

208/120V, 3-Phase, 150kW
ENGINE GENERATOR

PART 1 GENERAL

1.1 SUMMARY

- A This section includes the following items from a single supplier:
 - 1. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
 - 2. Any exceptions to the published specifications shall be subject to the approval of the engineer and submitted minimum 10 days prior to the closing of the bid with a line by line summary description of all the items of compliance, any items that have been omitted or have been taken exception to, and a complete description of all deviations.
 - 3. It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
 - 4. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

1.2 SUBMITTALS

- A Action Submittals
 - 1. Product Data
 - a The submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.
 - 2. Shop Drawings
 - 3. Samples
- B Informational Submittal
 - 1. Certificates
 - a The generator set shall be listed to UL 2200 or submitted to an independent third party certification process to verify compliance as installed.
 - 2. Test and Evaluation Reports
 - 3. Manufacturer's Instruction
 - 4. Source Quality Control Submittals
 - 5. Field or Site Quality Control
 - 6. Manufacturer's Report
 - 7. Special Procedure Submittal
 - 8. Qualification Statement

- C Closeout Submittal
 - 1. Maintenance Contracts
 - 2. Operation and Maintenance Data
 - 3. Bonds
 - 4. Warranty Documentation
 - 5. Record Documentation
 - 6. Software
- D Maintenance Material Submittals
 - 1. Provide one (1) copy of the following documents and manuals for the engine, the alternator, and the generator set:
 - a) Operation Manuals
 - b) Parts Catalogs
 - c) Wiring Diagrams.

1.3 Quality Assurance

- A Regulatory Agency
 - 1. The generator set shall conform to the requirements of the following codes and standards:
 - a CSA C22.2, No. 14-M91 Industrial Control Equipment.
 - b EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.
 - c EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
 - d IEC8528 part 4, Control Systems for Generator Sets.
 - e IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
 - f IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
 - g NFPA 70, National Electrical Code, Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
 - h NFPA 99, Essential Electrical Systems for Health Care Facilities.
 - i NFPA 110, Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit. Component level type tests will not substitute for this requirement.
 - 2. Qualifications
 - a The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
 - b The power system shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.
 - 3. Manufacturers
 - a The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.
 - 4. Suppliers
 - 5. Fabricators
 - 6. Installers/ Applicators/ Erectors
 - 7. Testing Agencies
 - 8. Licensed Professional
 - 9. Certificates
 - 10. Preconstruction testing

11. Field and Site Samples
12. Mock-ups

1.4 Delivery, Storage, and Handling

- A Delivery and Acceptance Requirements
- B Storage and Handling Requirements
- C Packaging Waste Management

1.5 Field or Site Conditions

- A Ambient Conditions
 1. Engine- generator set shall operate in the following conditions without any damage to the unit or its loads.
 - a Ambient Temperature: 77 °F
 - b Altitude: 500 ft
 - c Relative Humidity: 95%
- B Existing Conditions

1.6 Warranty

- A Manufacturer's Warranty
 1. The generator set shall include a standard warranty covering five (5) years or 3000 hours, whichever occurs first, to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup.
 2. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

PART 2 PRODUCTS

2.1 Equipment

- A Equipment
 1. The generator set shall be a Kohler model 150REOZJF with a 4R13X alternator. It shall provide 193 kVA and 154.00 kW when operating at 120/208 volts, 60 Hz, 0.80 power factor. The generator set shall be capable of a 130°C Standby rating while operating in an ambient condition of less than or equal to 77 °F and a maximum elevation of 500 ft above sea level. The standby rating shall be available for the duration of the outage. The 150kW generator shall be wired for 208/120V, 3-Phase.
- B Engine
 1. The minimum 6.8 liter displacement engine shall deliver a minimum of 237 HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:
 - a. Electronic isochronous governor capable of 0.25% steady-state frequency regulation
 - b. 12-volt positive-engagement solenoid shift-starting motor
 - c. 65-ampere automatic battery charging alternator with a solid-state voltage regulation

