

SECTION 263213 - PACKAGED ENGINE GENERATOR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide and acceptance test a complete and operable Emergency/Standby electric generating system, including all devices and equipment specified herein or required for the service. Equipment shall be new, factory tested, and delivered ready for installation.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hertz or cycles per second.

1.4 SUBMITTALS

- A. Proposal: Furnish (1) electronic copy of the items described in section 1.4B through 1.4F with the proposal.
- B. Product Data: Include the following:
 - 1. Data on features, components, accessories ratings, and performance.
 - 2. Data on the delivery time of the equipment from date of purchase
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- D. Qualification Data: For Installer and manufacturer.
- E. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.

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- F. Warranty: Warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 30 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- B. Packaged generator sets and auxiliary components from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.
- E. Engine Exhaust Emissions: Comply with applicable state and local government requirements. Engine to be certified US EPA Tier 3.
- F. 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.

1.6 COORDINATION

- A. The generator manufacturer shall coordinate the delivery of the equipment with the future installing contractor and owner's representative.
- B. The generator manufacturer shall coordinate the installation requirements with the future installing contractor.

1.7 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years or 1500 hour period from date of start-up. Warranty to include all parts, labor and travel from date of start-up.
 - 2. Warranty shall be no-deductible type.

1.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of 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

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proper operation. Maintenance agreements shall include parts and supplies as used in manufacture and installation of original equipment.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: One for every 10 of each type and rating, but not less than one of each.
 2. Indicator Lamps: Two for every six of each type used, but not less than two of each.
 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
1. Onan Corp./Cummins Power Generation; Industrial Business Group.
 2. Caterpillar
 3. Kohler
- B. In no case shall the equipment be sized smaller than the specified standard. However, the equipment size shall be increased, if necessary, to properly start all loads within 10 seconds.

2.2 DIESEL ENGINE-GENERATOR SET

- A. 4-cycle, 1800 rpm, diesel engine generator set. Generator set ratings: 300 kW, 375 kVA at 0.8 PF, standby rating, based on site conditions noted below. System voltage of: 120/208 Volts AC, Three phase, Four-wire, 60 hertz. Site Conditions: Altitude 1000 ft. (305 meters), ambient temperatures up to 122 degrees F (50 degrees C).
- B. Prototype Tests and Evaluation:
1. Prototype tests shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement. Prototype testing shall comply with the requirements of NFPA 110 for level 1 systems.
- C. Performance:
1. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load for both parallel and non-parallel applications. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.25 percent.

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2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.5%.
3. The diesel engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
4. Motor starting capability shall be a minimum of 1372 kVA. The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.

D. Engine:

1. The engine shall be diesel, 4 cycle, radiator and fan cooled. Minimum displacement shall be 661 cubic inches, with 6 cylinders. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Minimum horsepower rating of 470 bhp @ 1800 rpm, standby rating. Two cycle engines are not acceptable. Engine accessories and features shall include:
 2. An electronic governor system shall provide automatic isochronous frequency regulation.
 3. Skid-mounted radiator and cooling system rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at the generator air inlet. Radiator shall be provided with a duct adapter flange. The cooling system shall be filled with 50/50 ethylene glycol/water mixture by the equipment supplier. Rotating parts shall be guarded against accidental contact per OSHA requirements.
 4. An electric starter(s) capable of three complete cranking cycles without overheating.
 5. Positive displacement, mechanical, full pressure, lubrication oil pump.
 6. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
 7. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element.
 8. Replaceable dry element air cleaner with restriction indicator.
 9. Flexible supply and return fuel lines.
 10. Engine mounted battery charging alternator, 70-ampere minimum, and solid-state voltage regulator.

E. AC Generator:

1. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees Centigrade.
2. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.
3. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.
4. The subtransient reactance of the alternator shall not exceed 7.5 %, based on the standby rating of the generator set.

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F. Engine-Generator Set Control:

1. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.
2. The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.
3. The control shall be UL508 listed, CSA282-M1989 certified, and meet IEC8528 part 4. All switches, lamps and meters shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts. The controls shall meet or exceed the requirements of Mil-Std 461C part 9, and IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions. The entire control shall be tested and meet the requirements of IEEE587 for voltage surge resistance.
4. The generator set mounted control shall include the following features and functions:
 - a. Mode Select Switch: The mode select switch shall initiate the following control modes. When in the RUN or Manual position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - b. EMERGENCY STOP Switch: Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
 - c. RESET Switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 - d. PANEL LAMP Switch: Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
 - e. Generator Set AC Output Metering: The generator set shall be provided with a metering set including the following features and functions:
 - f. Analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.
 - g. Digital metering set, 1% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
 - h. Generator Set Alarm and Status Message Display: The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on a digital display panel:

