

Section 2.0: Products

2.1 Diesel Engine-Generator Set:

4-cycle, 1800 rpm, diesel engine generator set. Generator set ratings: 80 kW, 100 KVA at 0.8 PF, standby rating, based on site conditions noted below. System voltage of: 480Y/277 Volts AC, Three-phase, Four-wire, 60 hertz. Site Conditions: Altitude 500 ft., ambient temperatures up to 100 degrees F.

2.1.1 Prototype Tests and Evaluation:

Prototype tests will have been performed on a complete and functional unit, component level type tests will not substitute for this requirement. Prototype testing will comply with the requirements of NFPA 110 for level 1 system.

2.1.2 Performance:

Voltage regulation will be +/- 1.0 percent for any constant load between no load and rated load.

Frequency regulation will 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 will not exceed plus or minus 0.25%.

The diesel engine-generator set will 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.

Motor starting capability will be a minimum of 368 KVA. The generator set will 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.

2.1.3 Engine:

The engine will be diesel, 4 cycle, radiator and fan cooled. Minimum displacement will be 359 cubic inches, with six cylinders. The horsepower rating of the engine at its minimum tolerance level will be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. Engine accessories and features will include:

An electronic governor system will provide automatic isochronous frequency regulation.

Skid-mounted radiator and cooling system rated for full load operation in 104 degrees F (40 degrees C) ambient as measured at the generator air inlet. Radiator will be provided with a duct adapter flange. The cooling system will be filled with 50/50 ethylene glycol/water mixture by the equipment supplier. Rotating parts will be guarded against accidental contact per OSHA requirements.

An electric starter, capable of three complete cranking cycles without overheating.

Positive displacement, mechanical, full pressure, lubrication oil pump.

Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.

An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element.

Replaceable dry element air cleaner with restriction indicator.
Flexible supply and return fuel lines.

Engine mounted battery charging alternator, 37 ampere minimum, and solid-state voltage regulator.

2.1.4 AC Generator:

The AC generator will 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 will meet NEMA MG1 temperature

limits for Class H insulation system. Actual temperature rise measured by resistance method at full load will not exceed 125 degrees Centigrade.

The generator will 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.

A permanent magnet generator (PMG) will be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls will 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

2.1.5 Engine-Generator Set Control:

The generator set will be provided with a microprocessor-based control system which is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system will also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification. The control will be mounted at the location shown on the project drawings for medium voltage applications, and on the generator set for 600 volt and lower applications. When mounted on the generator set the control will be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered. The control will be UL508 listed, CSA282-M1989 certified, and meet IEC8528 part 4. All switches, lamps and meters will be oil-tight and dust-tight, and the enclosure door will be gasketed. There will be no exposed points in the control (with the door open) that operate in excess of 50 volts. The controls will 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 will be tested and meet the requirements of IEEE587 for voltage surge resistance. The generator set mounted control will include the following features and functions:

2.1.5.1 Three position control switch labeled RUN/OFF/AUTO.

In the RUN position the generator set will automatically start, and accelerate to rated speed and voltage. In the OFF position the generator set will immediately stop, bypassing all time delays. In the AUTO position the generator set will be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.

2.1.5.2 Red "mushroom-head" push-button EMERGENCY STOP switch.

Depressing the emergency stop switch will cause the generator set to immediately shut down, and be locked out from automatic restarting.

2.1.5.3 Push-button RESET switch.

The RESET switch will be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.

2.1.5.4 Push-button PANEL LAMP switch.

Depressing the panel lamp switch will cause the entire panel to be lighted with DC control power. The panel lamps will automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

2.1.5.5 Generator Set AC Output Metering:

The generator set will be provided with a metering set with the following features and functions:

Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage will be available in line-to-line and line-to-neutral voltages, and will display all three phase voltages (line to neutral or line to line) simultaneously.

2.1.5.6 Generator Set Alarm and Status Message Display:

The generator set will be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamps will be high-intensity LED type.

The lamp condition will be clearly apparent under bright room lighting conditions. The generator set control will indicate the existence of the following alarm and shutdown conditions on a digital display panel:

- 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)
- over load (alarm)
- emergency stop (shutdown)

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

2.1.5.7 Engine Status Monitoring:

The following information will 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)

2.1.5.8 Control Functions:

The control system provided will include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings will be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.

