

**SECTION 16420****STATIONARY ENGINE-GENERATOR SETS****PART 1 - GENERAL****1.01 SCOPE OF WORK**

- A. Furnish and install a stationary engine-generator system which will start automatically upon interruption of normal electrical service.
- B. Engine-generator systems shall be furnished to provide pump station standby power, when required in accordance with Subsection 1.09-H of Section UC-500.

**1.02 SUBMITTALS**

- A. Prepare and submit complete set of shop drawings of all generator equipment to be provided on this project to the Engineer for approval.
- B. Submit complete manufacturer's product data of all material and systems, consisting of complete product description and specifications, complete performance test.
- C. All shop drawing shall have clearly marked the appropriate specification number of drawing designation for identification of the submittal.
- D. Any notations marked on submission of the equipment as outlined in this Section by reviewing authority must be responded to, in writing, by the equipment manufacturer.
- E. Complete engineering submittal, catalog cuts, wiring diagrams, interface drawings, unit drawings, AC and DC schematics, termination chamber drawings, terminal strip drawings, foundation plans, annunciator panel layout and wiring, etc., must accompany all shop drawings.

**1.03 QUALITY ASSURANCE**

- A. In the best interest of the Miami-Dade Water and Sewer Department, the supplier of this equipment shall maintain a full-time "in-house" parts and service organization within 50 miles of the job site. Equipment offered by those who do not have an "in house" parts and service organization and who depend on others to provide services shall not be considered. This supplier shall have his name, address and telephone number clearly and visibly located on all equipment. Service shall be available on a 24-hour/7-day a week basis.
- B. The supplier of the equipment shall provide information and/or supervision required for the proper installation of the equipment, testing of equipment and training of operating personnel.
- C. All components shall bear UL labels.
- D. The stand-by system, including the generator set, associated controls and automatic load transfer switch shall be designed, fabricated, tested and furnished by one manufacturer to

assure one source of responsibility. The manufacturer shall have been regularly engaged in the production of engine-alternator sets and associated controls for a minimum of five years and shall manufacture either the engine, or the generator or both.

1.04 GUARANTEE

The equipment furnished under this Specification shall be new, unused, of the latest design. The generator set, associated controls, and automatic load transfer switch shall be warranted for a minimum of five years or 1,500 operating hours. The supplier of the system shall have a parts and service facility within fifty miles from the jobsite in order to assure the owner continuity of service.

1.05 REFERENCE STANDARDS

Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section and are hereby incorporated into, and made a part of, the Contract Documents:

- 1. NFPA 70: National Electrical Code
- 2. NFPA-110: Emergency and Standby Power Systems
- 3. NFPA-101: Life Safety Code
- 4. NFPA-AB1: Molded Case Circuit Breakers
- 5. NFPA MG1: Motors and Generators
- 6. NFPA 250: Enclosures for Electrical Equipment (Maximum 1,000 Volts)
- 7. NFPA 30: Flammable and Combustible Liquids Code

1.06 CHARACTERISTICS

Stationary Engine - Generator Set Characteristics

PUMPS H.P. (2)	25	30	40,50,60	75	100
GENERATOR (KW)	100	125	175	250	300
ENGINE (BHP)	166	216	325	377	464
DISPLACEMENT(CID)	366	366	531	674	930
MODEL	D100P2	D125P2	D200P4	250	300
				DFAC	DFCB
SUGG. FUEL TANK (GW)*	550	700	1000	2500	2500
EXHAUST LOUVER SIZE	3'X4'	3'X4'	5.5'X6'	4'X5'	5'X6'

The models of engine generators listed above are for equipment manufactured by Caterpillar and Onan Corporation, and are shown only for reference. Equipment with similar characteristics are acceptable if approved by the Miami-Dade Water and Sewer Department. Fuel Tank capacity: see Section 11500 - 2.02.

\* Suggested fuel tank capacities listed above shall not be less than capacity required under Section 11500-2.02.

**PART 2 - PRODUCTS**

## 2.01 GENERAL

The generators shall be capable of automatic starting, synchronizing and paralleling, if more than one generator is required.

## 2.02 EQUIPMENT

- A. Generators shall be three phase, 60 Hertz, single bearing, self-aligning, four pole, synchronous type, with amortisseur windings and brushless rotating, rectifier, exciter system and built according to NEMA MG-1 standards. Insulation shall meet NEMA Standards for Class F. Stator windings: impregnated with 100% solid epoxy. Maximum temperature rise shall not exceed 100 degrees C. at 40 degrees C.

