9. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

- a. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
- b. Size of Radiator: Non-ferrous metal construction sized to contain expansion of total system coolant from cold start to 110 percent load condition.
- c. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
- d. Temperature Control: Self-contained, thermostatic-control valve shall modulate coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

10. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

11. Air-Intake Filter: Heavy-Duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
12. Starting System: 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. Provide the following accessories:

- a. Battery: Voltage to match starter and cranking cycle of three times without recharging. Provide with acid resistant battery tray.
- b. Battery Cable: Size as recommended by engine manufacturer. Include required interconnecting conductors and connection accessories.
- c. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
- d. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

54

- 1) Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
- 2) Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
- 3) Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
- 4) Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
- 5) Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

**13. TO BE SUBMITTED AFTER EQUIPMENT ORDER:**

- a. Factory Test Reports: Provide for units to be shipped for this Project showing evidence of compliance with specified factory test requirements.
- b. Maintenance data for system and components for inclusion in Operating and Maintenance Manual.

**14. WARRANTY**

- a. The complete electrical power system (generator, weatherproof enclosure, engine, controls, automatic transfer switch and accessories) shall be warranted by the manufacturer against defects in materials and workmanship for a period of five (5) years from the date of Substantial Completion. Coverage shall include parts, travel expenses and labor to remove and install the necessary parts and equipment.

**15. MAINTENANCE SERVICE**

- a. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of the manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

**16. QUALITY ASSURANCE**

- a. Manufacturer Qualifications: Firms experienced in manufacturing equipment of the types and capacities indicated that have a record of successful in-service performance.
- b. Manufacturer's Service Personnel: Service personnel shall be factory trained and

55

- c. certified in the maintenance of the specified equipment.
- c. Emergency Service: System manufacturer shall maintain a service center capable of providing training, parts, and emergency maintenance and repairs at the Project site within a time period of less than 4 hours from time of notification, 365 days per year.
- d. Electrical Items and Components shall be listed (or recognized) by Underwriters Laboratories, Inc.
- c. Non-Electrical Components shall be listed (or recognized) by Underwriters Laboratories, Inc. or other applicable Nationally Recognized Testing Laboratory.
- f. Engine Exhaust Emissions: Comply with applicable Federal, State, and local government requirements.
- g. Single-Source Responsibility: Unit shall be a representative product built from components that have proven compatibility and reliability and are coordinated to operate as a unit as evidenced by records of prototype testing.

**17. NOISE EMISSION**

- a. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

**18. DELIVERY, STORAGE, AND HANDLING**

- a. Deliver engine generator set and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

**19. EXTRA MATERIALS**

- a. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents. Deliver extra materials to the Owner.
  - 1) Fuses: 1 for every 10 of each type and rating, but not less than 2 of each.
  - 2) Pilot Lights: 1 for every 3 of each type used, but not less than 2 of each.
  - 3) Filters: 1 set each of lubricating oil, fuel, and combustion air filters.

**20. COORDINATION**

- a. Coordinate size and location of concrete bases for engine generators. Concrete, reinforcement, shall be designed by the developer's engineer.
- b. Provide generator electronic CAD drawings to Coordinating Contractor for inclusion into composite coordination drawings. Show generator, fuel system components, battery system components, and exhaust system in 1/4 inch scale plan.

**21. CONTROL AND MONITORING**

- a. Configuration: Operating and safety indications, protective devices, engine gages, basic system controls, and other indicated components shall be grouped in a combination control and power panel. Panel shall be mounted on the generator set unless otherwise indicated. Control and monitoring section of panel shall be

56

- isolated from power sections by steel barriers.
- b. Ground Fault: **(Ground Fault sensing and indication is not normally required for generators (this small. Each project should make a determination if it is needed. If not, this requirement may be removed.)** Provide ground fault sensing at the generator. The sensor shall be located ahead of the generator service disconnect. Provide a ground fault indication on the engine-generator control panel. Provide an instruction nameplate at the control panel.

