SECTION 16230

DIESEL ENGINE GENERATOR

PART 1 - GENERAL

1.1 SUMMARY

A. Work included in this Section:

1. Standby Power Engine Generator including load test.
2. Dual containment sub base fuel tank with fuel fittings.

1.2 REFERENCES AND STANDARDS

A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:

2. California Fire Code (CFC), Including Article 79 and Appendix II-F with Santa Clara County Amendments.
4. Underwriters Laboratories (UL) standards for above ground fuel tank.
8. Santa Clara County Environmental Resources Agency: Construction Guidelines Aboveground Fuel Storage Tanks for
specific requirements. (Santa Clara county exception requires separation of 10-ft. between buildings and generator fuel tanks).

9. Bay Area Air Quality Management District (BAAQMD) permit requirements in effect at time of bidding including air toxic limits in accordance with BAAQMD approved risk screen procedures.


11. NEMA MG1, Motors and Generators.


13. UL 1004B, Electric Motors and Generators.

14. UL 1236, Battery Chargers for Charging Engine- Starter Batteries.

15. UL 2200, Stationary Engine Generator Assemblies.

1.3 PERMITS (NEW SECTION)

A. Stanford EH&S must manage all permit submittals and correspondence with BAAQMD for the air permit. Contractor or project manager shall provide all necessary emission and other engine specifications required for permit application. In addition, contractor or Project manager shall provide the following to EH&S:

B. A map drawn to scale showing the location of the generator and all buildings within 500 foot radius.

C. Height of exhaust point above ground level

D. Diameter of exhaust

E. Orientation of exhaust (vertical or horizontal)

F. Submit a completed Emergency Generator Application form to the Utility Power Systems Manager. (Forms are available at http://lbre.stanford.edu/sem/electric_service)

1.4 SUBMITTALS

A. Mark all proposed deviations from Specifications prominently in the submittals. Indicate compliance with the Specifications except for specifically identified exceptions. Submittals that do not clearly indicate compliance with the Specification may be rejected. Bills of material that do not correspond with the Specifications are not sufficient to establish compliance.
B. Review of submittals is for general conformance to design concept and general compliance with Specifications. Review comments do not imply waiver of Specifications unless specifically noted.

C. The County of Santa Clara requires a Tank System Installation Supplement as part of the permit process. Provide a copy of the Supplement to the Project Manager.

D. Submittals Shall Include:

1. Shop Drawings:
   a. Front, plan and side elevations with overall dimensions.
   b. Conduit entrance locations and requirements.
   c. Electrical schematic and interconnection wiring diagrams for all equipment to be supplied. Clearly mark all termination points and indicate quantity/size of all field-installed wiring.
   d. Control panel with front elevation indicating all devices and instruments.
   e. Nameplate legend.
   f. Connection and support including weight.
   g. Electrical characteristics including KW/KVA, voltage, number of phases, RPM’s, overcurrent device ratings. Provide Manufacturers published transient response data of the complete engine generator set upon 50%, 75% and 100% block loads at .9 pf. Data shall include maximum voltage dips, frequency dips and recovery time periods.
   h. Make and model of output circuit breaker(s).
   i. Fuel tank showing all specified options and pipe connection locations.
   j. Provide kilowatt output curve, fuel consumption curve and airflow requirements for combustion, ventilating and radiator cooling air.
   k. Outdoor weatherproof equipment enclosures and accessories.
1. Certified test data stating that the complete unit was factory tested at the rated full load and power factor with ambient, altitude and fuel grade recorded.

m. Submit Manufacturer's installation instructions.

n. Complete bill of material listing all components.

o. Final test results.

p. Warranty.

2. Operation and Maintenance Manuals:

a. A detailed explanation of the operation of the system.

b. Instructions for routine maintenance.

c. Detailed instructions for repair of the engine generator set and other major components specified in this Section.

d. Pictorial parts list and part numbers.

e. Pictorial and schematic electrical drawings of wiring systems, including operating and safety devices, control panels, instrumentation and annunciators.

f. Telephone numbers for the authorized parts and service distributors.

g. Include all service bulletins and torque Specifications for all terminations.

h. Final testing reports.