Volt regulation:  $\pm 2\%$  from no load to full load. The ability to start the second pump, with the other operating at full load and maximum voltage dip of 30%

- B. Engines: The engine shall be a stationary, liquid cooled, 1800 rpm, four-stroke cycle design, vertical in-line or V-type, turbocharged, compression ignition diesel, meeting specifications when operating on No. 2 domestic fuel oil. Diesel engines requiring premium fuels will not be considered. Equip units with fuel, lube oil, and intake air filters, lube oil cooler, fuel transfer pump, fuel priming pump, gear driven water pump, and on engine-mounted instrument panel including fuel pressure gauge, water temperature gauge, a lubricating oil pressure gauge, and a battery charging alternator. Mounted on a structural steel sub-base, provided with suitable vibration isolators. It shall not be manufactured with any Class I ozone depleting substances (ODS) as defined by Federal Register Vol 57 No. 86.

Equip unit with a hydraulic type governor as Model PSC, manufactured by Woodward, or approved equal. Safety shut-off devices for high water temperature, low oil pressure, overspeed, and engine over crank, shall be provided.

1. Radiator: Provide an engine-mounted radiator (with blower type fan) sized to maintain safe operation at 95 degrees F., maximum ambient temperature. Air flow restriction from the radiator shall not exceed 0.5 inch of water. Provide duct work of 16 gauge aluminum with flexible connecting section between radiator and exhaust louver.
2. Exhaust System: Provide a residential type silencer, including flexible exhaust fitting, properly sized and installed according to the manufacturer's recommendation. Mount silencer so that its weight is not supported by the engine. Size exhaust pipe to insure that exhaust back pressure does not exceed the maximum limitations specified by the generator set manufacturer. Steel pipe for the exhaust system shall be black seamless steel pipe meeting ASTM standard A 53 with plain ends beveled for field welding. Flanges shall be 150 lb. black forged steel meeting ANSI Standard B16.5.
3. Automatic Starting System: Furnish a DC electric starting system with positive engagement drive and of the voltage recommended by the engine manufacturer. Provide fully automatic generator set start-stop controls in the generator control panel, 30-second

single cranking cycle limit with lockout and automatic exercise function to start the generator once a week, run idle for ten minutes, run at full speed for one hour, return to idle for ten minutes, and automatically shut down.

Provide a lead-acid storage battery set of the heavy-duty diesel starting type. A battery set of voltage compatible with the starting system, of sufficient capacity to provide for one and one-half minutes total cranking time without recharging and rated no less than 220 amp-hours. A battery rack and necessary cables and clamps shall be provided.

Furnish a current limiting battery charger to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, and fused AC input. AC input voltage shall be 120 volts, single phase, 60 Hertz. Amperage output shall be no less than 5 amperes.

C. Control Panels: Provide a generator-mounted NEMA 1-A type, vibration isolated, dead front, 14-gauge steel control panel. Panel shall contain, but not be limited to the following:

1. Voltmeter, 3½ inch, 2% accuracy.
2. Ammeter, 3½ inch, 2% accuracy.
3. Ammeter-Voltmeter phase selector switch.
4. Frequency meter, 3½ inch, dial type.
5. Running time meter.
6. Automatic starting controls, as herein before specified.
7. Voltage level adjustment rheostat.
8. Dry contacts for remote alarms wired to terminal strips.
9. Fault indicators for low oil pressure, high water temperature, overspeed and overcrank.
10. Three position function switch marked "auto", "run" and "Stop".
11. Generator circuit breaker/contactors with shunt-trip by protective devices.