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- low oil pressure (alarm)
- low oil pressure (shutdown)
- oil pressure sender failure (alarm)
- low coolant temperature (alarm)
- high coolant temperature (alarm)
- high coolant temperature (shutdown)
- engine temperature sender failure (alarm)
- low coolant level (alarm or shutdown--selectable)
- fail to crank (shutdown)
- overcrank (shutdown)
- overspeed (shutdown)
- low DC voltage (alarm)
- high DC voltage (alarm)
- weak battery (alarm)
- low fuel-daytank (alarm)
- high AC voltage (shutdown)
- low AC voltage (shutdown)
- under frequency (shutdown)
- over current (warning)
- over current (shutdown)
- short circuit (shutdown)
- ground fault (alarm)
- over load (alarm)
- emergency stop (shutdown)
- (4) configurable conditions

In addition, provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

- i. Engine Status Monitoring: The following information shall be available from a digital status panel on the generator set control:

- engine oil pressure (psi or kPA)
- engine coolant temperature (degrees F or C)
- engine oil temperature (degrees F or C)
- engine speed (rpm)
- number of hours of operation (hours)
- number of start attempts
- battery voltage (DC volts)

The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

- j. Control Functions:

- 1) The control system provided shall include a cycle cranking system, which

- allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
- 2) The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
 - 3) The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
 - 4) The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
 - 5) The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

k. Alternator Control Functions:

- 1) The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alpha-numeric LED readout to indicate setting level.
- 2) Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.
- 3) Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load-shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
- 4) An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
- 5) A battery monitoring system shall be provided which initiates alarms when the

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DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine starting, the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a "weak battery" alarm shall be initiated.

- 6) When required by National Electrical Code or indicated on project drawings, the control System shall include a ground fault monitoring relay. The relay shall be adjustable from 100-1200 amps, and include adjustable time delay of 0-1.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay that will function correctly in system as installed.

1. Control Interfaces for Remote Monitoring: All control and interconnection points from the generator set to remote components shall be brought to a separate connection box. No field connections shall be made in the control enclosure or in the AC power output enclosure. Provide the following features in the control system:

- 1) Form "C" dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.
- 2) One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.
- 3) A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
- 4) A fused 20 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.

G. Base:

1. The engine-generator set shall be mounted on a heavy duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

H. Generator Set Auxiliary Equipment and Accessories:

1. Coolant Heater: Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings.
2. The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall be installed using quick disconnect couplers to isolate the heater for replacement of the heater element. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.
3. The coolant heater shall be provided with a 24VDC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.

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4. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 100F (40C) in a 40F ambient, in compliance with NFPA110 requirements.

I. Vibration Isolators

1. Vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.

J. Starting and Control Batteries

1. Starting battery bank, calcium/lead antimony type, 24 volt DC, sized as recommended by the generator set manufacturer, shall be supplied for each generator set with battery cables and connectors.

K. Exhaust Silencer(s)

1. Exhaust muffler(s) shall be provided for each engine, size and type as recommended by the generator set manufacturer. The mufflers shall be critical grade. Exhaust system shall be installed according to the generator set manufacturers recommendations and applicable codes and standards.

- L. Provide and install a 20-light LED type remote alarm annunciator with horn, located as shown on the drawings or in a location that can be conveniently monitored by facility personnel. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems for the local generator control panel. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps shall be replaceable, and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2. The interconnecting wiring between the annunciator and other system components shall be monitored and failure of the interconnection between components shall be displayed on the annunciator panel.

- M. The annunciator shall include the following alarm labels, audible annunciation features, and lamp colors:

Condition	Lamp Color	Audible Alarm
Normal Power (to Loads)	Green	No
Genset Supplying Load	Amber	No
Genset Running	Green	No
Not in Auto	Red (Flashing)	Yes
High Battery Voltage	Red	Yes
Low Battery Voltage	Red	Yes
Charger AC Failure	Red	Yes
Fail to Start	Red	Yes
Low Engine Temperature	Amber	Yes
Pre-High Engine Temperature	Amber	Yes

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High Engine Temperature	Red	Yes
Pre-Low Oil Pressure	Amber	Yes
Low Oil Pressure	Red	Yes
Overspeed	Red	Yes
Low Coolant Level	Amber	Yes
Low Fuel Level	Amber	Yes
Network OK	Green	Yes
(4) Spares	Configurable	Configurable