208/120V, 3-Phase, 150kW ENGINE GENERATOR - 3

- d. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain
 - e. Dry-type replaceable air cleaner elements for normal applications
 - f. Engine-driven or electric fuel-transfer pump including fuel filter and electric solenoid fuel shutoff valve capable of lifting fuel
 - g. The turbocharged engine shall be fueled by diesel
 - h. The engine shall have a minimum of 6 cylinders and be liquid-cooled
 - 2. The engine shall be EPA certified from the factory
 - 3. The generator must accept rated load in one-step.
- C Cooling System
- 1. The engine shall be liquid-cooled by a closed loop, unit mounted radiator rated to operate the generator set at full load at an ambient temperature of 50 degrees C (122 degrees F). The radiator fan and other rotating engine parts shall be guarded against accidental contact.
- D Standard Air Cleaner
- 1. The air cleaner shall provide engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.
- E Battery
- F Housing
- 1. Sound Attenuated Enclosure
 - a The generator set shall be supplied with a Sound Attenuated Enclosure, providing a sound pressure of 75 dB(A) while the generator is operating at 100% load at 7 meters (23 feet) – free field – using acoustic insulation and acoustic-lined inlet hoods, constructed from high strength, low alloy 14 gauge galvanized steel. The acoustic insulation used shall meet UL 94 HF1 flammability classification. The enclosure shall be manufactured from bolted panels to facilitate service, future modifications, or field replacement. The enclosure shall use external vertical air inlet and outlet hoods with 90 degree angles to discharge air up and reduce noise. The enclosure shall have an integral rodent guard and skid end caps and shall have bracing to meet 241 kph (150 mph) wind loading.
 - b The enclosure components and skid shall be cleaned with a two-stage alkaline cleaning process to remove grease, grit, and grime from parts. Components shall then be subjected to a Zirconium-based conversion coating process to prepare the metal for electrocoat (e-coat) adhesion. All enclosure parts shall receive an 100% epoxy primer electrocoat (e-coat) with high-edge protection. Following the e-coat process, the parts shall be finish coated with powder baked paint for superior finish, durability, and appearance with a Power Armor™ industrial finish that provides heavy duty durability in harsh conditions, and is fade-, scratch- and corrosion-resistant.
 - c The enclosure must surpass a 3,000 hour salt spray corrosion test per ASTM B-1117.
 - d Enclosures will be finished in the manufacturer's standard color.
 - e The enclosures shall allow the generator set to operate at full load in an ambient temperature of 50°C with no additional derating of the electrical output of the generator set.
 - f Enclosures shall be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit breaker shall meet the requirements of the National Electric Code.
 - g Doors shall be fitted with hinges, hardware, and the doors shall be removable.
 - h Doors shall be equipped with lockable latches. Locks shall be keyed alike. Door locks shall be recessed to minimize potential of damage to door/enclosure.
 - i A duct between the radiator and air outlet shall be provided to prevent re-circulation of hot air.
 - j The complete exhaust system shall be internal to the enclosure.
 - k The critical silencer shall be fitted with a tailpipe and rain cap.
- G Fuel oil storage
- 1. Double Wall Secondary Containment Sub-base Fuel Tank