The control system will 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 will be disabled.

The control system will include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control will 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 will be suitable for use in paralleling applications without component changes.

The control system will include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.

The control system will include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed senders or wiring components, and an actual failure conditions.

2.1.5.9 Alternator Control Functions:

The generator set will include an automatic voltage regulation system which is matched and prototype tested with the governing system provided. It will 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 will be equipped with three-phase RMS sensing and will control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system will include a torque-matching characteristic, which will reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator will include adjustments for gain, damping, and frequency roll-off. Adjustments will be broad range, and made via digital raise-lower switches, with an alpha-numeric LED readout to indicate setting level.

The voltage regulation system will include provisions for reactive load sharing and electronic voltage matching for paralleling applications. Motorized voltage adjust pot is not acceptable for voltage matching.

Controls will 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 will shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.

Controls will 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 will 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.

An AC over/under voltage monitoring system which responds only to true RMS voltage conditions will be provided. The system will 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 will occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

A battery monitoring system will be provided which initiates alarms when the DC control and starting voltage is less than 10VDC or more than 16 VDC. During engine starting, the low voltage limit will be disabled, and if DC voltage drops to less than 7 volts for more than two seconds a "weak battery" alarm will be initiated.

2.1.6 Base:

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

2.1.7 Generator Set Auxiliary Equipment and Accessories:

2.1.7.1 Water Jacket Heater

Engine mounted, thermostatically controlled, water jacket heater for each engine. The heater will be sized as recommended by the generator set manufacturer. Heater voltage will be as shown on the project

drawings. Provide proper power supply circuits for the heater as required for the voltage and load of the heater, connected to a normally served distribution circuit.

2.1.7.2 Vibration Isolation

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

2.1.7.3 Exhaust Silencer

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

2.1.7.4 Starting and Control Batteries

Starting battery bank, calcium/lead antimony type, 12 volt DC, sized as recommended by the generator set manufacturer, will be supplied for each generator set with battery cables and connectors.

2.1.7 Battery Charger

A UL listed/CSA certified 10 amp voltage regulated battery charger will be provided for each engine-generator set. The charger may be located in an automatic transfer switch, or may be wall mounted, at the discretion of the installer. Input AC voltage and DC output voltage will be as required. Chargers will be equipped with float, taper and equalize charge settings. Operational monitors will provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of:

- Loss of AC power - red light
- Low battery voltage - red light
- High battery voltage - red light
- Power ON - green light (no relay contact)
- Analog DC voltmeter and ammeter, 12 hour equalize charge timer, AC and DC fuses will also be provided on the charger.

2.1.7 Generator Set Main Circuit Breaker

Generator main circuit breaker: set-mounted and wired, UL listed, molded case type with electronic trip unit, rated at 150 amps, 3 pole, 480 volts. Submittals will demonstrate that the circuit breaker provides proper protection for the alternator by a comparison of the trip characteristic of the breaker with the thermal damage characteristic of the alternator. Field circuit breakers will not be acceptable for generator overcurrent protection.

2.1.7 Remote Annunciator:

Provide and install a 20-light LED remote alarm annunciator with horn, located as shown on the drawings or in a location which can be conveniently monitored by facility personnel. The remote annunciator will provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 system; and in addition will provide indications for high battery voltage, low battery voltage, loss of normal power to the charger. Spare lamps will 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 will be provided. Alarm silence and lamp test switch (es) will be provided. LED lamps will be replaceable, and indicating lamp color will be capable of changes needed for specific application requirements. Alarm horn will be switchable for all annunciation points. Alarm horn (when switched on) will sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2.

2.1.7 Outdoor Weather-Protective Housing

Generator set housing will be provided factory-assembled to generator set base and radiator cowling. Housing will provide ample airflow for generator set operation at rated load in the ambient conditions previously specified. The housing will have hinged side-access doors and rear control door. All doors will be lockable. All sheet metal will 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 will be primed and painted. The painting process will result in a coating which 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 will not be acceptable. Fasteners used will be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

2.1.7 Sub-Base Fuel Storage Tank

Provide a dual wall sub-base fuel storage tank with 150 gallons capacity. The tank will be constructed of corrosion resistant steel and will be UL listed. The equipment, as installed, will meet all local and regional requirements for above ground tanks.

End of Section 2 Products.