- N. Low battery voltage lamp shall also be lighted for low cranking voltage or weak battery alarm.
- O. The generator set shall be provided with (1) 100% rated 1200 amp mounted main line circuit breaker and provisions within the generator to accept a future second main-line breaker. The circuit breaker(s) shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions.
- P. Outdoor Weather-Protective Enclosure
1. The generator set shall be provided with an outdoor enclosure, with the entire package listed under UL2200. The package shall comply with the requirements of the National Electrical Code for all wiring materials and component spacing. The total assembly of generator set, enclosure, and sub-base fuel tank (when used) shall be designed to be lifted into place using spreader bars. Housing shall provide ample airflow for generator set operation at rated load in an ambient temperature of 100 degrees F. The housing shall have hinged access doors as required to maintain easy access for all operating and service functions. All doors shall be lockable, and include retainers to hold the door open during service. Enclosure roof shall be cambered to prevent rainwater accumulation. Openings shall be screened to limit access of rodents into the enclosure. All electrical power and control interconnections shall be made within the perimeter of the enclosure.
 2. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color using a two-step electrocoating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating that meets the following requirements:
 - Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.
 - Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.
 - Crosshatch adhesion, per ASTM D3359-93, 4B-5B.
 - Impact resistance, per ASTM D2794-93, 120-160 inch-pounds.
 - Salt Spray, per ASTM B117-90, 1000+ hours.
 - Humidity, per ASTM D2247-92, 1000+ hours.
 - Water Soak, per ASTM D2247-92, 1000+ hours.

Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion-resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

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Enclosure shall be constructed of minimum 12-gauge steel for framework and 14-gauge steel for panels. All hardware and hinges shall be stainless steel.

A factory-mounted exhaust silencer shall be installed inside the enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with a rain cap. Exhaust connections to the generator set shall be through seamless flexible connections.

The enclosure shall include the following maintenance provisions:

- Flexible coolant and lubricating oil drain lines, that extend to the exterior of the enclosure, with internal drain valves.
- External radiator fill provision.
- Inlet ducts shall include rain hoods.

Q. The generator set shall be provided with a Level 1 sound-attenuated housing which allows the generator set to operate at full-rated load in an ambient temperature of up to 100 degrees F. The enclosure shall reduce the sound level of the generator set while operating at full-rated load to a maximum of 87.9 dBA at any location, 7 meters from the generator set in a free field environment. Provide an adder price for a Level 2 sound attenuated housing rated 75.8 dBA 7 meters from the generator set in a free field environment

R. The enclosure shall be insulated with non-hydroscopic materials.

Provide a sub-base fuel tank for the generator set, sized to allow for full load operation of the generator set for 24 hours, 600-gallon minimum. The sub-base fuel tank shall be UL142 listed and labeled. Installation shall be in compliance to NFPA37. The fuel tank shall be a double-walled, steel construction and include the following features:

- Emergency tank and basin vents.
- Mechanical level gauge.
- Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by the engine manufacturer and in compliance to UL2200 and NFPA 37 requirements.
- Leak detection provisions, wired to the generator set control for local and remote alarm indication.
- High and low level float switches to indicate fuel level. Wire switches to generator control for local and remote indication of fuel level.
- Basin drain.
- Integral lifting provisions.
- Comply with the requirements of Ohio Fire Code, Article 34, to include Alarm for 90% Full, Shut-off valve for 95% of Full, 5-gallon Spill-Box on fuel filler, and extended vents.

PART 3 - EXECUTION

3.1 OPERATION

A. SEQUENCE OF OPERATION

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1. Generator set shall start on receipt of a start signal from remote equipment. The start signal shall be via hardwired connection to the generator set control.
2. The generator set shall complete a time delay start period as programmed into the control.
3. The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:
4. The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set, and indicate "fail to crank" shutdown.
5. The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate "fail to start".
6. The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed, and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.
7. On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous state.
8. When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.
9. On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.
10. Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

3.2 OTHER REQUIREMENTS

A. SUBMITTALS

1. Within 10 days after award of contract, provide six sets of the following information for review:
 - Manufacturer's product literature and performance data, sufficient to verify compliance to specification requirements.
 - A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.
 - Manufacturer's certification of prototype testing.
 - Manufacturer's published warranty documents.
 - Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
 - Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
 - Manufacturer's installation instructions.

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3.3 FACTORY TESTING

- A. The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.
- B. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

3.4 INSTALLATION

- A. Manufacture shall provide instructions and instructions included in the listing or labeling of UL listed products.
- B. Equipment manufacture shall provide supervision to the installing contractor for the interconnecting wiring between equipment sections (If and when required.)
- C. Equipment shall be initially started and operated by representatives of the manufacturer.

3.5 ON-SITE ACCEPTANCE TEST

- A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests.
- B. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two-hour full load test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, as necessary.

3.6 TRAINING

- A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

3.7 SERVICE AND SUPPORT

- A. The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

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- B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
- C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

3.8 WARRANTY

- A. The generator set and associated equipment, including the housing, fuel tank, and transfer switches, shall be warranted for a period of not less than 5 years from the date of commissioning against defects in materials and workmanship.
- B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

END OF SECTION 263213