- a The generator set shall be supplied with a sub-base fuel tank of sufficient capacity to hold 583 gallons of diesel fuel.
- b The sub-base fuel system shall be listed under UL 142, subsection entitled Special Purpose Tanks EFVT category, and will bear their mark of UL Approval according to their particular classification.
- c The above ground steel secondary containment rectangular tank for use as a sub base for diesel generators is manufactured and intended to be installed in accordance with the Flammable and Combustible Liquids Code—NFPA 30, the Standard for Installation and Use of Stationary Combustible Engine and Gas Turbines—NFPA 37, and Emergency and Standby Power Systems—NFPA 110.
- d The primary tank shall be rectangular in shape and constructed in clam shell fashion to ensure maximum structural integrity and allow the use of a full throat fillet weld.
- e Steel Channel Support System. Reinforced steel box channel for generator support, with a load rating of 5,000 lbs. per generator mounting hole location. Full height gussets at either end of channel and at generator mounting holes shall be utilized.
- f Exterior Finish. The sub-base tank exterior finish shall be Power Armor Plus™, a polyurea-textured rubberized coating.
- g Normal venting shall be sized in accordance with the American Petroleum Institute Standard No 2000, Venting Atmospheric and Low Pressure Storage Tanks not less than 1-1/4" (3 cm.) nominal inside diameter.
- h The emergency vent opening shall be sized to accommodate the total capacity of both normal and emergency venting and shall be not less than that derived from NFPA 30, table 2-8, and based on the wetted surface area of the tank. The wetted area of the tank shall be calculated on the basis of 100 percent of the primary tank. The vent is to be spring-pressure operated: opening pressure is 0.5/psig and full opening pressure is 2.5 psig. The emergency relief vent is to be sized to accommodate the total venting capacity of both normal and emergency vents.
- i There shall be a 2" NPT opening within the primary tank and lockable manual fill cap.
- j A direct reading, UL listed, magnetic fuel level gauge with a hermetically sealed, vacuum tested dial, to eliminate fogging, shall be provided.
- k A float switch for remote or local annunciation of a (50% standard) low fuel level condition shall be supplied.
- l Inner Tank Leak Alarm Kit – Includes one light, one horn remote annunciator panel, leak alarm switch and wiring. This kit is intended when the inner tank has leaked into the outer tank, thus indicating a need for a replacement tank.

H Controller

1. Decision-Maker® 3000 Generator Set Controller
 - a. The generator set controller shall be a microprocessor based control system that will provide automatic starting, system monitoring, and protection. The controller system shall also provide local monitoring and remote monitoring. The control system shall be capable of PC based updating of all necessary parameters, firmware, and software.
 - b. The controller shall be mounted on the generator set and shall have integral vibration isolation. The controller shall be prototype and reliability tested to ensure operation in the conditions encountered.
2. Codes and Standards
 - a. The generator set controller shall meet NFPA 110 Level 1 requirements and shall include an integral alarm horn as required by NFPA.
 - b. The controller shall meet NFPA 99 and NEC requirements.
 - c. The controller shall be UL 508 listed.
3. Applicability
 - a. The controller shall be a standard offering in the manufacturer's controller product line.
 - b. The controller shall support 12-volt and 24volt starting systems.
 - c. The controller's environmental specification shall be: -40°C to 70°C operating

- temperature range and 5-95% humidity, non-condensing.
- d. The controller shall mount on the generator or remotely within 40 feet with viewable access.
4. Controller Buttons, Display and Components
- a. The generator set controller shall include the following features and functions:
 1. Push button Master Control buttons. The buttons shall be tactile-feel membrane with an indicator light to initiate the following functions:
 - a. Run Mode: When in the run mode the generator set shall start as directed by the operator.
 - b. Off/Reset Mode: When in the Off/Reset mode the generator set shall stop, the reset shall reset all faults, allowing for the restarting of the generator set after a shutdown.
 - c. Auto Mode: When in Auto the mode the generator set shall be ready to accept a signal from a remote device.
 2. Emergency Stop Switch. The remote stop switch shall be red in color with a "mushroom" type head. Depressing the stop button will immediately stop the generator set and lockout the generator set for any automatic remote starting.
 3. Push Button/Rotary Selector dial. This dial shall be used for selection of all Menus and sub-menus. Rotating the dial moves you through the menus, pushing the dial selects the menu and function/features in that menu. Pushing the button selects the feature/function and sub-menus.
 4. Digital Display. The digital display shall be alphanumeric, with 2 lines of data and approximately 24 characters. The display shall have back lighting for ease of operator use in high and low light conditions. The display shall display status of all faults and warnings. The display shall also display any engine faults. While the generator set is running, the display shall scroll all-important information across the screen for ease of operator use. The scroll can be stopped by pushing the rotary dial. The display shall fall asleep when the generator set is not running and will wake-up when the generator set starts or the rotary dial is depressed.
 5. Fault Light. The controller shall have an annunciator fault light that glows red for faults and yellow for warnings. These faults and warnings shall be displayed in the digital display. The fault light will also glow yellow when not in AUTO.
 6. Alarm Horn. The controller shall provide an alarm horn that sounds when any faults or warnings are present. The horn shall also sound when the controller is not in the AUTO mode.
 7. Alarm Silence/Lamp Test Button. When this button is depressed, it shall test all controller lamps. This button will also silence the alarm horn when the unit is not AUTO.
 8. USB Connection. The controller shall have a USB connection on the face of the controller. This connection shall allow for updating of all software and firmware. This port shall also allow for all servicing of generator set parameters, fault diagnostics and viewing of all controller information via use a laptop computer.
 9. Dedicated user inputs. The controller shall have dedicated inputs for remote emergency stop switch, remote 2-wire star for transfer switch and auxiliary shutdown.
 10. The controller shall have auto resettable circuit protection integral on the circuit board.
5. System Controller Monitoring and Status Features and Functions
- a. The generator controller shall display and monitor the following engine and alternator functions and allow adjustments of certain parameters at the controller:
 1. Overview menu