D. Automatic Load Transfer Switches: Shall be rated for continuous duty and for all classes of load, with sufficient ampere rating to handle the capacity of the loads being transferred. The control components shall be compatible with the electrical requirements of the emergency generator set and shall provide the following functions:

1. Upon power line interruption, automatically initiate starting of the generator set and when the set comes up to speed and voltage, disconnects the load circuit from the utility and transfers it to the emergency generator set's output.
2. Upon utility voltage re-establishment, automatically transfers the load circuit back to the utility and initiates shutdown of the emergency generator set.
3. Mechanically interlocked with break-before-make action and shall have permanently mounted handles to allow for safe manual switching under full rated load. When in either the "Normal" or "Emergency" position, the transfer mechanisms shall be mechanically locked at that position. An interlocking steel beam shall prevent contact closure on both positions simultaneously. The main contacts shall be of high pressure silver alloy construction. Provide arc interruption by multiple leaf arc chutes with covers to prevent

flashover between phases. Main contacts shall be rated 600 VAC, capable of carrying 100% of its current rating continuously and constructed such that they can be visual inspected behind a safety shield whether contacts are open or closed. Provide a plug type connector to allow for maintenance disconnection to control section. Supply a full neutral bar with connecting lugs in the switch cabinet. Auxiliary switches shall be provided on both sides of the transfer switch to operate peripheral equipment; switches shall be single pole, double throw, rated 10 amperes, and shall be wired to an accessible terminal block.

4. Incorporate a programmed transition control to provide a disconnect period beyond the normal six cycle transfer time between "Emergency" and "Normal" position to allow residual voltages generated by inductive loads to decay to safe levels before these loads are re-energized. The transition period shall be field adjustable from 0.5 to 5 seconds. Phase angle dependent controls which do not compensate for induction motor slip shall not be accepted.
5. Incorporate a solid state electronic control system with the following
  - a. Adjustable under voltage sensors to monitor all phases of both the Normal and Emergency sources.
  - b. Adjustable time delay on engine starting to prevent starting of the set in the event of momentary loss of Normal power.
  - c. Adjustable time delay on transferring to Emergency, allowing generator set to stabilize before application of load.
  - d. Adjustable time delay on retransfer to Normal, to prevent power interruption in case of momentary re-establishment of Normal power.
  - e. Adjustable time delay on stopping generator set, allowing engine to cool down by running unloaded.
  - f. Starting dry contacts, one N.O., one N.C. for two wire, 24 VDC, engine control.
  - g. Normal-Test switch.
  - h. Adjustable exerciser clock for periodic testing of generator set with "With-load, Without-load" selector switch.
  - i. Voltage regulated SCR battery charger with float, taper, and equalize charge settings, inherently self-protected, rate 6 amperes, 24 VDC.
  - j. Normal-Emergency position indicating lamps.
  - k. Diagnostic lights for monitoring control sequence. The automatic load transfer switch shall be provided in NEMA 12, 14-gauge welded steel construction cabinet, with key locking door. Wiring space in the interior of the cabinet shall comply with N.E.C., Table 373-6(b).

- E. Factory Tests: Certified factory full load test results shall be provided (not less than 4 hours continuous full-load test at rated KW). All pertinent temperature readings shall be presented, including but not limited to generator stator, generator rotor, (after shut-down), all main bearings, engine cooling water inlet and outlet of radiator, lubricating oil, engine compartment, generator compartment. The MD-WASD's representative shall have the privilege of witnessing these tests and the Engineer shall be notified in writing not less than 14 calendar days before the anticipated test. 48 hours prior to test, confirmation of test date shall be made. Tests shall be performed in the manufacturer's facility in the continental U.S.A.
- F. Initial Start-up: The complete installation shall be initially started and checked out for operational compliance by a factory-trained representative of the manufacturer.

Upon completion of the initial start-up and system checkout, perform a field test, with the Engineer notified in advance, to demonstrate full specified power, stability, voltage, and frequency. The generator set shall be tested for a period of four hours using a portable, dry resistive load bank which shall be capable of incremental loading. The load bank instrumentation shall be used to check the meters on the generator. The generator set shall be capable of assuming its full rated KW load when applied in one step. The generator set shall also run for a period of four hours continuously with all available load connected through the automatic load transfer switch. Records shall be maintained throughout the testing periods on coolant temperature, lubricating oil pressure, ambient air temperature, voltage, current, frequency and kilowatts. This data shall be recorded at fifteen minute intervals throughout the tests. There shall be a thirty minute unloaded run at the conclusion of each test to allow the engine to cool down before shutdown. Three copies of the field test data shall be furnished to the Engineer. The Contractor shall make all necessary connections to facilitate the field tests and provide all necessary fuel. The generator shall be tested under a simulated power failure by setting the control switch on the automatic position and then started by means of the test switch on the automatic transfer switch. The generator set shall then run for the duration of all time delays on the transfer switch and the automatically shut down.

### **PART 3 - EXECUTION**

(Not Used)

END OF SECTION