3. Color sample for enclosure for approval when non-standard color is specified.

4. Mounting details and seismic calculation information for anchorage of the generator and tank assembly.

5. Operating check and test reports of the generator, tank, and transfer switch.

6. Engine block heater electrical requirements.

7. Certified Air Emissions Specifications in accordance with EPA, California Air Resources Board and BAAQMD requirements. EPA engine Family Number.
8. University and Santa Clara County Fire Marshal approval letter for the fuel tank.

1.5 PRODUCT DELIVERY AND HANDLING

A. Delivery: Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner. Components shall be properly packaged in factory-fabricated containers and mounted on shipping skids.

B. Handling: Handle in accordance with Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

1.6 FACTORY TESTS:

A. Engine generator set shall be completely factory tested under rated full load and rated power factor for performance and proper functioning of control and interfacing circuits. Test shall be a minimum of 2 hours or time required reaching operating temperature. Testing at unity power factor only (resistance only banks) is not acceptable.

B. In addition to the above, provide the following minimum factory tests:

1. Monitor voltage regulation.

2. Verify transient and steady state governing.


4. Monitor engine operating parameters: Coolant temperature, oil pressure, etc.

5. Operate safety shutdowns.

6. Test alternator to determine that they are free of mechanical and electrical defects. Tests shall include the following:
   a. Resistance of all windings (cold).
   b. Insulation resistance of all windings.
   c. High potential on all windings.
   d. Open circuit saturation.
   e. Voltage balance on windings.
f. Current balance on windings.
g. Voltage transient at rated KVA (voltage regulation, stability and response).
h. Regulator range test (voltage adjust).
i. Phase sequence.
j. Mechanical balance (vibration).
k. Inherent voltage regulation.
l. Circulating current.
m. Dissipation factor tests.

7. The above tests shall be conducted in accordance with IEEE-115, NEMA MG-1 and MIL-STD 705 standards. Dissipation factor tests shall be performed per IEEE Std. 286.

C. All operational and alarm functions shall be factory tested prior to shipping to the field. All alarm functions shall be field tested after installation.

D. Record all factory test data on approved Manufacturers log format and submit to Engineer for review.

1.7 WARRANTY

A. A full one-year warranty is required for all parts and equipment (generator set, transfer switch, battery, etc.). Warranty shall begin upon acceptance by the Owner.

1.8 MAINTENANCE

A. Extra material:

1. Special tools: Provide to the Owner the special tools required for routine maintenance.

2. Provide one spray can of matching finish paint for touching up damaged surfaces after installation.

B. Maintenance Service:

1. Provide a two year Manufacturer's maintenance contract of the engine generator system. The two year period shall begin from the date of Owner's acceptance. During this period, Manufacturer's
maintenance staff shall visit the installation not less than 8 times for routine inspection and preventive maintenance. The maintenance visits shall be scheduled at 3 month intervals and shall be coordinated with the Owner and performed at times selected by the Owner. A written report of each maintenance visit shall be submitted to the Owner within 10 days. The Manufacturers shall submit a preventative maintenance schedule outlining in detail the following:

a. Time when services are to be performed.
b. Work to be performed.
c. Shutdowns required for service.
d. Company or Contractor support services required.

2. The contract shall include, but not be limited to, the following:

a. Engine generator Manufacturer's recommended procedures for weekly inspection and maintenance to be done by user.
b. Quarterly inspections by the Supplier personnel to review the weekly maintenance record being kept by user and train any new Owner operating personnel.
c. Annual inspection shall include all of items in above paragraph and shall also include a 100% load test. The Supplier shall provide System load bank and load bank cables.