- a. Active shutdowns and warnings shall be displayed if present and without the need of operator interface
 - b. Engine runtime with total hours
 - c. Average line to line voltage
 - d. Coolant temperature
 - e. Fuel level or pressure
 - f. Oil pressure
 - g. Battery voltage
 - h. Software version
 - i. Frequency
 - j. Average current
- 2. Engine metering menu.
 - a. Engine speed
 - b. Oil pressure
 - c. Coolant temperature
 - d. Battery voltage
- 3. Generator metering menu.
 - a. Total power in VA
 - b. Total power in W
 - c. Rated power % used
 - d. Voltage L-L and L-N for all phases
 - e. Current L1, L2, L3
 - f. Frequency
- 4. Generator set information.
 - a. Generator set model number
 - b. Generator set serial number
 - c. Controller set number
- 5. Generator set run time.
 - a. Engine run time total hours
 - b. Engine loaded total hours
 - c. Number of engine starts
 - d. Total energy in kW
- 6. Generator set system
 - a. System voltage
 - b. System frequency 50/60Hz
 - c. System phase, single/three phase
 - d. Power rating kW
 - e. Amperage rating
 - f. Power type standby/prime
 - g. Measurement units, metric/English units adjustable
 - h. Alarm silence, always or auto only
- 7. Generator set calibration, the following are adjustable at the controller.
 - a. Voltage L-L and L-N all phases
 - b. Current L1, L2, L3
 - c. Reset all calibrations
- 8. Voltage regulation, +/-0.5% regulation, the following is adjustable at the controller.
 - a. Voltage Adjustable +/- 10%
- 9. Digital and Analog Inputs and outputs
 - a. Displays settings and status
- 10. Event Log
 - a. Stores event history, up to 1000 events
- 6. Controller Engine control features and functions
 - a. Automatic restart - the controller has automatic restart feature that initiates the start