- 1) Instruction nameplate: Provide operational instructions for a ground fault indication as approved by the local Authority Having Jurisdiction.

- c. Generator Circuit Breaker: Molded or insulated case, service-rated thermal-magnetic type; 100% rated breaker complying with NEMA AB1 and UL 489.

- 1) Tripping Characteristic: Designed specifically for generator protection.
- 2) Trip Rating: Matched to generator rating.
- 3) Mounting: Provide freestanding enclosure or mount integrally with control and monitoring panel.
- 4) Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator circuit breaker shall open the circuit breaker to disconnect the generator from load circuits. Protector shall perform the following functions:
  - a) Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm shall be integrated with other generator-set malfunction alarms.
  - b) Under single or three-phase fault conditions, regulate generator to 300 percent of rated full-load current for up to 10 seconds.
  - c) As overcurrent heating effects on the generator approach the thermal damage point of the unit, protector shall switch the excitation system off, open the generator circuit breaker, and shut down the generator set.
  - d) Sense clearing of a fault by other overcurrent devices and control recovery of rated voltage to avoid overshoot.

- 5) Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

- 6) Indicating Devices, Protective Devices, and Controls: Common Audible with Individual Visible Alarm to conform to NFPA 110 requirements for [Level 1] [Level 2] systems. Include necessary Form C contacts and terminals in control and monitoring panel. Include the following:
  - a) A.C. Voltmeter
  - b) A.C. Ammeter
  - c) A.C. Frequency Meter
  - d) D.C. Voltmeter (Alternator Battery Charging)
  - e) Engine Coolant Temperature Gage
  - f) Low Engine Coolant Temperature Indicator Lights

57

- g) Engine-Lubricating Oil Pressure Gage
- h) Running Time Meter
- i) 4 position Ammeter Phase Selector Switch
- j) Auxiliary Contacts: If required for control of ventilation fans and/or motorized dampers, separate terminal blocks factory wired to separate form C dry contacts. Contacts shall be for field connection and to start generator ventilation fans and motorized dampers. Contacts shall activate upon generator start signal. Provide two Form A and two Form B contacts, each rated no less than 10 amperes at 120 volts AC and no less than 5 amperes at 24 volts DC.
- k) Generator Voltage-Adjusting Control.
- l) Fuel tank derangement alarm with contacts to annunciate to SCADA
- m) Fuel tank high level shutdown of fuel supply alarm.
- n) Generator overload or fault with contacts to annunciate to SCADA
- o) Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support specified items. Locate sensors and other supporting items in engine generator control panel unless otherwise indicated.
- p) Temperature Relay: **(Temperature monitoring of the alternator bearing and stator windings is typically used for Prime Power applications as opposed to Standby Power applications. This can usually be deleted.)** Provide temperature relay(s) as required at generator to monitor bearing and stator windings. Provide minimum of two contacts (form C) for each of alarm and shutdown. Factory wire shutdown output contacts to generator control panel. Temperature relay may be omitted if the generator control panel can perform the same monitoring and output contact functions.

**22. LOCAL ALARMS AND SHUTDOWN**

- a. Conform to NFPA 110 requirements for Level 1 systems. Include necessary Form C contacts and terminals in control and monitoring panel.
- b. Local Alarms: Provide generator set mounted alarms as follows with shutdown where noted:
  - 1) Over-crank (with shutdown).
  - 2) Over-speed (with shutdown).
  - 3) Low lube oil pressure (with shutdown).
  - 4) High engine temperature pre-alarm.
  - 5) High engine temperature (with shutdown).
  - 6) Low fuel main tank.
  - 7) Generator supplying load.
  - 8) Low water temperature.
  - 9) Control switch not in auto.
  - 10) High battery voltage.
  - 11) Low battery voltage.
  - 12) Battery charger A.C. failure.
  - 13) Storage tank leak.
  - 14) Low coolant level.