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

A. System shall consist of diesel engine-generator set in a sound attenuated weatherproof enclosure complete with all necessary controls, protection, wiring, and accessories to provide an electrical standby source that will be activated automatically and attain rated speed and voltage, accept load, and be able to supply continuous electrical service within ten seconds in the event of utility power failure and maintain electrical service to selected critical loads.

B. All materials, equipment and parts comprising the units specified herein, shall be new, unused, of current manufacture, and of highest grade.

C. It is the intent that the engine-generator manufacturer furnishes all accessories required for operation of the set and compliance with codes whether specifically mentioned or not.
D. System may require a diesel particulate filter system to meet Bay Area Air Quality Management District limits on diesel particulate emissions. The Contractor shall consider the potential need for this equipment when designing enclosure and sound attenuation provisions, as well as accessibility for system maintenance.

E. Acceptable products:


2. Cummins/Onan: c/o Cummins West, Inc., 1601 Aurora Drive, San Leandro, CA 94577; (510) 351-6101.

F. Generator Set Characteristics:

1. Voltage: __408Y/277, 3Φ or __208Y/120, 3Φ

2. Standby KW: ____

3. Standby KVA: ____

4. Power Factor: 0.8

5. Frequency: 60Hz at 1800 rpm.

G. The specified standby KW shall be for continuous electrical service during interruption of the normal utility source. These ratings must be substantiated by manufacturer’s published curves. Special ratings or maximum ratings are not acceptable.

H. Engine generator set shall be capable of producing the KW/KVA rating as indicated on the Drawings continuously at 500 feet above sea level, 104°F ambient temperature (120°F max., 40°F min.) and with 100% rated load.

I. Provide anti-corrosive and anti-rust coatings on all components subject to corrosion or rust.

2.2 ENGINE

A. The engine shall be diesel-fueled, liquid-cooled with integrally mounted radiator, fan and coolant pump.

B. Full pressure lubrication shall be supplied by a positive displacement gear design lube oil pump. The engine shall have coolant and oil filters with replaceable elements; lube oil cooler, air filters and a fuel pump.
C. Engine speed shall be governed by an electronic governor to maintain isochronous alternator frequency from no-load to full-load alternator output with the following characteristics:

1. Stability: +/- 0.25% of rated frequency at any constant load from no load to full load.
2. Droop: 0% (isochronous) to 10% (adjustable).
3. Recovery time: 6 seconds upon application or removal of full load.
4. Frequency: Modulation shall not exceed one cycle per second.
5. Protection: Include protection from voltage spikes and reverse polarity.

D. Safety Devices: Safety shut-offs for high coolant temperature, low oil pressure, over-speed and engine over-crank shall be provided with signal lights and alarm terminals. Engine lube oil shall be supplied by the manufacturer.

E. Emissions: Contractor shall include design, specifications and pricing for an optional diesel particulate control system, such as a filter. The system must reduce diesel particulate emissions by at least 85%, and must be certified by the California Air Resources Board (CARB). The system design shall include equipment for measuring pressure drop differential across the filter (back pressure) to aid in determining when maintenance is required. The engine and emissions control system shall also meet all other applicable Federal, State and BAAQMD emission limits for all other pollutants. All applications for BAAQMD air permits must be managed by Stanford EH&S.

F. Jacket water heater: Thermal circulation type water heater sized to maintain the engine jacket water at 90° F in an ambient temperature of 40° F. Heater shall be controlled by an integral adjustable thermostat, which shall be automatically deactivated while engine generator is running.

G. Cylinder liners for generators 200kW and larger: Provide removable wet type cylinder liners of close-grained alloy iron.

2.3 COOLING SYSTEM

A. Provide an engine-mounted cooling system consisting of a radiator, pump, fan and thermostat control. Air shall draw from engine side and exhaust through radiator core with no more than 0.5 inches of water external restriction in addition to core restriction.
B. Anti-freeze: The engine cooling system shall be filled with a solution of 50% ethylene glycol. Supplier shall provide all required coolant and anti-freeze.