- routine and re-crank after a failed start attempt.
 - b. Cyclic cranking - the controller shall have programmable cyclic cranking
 - c. Engine starting aid - the controller shall have the capability of providing control for an optional engine starting aid.
 - d. The control system shall include time delays for engine start and cool down.
 - e. The control system shall interface with the engine ECM and display engine fault codes and warnings. The ECM shall also include sender failure monitoring to help distinguish between failed senders and actual failure conditions.
 - f. The controller shall monitor and display engine governor functions with include steady state and transient frequency monitoring
- 7. Controller Alternator control features and functions
 - a. Integrated hybrid voltage regulator. The system shall have integral microprocessor based voltage regulator system that provides +/- 5% voltage regulation, no-load to full load with three phase sensing. The system is prototype tested and control variation of voltage to frequency. The voltage regulator shall be adjustable at the controller with maximum +/- 10% adjustable of nominal voltage.
 - b. AC output voltage regulator adjustment. The system shall allow for adjustment of the integral voltage regulator with maximum of +/- 10% adjustment of the system voltage.
 - c. Alternator thermal overload protection. The system shall have integral alternator overload and short circuit protection matched to each alternator for the particular voltage and phase configuration.
 - d. Power metering. The controller digitally displays power metering of kW and kVA.
- 8. Other control features and functions
 - a. Event logging. The controller keeps a record of up to 1000 events, for warning and shutdown faults. This fault information becomes a stored record of systems events and can be reset.
 - b. Historical data logging. The controller total number of generator set successful start shall be recorded and displayed.
 - c. Programmable access. The control system shall include a USB port that gives service technicians the ability to provide software and firmware upgrades. The system shall also be capable of allowing setting of all critical parameters using the service software and a laptop computer. All parameters and setting should be capable to being stored on a laptop for future upgrades of printing for analysis.
- 9. Generator Set Warning, Shutdown Alarm and Status
 - a. The generator set shall have alarms and status indication lamps that show non-automatic status and warning and shutdown conditions. The controller shall indicate with a warning lamp and or alarm and on the digital display screen any shutdown, warning or engine fault condition that exists in the generator set system. The following alarms and shutdowns shall exist as a minimum:
 - 1. Engine functions
 - a. Critical high fuel level (alarm)
 - b. ECM communication loss (shutdown)
 - c. ECM diagnostics (alarm & shutdown)
 - d. Engine overspeed (shutdown)
 - e. Engine start aid active
 - f. Engine under speed (shutdown)
 - g. Fuel tank leak (alarm & shutdown)
 - h. High DC battery voltage (alarm)
 - i. High coolant temperature (alarm & shutdown)
 - j. High fuel level (alarm)
 - k. Low DC battery voltage (alarm)
 - l. Low coolant level (shutdown)
 - m. Low coolant temperature (alarm)

- n. Low cranking voltage (alarm)
 - o. Low engine oil level (alarm & shutdown)
 - p. Low fuel level (alarm & shutdown)
 - q. Low fuel pressure (alarm)
 - r. Low oil pressure (alarm & shutdown)
 - s. No coolant temperature signal (shutdown)
 - t. No oil pressure signal (shutdown)
 - u. Overcrank (shutdown)
 - v. Speed sensor fault (alarm)
 - 2. Generator functions
 - a. AC sensing loss over & under current (alarm & shutdown)
 - b. Alternator protection (shutdown)
 - c. Ground fault input (alarm)
 - d. kW overload (shutdown)
 - e. Locked rotor (shutdown)
 - f. Over-frequency (shutdown)
 - g. Over AC voltage (shutdown)
 - h. Under-frequency (shutdown)
 - i. Under AC voltage (shutdown)
 - j. Emergency stop (shutdown)
 - 3. Other General functions
 - a. Battery charger fault (alarm)
 - b. Common fault (shutdown)
 - c. Common warning (alarm)
 - d. Master switch not in auto (alarm)
 - e. Generator running
 - f. Input/Output fault (alarm)
 - 4. The generator set controller shall also be capable of meeting all necessary NFPA 110 level 1 requirements that include several of the above along with; EPS supplying load, Master switch “not in auto”, and contacts for local and remote common alarm.
10. Communications
- a. If the generator set engine is equipped with an ECM (engine control module), the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards
 - b. Kohler proprietary RBUS communication shall be available.
 - c. A RBUS shall be able to monitor and alter parameters, and start or stop a generator.
 - d. The controller shall have the capability to communicate to a personal computer (IBM or compatible) and appropriate application software
 - e. A variety of connections shall be available based on requirements:
 - 1. A single control connection to a PC via USB
 - 2. Internet connection via Ethernet
 - f. Generator and transfer switch controls shall be equipped with communications modules capable of connecting to the same communication network.
- I Generator Overcurrent and Fault Protection
- 1. The generator shall be provided with a factory installed, 100% rated line circuit breaker rated at 400.00 amperes that is UL489 listed. Line circuit breakers shall be sized for the rated ampacity of the loads served by the breaker per the NEC.
 - 2. The circuit breaker(s) shall incorporate an electronic trip device with the following characteristics:
 - 3. Adjustable long time delay
 - 4. Adjustable short time delay *[As applicable]*
 - 5. Instantaneous