58

- 15) Low cranking voltage.
- 16) Generator run.
- c. The above alarms shall include a run alarm set to call the City and be by individually identified visual indications plus a common audible alarm.
- d. There shall be a lamp test switch to test all of the above lamps.
- e. The remote emergency stop switch shall also shut the unit down.

**H. GENERATOR, EXCITER, AND VOLTAGE REGULATOR**

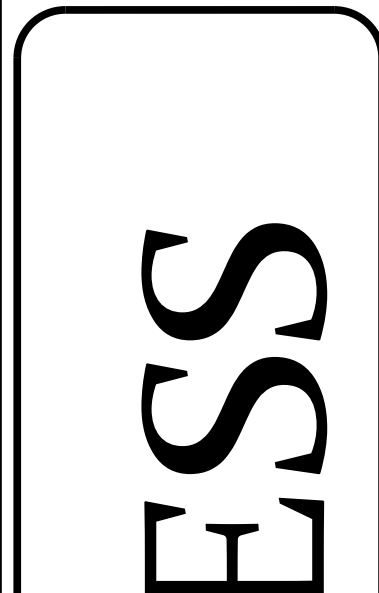
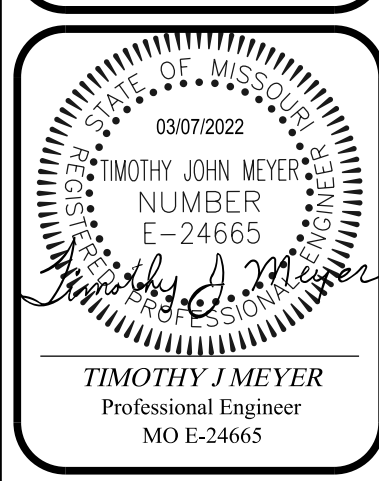
1. Comply with NEMA MG 1, "Motors and Generators," and specified performance requirements.
2. Rating: As indicated on the drawings, at 0.8 power factor, 60 Hertz at RPM to match engine rating.
3. Electrical Insulation: All windings shall be Class F insulation applied under a vacuum pressure impregnation (VPI) cycle.
4. Temperature Rise 105°C continuous.
5. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
6. The AC generator shall be re-connectible brushless synchronous, four pole generator with brushless exciter and PMG alternator excitation.
7. Enclosure: ANS/NEMA MG1, open drip-proof.
8. A permanent magnet generator (PMG) shall provide excitation power to the automatic voltage regulator for immunity from voltage distortion caused by non-linear SCR controlled loads on the generator. The PMG shall sustain main field excitation power for optimum motor starting and to sustain short circuit current as described above under "System Performance."
9. The automatic voltage regulator shall be temperature compensated solid-state design. The voltage regulator shall be equipped with three-phase RMS sensing. The regulator shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. Overvoltage protection shall sense the AC generator output voltage and in the event of regulator failure or loss of reference, shut down regulator output on a sustained overvoltage of one (1) second duration. Overexcitation protection shall sense regulator output and shut down regulator output if overloads exceed ten (10) seconds duration. Both overvoltage and overexcitation protection shutdowns shall be latched, requiring the AC generator to be stopped for reset.

- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

**J. GENERATOR OUTDOOR HOUSING**

1. Provide a prefabricated or pre-engineered weatherproof housing over unit with the following features:
  - a. Construction: Reinforced galvanized-steel, metal-clad, integral structural-steel-framed building anchored to a concrete foundation. Structural design and anchorage to comply with ASCE 7 for wind loads up to 100 mph.
  - b. Hinged doors on opposite sides with cylinder type locks keyed alike.
  - c. Mount control panel and circuit breaker on inside of housing in such a fashion as to enable opening of the disconnect door and easy access.

59



**PUMP STATION - DETAILS**

**PHASE 3**

1575 BRYAN RD.  
Project # 22450

01/20/2022  
**C56**