C. Provide shut-off valves arranged for replacement of the block heaters without draining the radiator.

D. Provide suitable guards on all moving parts of cooling system to meet safety requirements.

2.4 FUEL SYSTEM

A. General:

1. Fuel: Diesel No. 2 fuel oil having 35 degree API (16°C or 60°F) specific gravity.

2. Provide fuel pressure gauge and hand-operated auxiliary priming pump.

3. Engine shall be equipped with all pumps, filters, lines, etc., necessary to supply fuel to the engine. The engine fuel pump shall have adequate capacity to lift fuel at least 96-inch. Individual fuel injectors shall be provided for each cylinder.

4. Provide a fuel/water separator to protect the fuel system from water damage.

5. Provide oversize heavy-duty fuel filter.

6. The fuel transfer pump, injection pumps, rack and pinion assembly and timing mechanism shall be maintenance free for the life of equipment.

7. Flexible fuel lines shall be installed between the engine and the sub-base tank to isolate vibration.

8. Provide fuel oil cooler for fuel returning to tank in order to maintain temperature within acceptable limits to allow engine to operate at full rated horsepower.

B. Fuel Tank:

1. Furnish an integral double contained, UL labeled fuel tank in a sub-base or free standing tank with sufficient fuel for at least 24 hours of full load operation except capacity shall not exceed 1320 Gallons. Tanks exceeding 660 gallons shall be protected type. Underground tanks are not permitted. The tank shall meet
requirements of the Santa Clara County and the University Fire Marshall. Fuel tank shall be constructed of heavy gauge steel. Epoxy coated inside, rust proofed and finish painted outside. Construction shall meet earthquake resistance requirements. Fuel tank shall have NPT threaded pipe connections of required size for fill, drain, vent, overflow, engine suction, engine fuel return, etc. The unit shall include:

a. Complete fuel connections including flexible supply and return lines.

b. Fuel level gauge complete with probes to indicate fuel level. Mount gauge such that it is visible from fuel tank filling inlet.

c. Low fuel level local alarm and contacts for remote annunciation and low-low fuel level for engine shutdown:

1) Low level alarm: Separate low fuel level float switch alarm with local red indicating light and separate auxiliary DPDT dry contacts for remote alarm monitoring. Terminate contacts on a labeled terminal strip. Set low-level alarm at tank half full level.

2) Low-low level and engine generator shutdown: Separate float switch for engine generator shutdown. This switch shall shutdown the engine generator before the fuel tank is sucked dry to prevent "air locking" the fuel injectors. Set activation level for just above the fuel supply intake line to the engine. Provide local red indicating light and separate auxiliary DPDT dry contacts for remote alarm monitoring. Terminate contacts on a labeled terminal strip.

d. Provide tank with a 2-inch manual fill port with camlock fitting. Tanks with capacity exceeding 500 gallons shall have automatic overfill prevention system to limit maximum fill to 95% of tank capacity.

e. Rupture basin with leak detector, local annunciation, and provisions for remote monitoring of primary containment failure. Separate float switch in dual containment basin to sense presence of fuel due to leak or rupture of inner tank. Provide with local red indicating light and separate
auxiliary DPDT dry contacts for remote alarm monitoring. Terminate contacts on a labeled terminal strip.

f. Fill basin with five gallon overfill containment capacity. UL listed, with internal reservoir and normally closed UL listed drain port.

g. Local high fuel level alarm and separate DPDT dry contacts for remote alarm monitoring.

h. Provide normal and emergency venting according to the CFC and Santa Clara County requirements. Normal vent shall terminate 10 feet above tank or 12 feet above grade minimum. The vents shall terminate outside the enclosure.

i. Acceptance pressure test in the field after the unit is installed and before fuel is added according to Santa Clara county requirements.