6. Load side lugs shall be provided from the factory. The line circuit breaker shall include auxiliary contacts, shunt trip, undervoltage trip, alarm switch, and overcurrent switch functionality. Load side breaker connections made at the factory shall be separated from field connections.
7. The shunt trip device shall be connected to trip the generator breaker when the generator-set is shut down by other protective devices.
8. When GFI is required per the NEC, additional neutrals shall be factory installed, and the alarm indication shall be integrated with the generator-set alarms.
9. Barriers to provide segregation of wiring from an emergency source to emergency loads from all other wiring and equipment, if required by the NEC, shall be provided.

J Alternator

1. The alternator shall be salient-pole, brushless, 2/3-pitch, with 4 bus bar provision for external connections, self-ventilated, with drip-proof construction and amortisseur rotor windings, and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a vacuum pressure impregnated, fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to 130°C Standby. The PMG based excitation system shall be of brushless construction controlled by a digital, three phase sensing, solid- state, voltage regulator. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.
2. The alternator shall have a maintenance-free bearing, designed for 40000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
3. The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.
4. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 406.00 LKVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip, i.e., engine, alternator, voltage regulator, and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.

K Vibration Isolation

1. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.

2.2 Accessories

- A. The generator shall be supplied with a thermostatically controlled strip heater to prevent the accumulation of moisture and dampness and to maintain the stator windings above the dew point. The heater shall be wired to be "on" at all times that the generator set is not operating.
- B. The generator shall be furnished with an externally mounted, recessed, emergency stop switch (break glass, pushbutton style) protected from accidental operation.
- C. The generator set shall be supplied with a thermostatically controlled strip heater to maintain the temperature of the batteries above 10° C, for the ambient temperature operating range specified under project conditions.
- D. The generator set shall be supplied with a 10-ampere automatic float/equalize battery charger capable of charging both lead-acid and ni-cad type batteries, with the following features:
 - i. Automatic 3-stage float to equalization charge
 - ii. Voltage regulation of 1% from no to full load over 10% AC input line voltage variations
 - iii. Battery charging current Ammeter and battery voltage voltmeter with 5% full-scale accuracy
 - iv. LED lamp for power ON indication
 - v. Current limited during engine cranking, short circuit, and reverse polarity conditions