2. Auxiliary diesel fuel tanks or “day” tanks and their associated pumps and controls are not recommended, due to increased complexity and opportunity for failure. Wherever possible, main fuel tanks should sit above ground directly beneath the diesel engine generator in integral secondary spill containment. Auxiliary diesel fuel tanks or “day” tanks, if required, must be reviewed and approved during Project schematic design by Environmental Health and Safety and the responsible facilities maintenance organization.

2.5 EXHAUST SYSTEM

A. Exhaust Silencer: Provide critical grade silencer including flexible exhaust fitting and rain cap, properly sized for exhaust backpressure and noise levels and installed, according to the manufacturer’s recommendations. Silencer shall be mounted per the following requirements:

1. The exhaust silencer shall be mounted on the roof of the engine generator set weatherproof housing. Coordinate to maintain a minimum height requirement above roof. The exhaust piping shall discharge in the horizontal direction toward the radiator end with a 45-degree cutoff to minimize noise or shall discharge in the vertical direction with a rain cap.

2. The silencer shall be supported by means of supports provided on the weatherproof housing so that its weight is not supported by the engine. These supports shall not interfere with access doors or routine maintenance procedures.
3. Post-fabrication treatment: The exhaust silencer, piping, support system and hardware shall be spray paint black color with a silicone-based, heat-resistant to 1200 degrees F, anti-corrosive, VOC compliant, water-soluble. All components shall be coated and heat cured in accordance with Manufacturer’s directions prior delivery to the Project site and field assembly. Touch-up paint marred surfaces immediately after assembly. Manufacture: Aremco Corr-Paint #CP4000, SermaGard or approved equal.

4. Silencers shall be maxim series M51, Nelson Level 400 or approved equal.

B. Discharge: The termination point for the exhaust discharge into the atmosphere shall be according to the UMC but not less than ten feet above the adjacent grade.

C. Particulate Filter: See 2.2 E.

2.6 AUTOMATIC STARTING SYSTEM

A. Starting Motor: A 24V DC electric starting system with positive engagement drive.

B. Automatic Controls: Provide fully automatic generator set start-stop controls in the generator control panel. Controls shall provide shutdown for low oil pressure, high water temperature, over-speed, over-crank, and one auxiliary contact for activating accessory items. Control shall include two means of automatic starter cutout upon starting. The starter shall crank the engine for three, 15 second on - 15 second off, periods (45 seconds of cranking) before activating the overcrank lock-out device. Engine shall start and transfer load within 10 seconds. Starting shall be initiated by a remote dry contact closure at the transfer switch.

C. Battery: Provide lead-acid batteries capable of delivering manufacturer’s recommended minimum cold cranking amps sized to allow continuous cranking of the engine for six 15 second on - 15 second off periods (90 seconds of cranking) in a 40° F. ambient temperature and maintain a minimum cell end voltage of 1.75 volts per cell. Provide battery mounting, rated for Seismic Zone 4, within the weatherproof enclosure, rack mounted on the engine generator set frame. The rack shall be as manufactured by the Battery’s Manufacturers.

1. Batteries shall be SAB Nife, ALCAD, Delco, Trogan or approved equal.

2. Provide all interconnecting bars and extra-flexible locomotive cables with the batteries and high compression, circumferentially crimp type lugs.
3. Locate batteries as close as possible to the starter.

D. Battery charger shall be of the fully automatic, two rate type, constant voltage current limiting, with automatic high rate charge timer, voltmeter and ammeter. Locate battery charger within the generator switch enclosure.

1. 24V DC output, 120V AC, solid state, input transistor controlled, constant voltage, battery charger suitable for the lead-acid batteries specified. The output current shall be current limited to 120% of maximum and shall not require a cranking disconnect relay.

2. Provide 5% accurate DC ammeter and 5% accurate DC voltmeter to indicate rate of charge on front door of unit.

3. Input and output shall be fused.

4. Unit shall not discharge battery when AC power fails.

5. Unit shall operate and be capable of fully charging the starting batteries while the engine generator set is running and shall be capable of returning to the fully discharged battery 100 percent of its ampere-hour rating within 24 hours.

6. The charger shall float the batteries at 2.17 to 2.20 volts per cell and equalize them at 2.33 to 2.35 volts per cell.

7. Unit shall be sized to accommodate all control panel loads, such as meters and indicating lights, in addition to battery charging requirements.

8. Unit shall be Sens model #CC-FS-24V, sizes as required (min. 10 amp) or approved equal.

9. The following accessories shall be included:

a. Low DC battery voltage alarm relay. Contacts, 120 VAC, 10 amperes. Alarm shall be locked out during engine cranking.

b. High DC battery voltage alarm relay. Contacts, 120 VAC, 10 amperes.

c. AC input power failure alarm relay contacts, 120 VAC, 10 amperes.

d. DC current failure alarm relay contacts, 120 VAC, 10 amperes.
e. Hermetically sealed semiconductors and integrated circuits.

f. Ambient temperature compensation circuit.

g. Green power on indicator light.

10. Wire alarm relays #a and #b above together in parallel so that any one or both will remotely annunciate as "High or Low Battery Voltage".

11. Wire alarm relays #c and #d above together in parallel so that any one or both will remotely annunciate as "Battery Charger Malfunction".

2.7 GENERATOR:

A. Type: Generator shall be a three phase, 60Hz, with brushless exciter, built to NEMA standards. Class F insulation (NEMA MG1-1.65) shall be used on the stator and rotor. The generator shall be suitable for linear and non-linear loads (such as UPS). The generator shall be drip-proof, random wound, tropicalized construction type with amortisseur windings in the pole faces of the rotating field. Generator shall not provide greater than 5% total harmonic distortion. Generator shall be capable of sustaining a three phase load of 300% rated current for 10 seconds and sustain 150% of continuous load current for two minutes with field set for normal rated load excitation.

B. Stator Insulation:

1. All insulation materials used in the stator shall have a minimum temperature rating of Class 155 degrees C (Class F) per IEEE Std. 1. The coils shall be of a form random wound coil construction using a magnet wire meeting NEMA MW36-C Specifications.

2. Turn-to-turn testing shall be performed on all stator windings per IEEE Std. AA 522 prior to impregnation. A high-potential test shall be conducted on the stator prior to impregnation per IEEE Std 115.

3. The complete stator shall be processed in a Vacuum Pressure Impregnation (VPI) chamber or wet wound.

C. Rotor Construction:

1. The rotor shall be of the fully laminated, salient pole type.
2. Low resistance amortisseur bars shall be inserted through slots in the field poles and brazed/welded to a continuous shorting ring to complete the damping circuit.

3. Cooling fans shall be an integral part of the rotor assembly.

4. The rotor shall have accessible provisions for bolt-on balancing weights.

5. All insulation materials used in the rotor shall have a minimum temperature rating of Class 155 Degrees C (Class F) per IEEE Std. 1. The poles shall be of a layer wound construction using a magnet wire meeting NEMA MW35-C or MW36-C Specifications.

6. A high-potential test shall be conducted on the rotor prior to impregnation per IEEE Std. 115.

7. The complete winding and rotor pole assembly shall be processed in a Vacuum Pressure Impregnation (VPI) chamber.

D. Brushless Exciter System:

1. The exciter shall be a high frequency, direct connected, rotating brushless type, three phase, full wave rectified, surge protected and shall be matched with the generator rotor and control system.

2. The rotating part of the exciter, including the rectifier assembly, shall rotate together with the alternator rotor as a complete assembly on one shaft.

3. Both the armature and field windings shall be Vacuum Pressure Impregnated (VPI) with Epoxy resin.

4. The brushless exciter shall be compatible with the voltage regulator.

5. The automatic voltage regulator shall be supplied with the alternator, a complete solid-state type.

E. Overspeed: The system shall be free of injurious torsional and bending vibrations within a speed range from 10% below to 10% above synchronous speed. The rotor assembly shall demonstrate 125% overspeed capability at 170o C. for 2 hours. Rotor dynamic, two-plane balance shall not exceed 0.002-inch peak-to-peak amplitude at operating speed. All rotating components shall be secured with SAE Grade 8 hardware.
F. Drive configuration: The generator shall be of the single bearing design type. It shall have an adapter and disc type coupling suitable for direct connection to the standard SAE flywheel and bell housing of the engine.