- vi. Temperature compensated for ambient temperatures for -40°C to 60°C
 - vii. Alarm circuit board featuring alarm contacts for low battery voltage, high battery voltage, and battery charger malfunction.
 - viii. UL 1012 Listed
 - ix. CSA Certified
- E. The generator set shall be furnished with rodent guards to prevent rodent intrusion and protect internal components.
- F. Skid end caps – Steel plates will be installed on each end of the skid to close in and make the ends of the skid flush.
- G. The air cleaner restriction indicator shall indicate the need for maintenance of the air cleaners.
- H. The generator shall be equipped with a crankcase vent. The fumes coming from the vent (Blow-by) will need to be contained with the solids being separated and collected while the gases are being released back into the engine.
- I. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.
- J. The exhaust piping shall be gas proof, seamless, stainless steel, flexible exhaust bellows and includes the flex exhaust tube and the mounting hardware.
- K. Block Heater - The block heater shall be thermostatically controlled, 1,800 watt, 110-120 VAC - single phase, to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 99 and NFPA 110, Level 1.
- L. Supply flexible fuel lines to provide a flexible connection between the engine fuel fittings and the fuel supply tank piping and for the fuel return lines from the injector pump per engine manufacturer's recommendations. Flex line shall have a protective steel wire braid to protect the hose from abrasion.
- M. A radiator duct flange to provide a convenient connection to duct work for the radiator discharge air shall be included.
- N. The generator set shall be provided with a run relay which shall provide a three-pole, double-throw relay with 10-amp/ 250 VAC contacts to indicate that the generator is running. The run relay dry contacts can be used for energizing or de-energizing customer devices while the generator is running (e.g. louvers, indicator lamps, etc.)
- O. The generator set shall be supplied with a common failure relay to provide means of signaling fault and/or shutdown conditions.
- i. The common failure relay shall remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, overcrank, and over speed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts.
 - ii. The relay contacts shall be gold flashed to allow use of low current draw devices (100ma @ 28VDC min.).
 - iii. Once energized the relay shall remain latched until the system is reset by the main controller switch.
- P. Remote annunciator panel – The remote annunciator shall meet NFPA 110, Level 1 requirements and enable remote viewing of the generator status. The panel shall be connected to the generator controller via either network communication wires or via hard wired connections. Options shall be available to provide ATS source availability, contactor position, and loaded or unloaded test for up to four transfer switches. The panel shall have the capability to be either flush- mounted or surface-mounted. The annunciator shall meet UL508 requirements.
- Q. The controller must have the capability to communicate to a personal computer (IBM or compatible) running Windows '9X, Windows XT, Windows 7, Windows 8, or Windows NT.
- R. A variety of connections shall be available based on requirements:
- i. A single connection to a PC. A cable length of up to 1220 m (4000 ft) must be supported.
 - ii. Multiple devices at a single location connected to a PC.
 - iii. A single connection from a device to a PC over phone lines.
 - iv. Multiple devices to a PC over phone lines.
- S. When equipped with communications modules, transfer switches and power monitors along with generator set controllers must be able to be connected to the same communication network with no additional interfaces being required.

- T. The capability to connect up to 128 devices (generator set controls and transfer switches) on a single network must be supported.
- U. Cabling is to be device to device in a daisy chain fashion with no limitation on device locations within the network.
- V. The network must be self- powered. No power wiring between devices is allowed.
- W. A single software package with the following capabilities is required:
 - i. Any combination of transfer switches and generator set controls.
 - ii. Up to 128 devices at a single site must be supported.
 - iii. The same software package must support communications over phone lines. The software shall allow communications with up to 128 sites (phone numbers) including phone number fields large enough for International communication.
 - iv. Access to individual devices by the software shall be protected by password.
 - v. To support future expansion, it must be possible to add devices (ATS and generator set controllers), up to 128 and sites up to 128, with the installed software. Changing to a different software package is not acceptable.
 - vi. All displays, data inquires, and program functions allowed on the controllers, both generator set and ATS, shall also be available through the software.
 - vii. A single software screen must be capable of displaying data from multiple devices simultaneously.
 - viii. It shall be possible to reset shutdown faults, and restart the generator set using the software.
 - ix. If a transfer switch is used, it must be possible to start the generator set and transfer the loads to the generator.

2.3 Source Quality Control

A. Non-Conforming Work

- 1. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
 - a. **Design Prototype Tests.** Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
 - i. Maximum power (kW)
 - ii. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
 - iii. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
 - iv. Governor speed regulation under steady-state and transient conditions.
 - v. Voltage regulation and generator transient response.
 - vi. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
 - vii. Three-phase short circuit tests.
 - viii. Alternator cooling air flow.
 - ix. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
 - x. Endurance testing.
 - b. **Final Production Tests.** Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
 - i. Single-step load pickup
 - ii. Safety shutdown device testing
 - iii. Rated Power @ 0.8 PF
 - iv. Maximum power
 - v. Upon request, a witness test, or a certified test record sent prior to shipment.
 - c. **Site Tests.** The manufacturer's distribution representative shall perform an installation check, startup, and NFPA 110 load test. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:

- i. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
- ii. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
- iii. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
- iv. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.

B Non-Conforming Work

C Manufacturer's Services

D Coordination of Other Tests and Inspections

END OF SECTION