G. Bearings: The bearing shall be of a re-greasable, single row, ball bearing design.

H. Regulator: A generator mounted volts-per-Hz type temperature compensated solid state regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be +/-2% from no load to full rated load. Readily accessible voltage drop, voltage level and voltage gain controls shall be provided. Voltage level adjustment shall be a minimum of +/- 5%. The solid state regulator module shall be shock mounted and protected against atmospheric deterioration. The regulator shall have the following performance characteristics:

1. Generator output voltage drift no more than +/- 1/2% of rated value at constant temperature.

2. Generator output voltage drift no more than +/- 1% of rated value over ambient temperature range of -40°C to 70°C.

3. Transient overvoltage shall not exceed 25% upon removal of 80% of full load at .8 pf. with recovery in less than 2 seconds.

4. Telephone Influence Factor (TIF) of less than 50.

5. Electronic Interference/Radio Frequency Interference (EMI/RFI) suppressed to commercial standards.

6. The regulator shall include the following features:

   a. Automatic gain adjustment shall provide output voltage compensation for changes in load or frequency.

   b. At full throttle engine starting, output voltage shall not overshoot more than 5% of its rated value, with respect to the volts/Hz curve.

   c. Response time shall be less than seventeen milliseconds.

   d. Protection shall be provided against loss of voltage sensing and long-term overcurrent conditions. The overcurrent protection function shall automatically reset when the regulator is de-energized. The regulator shall not be damaged or result in unsafe operation when subjected to open or shorted input due to sensing loss or in short to
ground or adjacent conductor. Fast blow fuses shall be included in two of the sensing leads to fully protect the regulator. The regulator shall also include internal protection for under frequency, over voltage and over excitation.

e. The regulator module shall be sealed in a waterproof and air-proof shock resistant plastic housing and shall withstand:

1) Temperatures between -20° to 70°C.

2) Vibration of 4.5 G's (peak) between frequencies of 18 to 2000 Hz in three perpendicular planes and mechanical shock of 20 G's in all three planes.

3) Salt spray as described by MIL-STD - 810C, Method 509.1 and ASTM-B117.

f. If SCR's are used within the regulator, isolating circuits shall be included to prevent the harmonic distortion from building load SCR's interfering with the triggering of the regulator SCR's.

g. The voltage regulator "burned-in" period shall be a minimum of 24 hours.

I. Transient Response: The maximum voltage dip shall not exceed the specified percent as defined by NEMA MG1-16.48 and the generator set with proposed engine shall be rated for a maximum of 25% voltage dip upon application of any size load, up to 60 percent of full load. The voltage shall recover to and remain within the steady state band in not more than 5.0 seconds.

J. Generator Accessories:

1. (For units below 600kW) The generator shall contain a series boost circuit that shall sustain generator output at 300% rated current for a minimum of 10 seconds and maximum of 16 seconds before automatically removing power to the exciter field.

2. (For units above 600kW) The generator shall contain a permanent magnet excitation system that shall derive excitation current from a pilot exciter mounted on the rotor shaft. It shall enable the generator to sustain 300% of rated current into any phase-to-phase or phase-to-neutral short circuit for 10 seconds. The circuitry shall remove excitation after 10 seconds for overload conditions in excess of 150% of full rated current.
K. Generator Control Panel:

1. Type: A generator mounted vibration isolated dead front control panel shall be provided.

2. The 24 VDC starting batteries shall power all indicating lights and shutdown controls.

3. The controls must maintain accuracy and be capable of operating at the reduced voltage levels during cranking and at the higher voltage levels imposed by the battery charger and temperature extremes of 40°F to 125°F.

4. All control relays shall be industrial control grade with gold flashed contacts rated for low voltage DC circuits.

5. True RMS sensing meters shall employ non-linear converting circuits and shall be capable of at least a 5:1 peak to RMS ratio to insure accuracy.

6. Current and potential transformers, where used shall be 0.3% accuracy class and selected and coordinated to cause meter deflections in the top 25% of meter scale for nominal and rated values.

7. The control panel shall consist of the following indicators and equipment mounted logically and symmetrically on the face of the panel:

   a. Voltmeter, True RMS sensing AC. Digital or switchboard type with 1% accuracy, 4.5 inch, 250° scale.

   b. Ammeter, True RMS sensing AC. Digital or switchboard type with 1% accuracy, 4.5 inch, 250° scale.

   c. Combination ammeter and line to line voltmeter four position phase selector switch: Phase A, Phase B, Phase C and off.

   d. Frequency Meter, 2% accuracy based on 10% waveform distortion from non-linear loads. (55 to 65 Hz with 1/10 Hz divisions).

   e. Automatic starting controls, as specified in 2.6 above.

   f. Panel illumination lights and switch.

   g. Voltage level adjustment rheostat, (+/- 5%).
h. Fault indicators for low oil pressure, high water temperature, over-speed and over-crank.

i. Fault indicator for “not-in-auto” that initiates “common trouble”.

j. Four position function switch marked "auto", "manual", and "stop"

k. Running time meter.

l. Indicating lights as follows:

<table>
<thead>
<tr>
<th>ALARM/STATUS</th>
<th>LAMP COLOR</th>
<th>HORN ALARM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Low Oil Pressure:</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Oil Pressure:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Pre-high Jacket Water Temperature:</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>High Jacket Water Temperature:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Jacket Water Temperature (&lt;70°F):</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>Overspeed:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Overcrank:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Emergency Stop:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Fuel Level (Day tank):</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>Battery Charger Malfunction:</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>(AC power failure or current failure)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Ready:</td>
<td>Green</td>
<td>No</td>
</tr>
<tr>
<td>Not-In-Auto:</td>
<td>Red/Flash</td>
<td>Yes</td>
</tr>
<tr>
<td>(Also for tripped or open generator output breaker)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low or high DC Battery Voltage:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Coolant Level:</td>
<td>Yellow</td>
<td>Yes</td>
</tr>
<tr>
<td>Particulate Filter High Pressure (if installed)</td>
<td>Amber</td>
<td>Yes</td>
</tr>
</tbody>
</table>

m. Single pushbutton for testing all indicating lamps.

n. Elapsed hour meter. (non-resettable, 5 digit)

o. The control panel shall also contain the following items:

1) Fuel pressure gauge.
2) Engine oil pressure gauge.
3) Engine water temperature gauge.
4) Three Form C dry contacts for engine running.
a) One for ventilation fan on/off control.
b) One for remote annunciation.
c) One to interface the UPS control system.
d) One spare.

5) Two Form C dry contacts for common failure.

6) Engine shutdown relays for low oil pressure, high water temperature, overspeed, overcrank and emergency stop.

7) Three position function switch, "AUTO," "OFF/RESET," and "RUN."

8) All required fuses, current and potential transformers.

9) Emergency "STOP" red mushroom-head pushbutton. Provide one additional, identical "stop" pushbutton with plastic safety guard and all required interface provisions for remote mounting. Provide engraved nameplate "Generator Emergency Off." Mounting, conduit and wire to the remote pushbutton will be provided under this contract. Operation of emergency off pushbutton shall be annunciated at control panel.

10) A fault-reset function shall be provided to clear fault indications and allow restarting of the engine after the shut-down faults has been corrected. The control design shall be such that the fault indication shall remain until reset. The fault-reset function shall operate only when the function switch is in the "OFF/RESET" position.

11) Alarm horn with silencing button. After silencing, alarm shall automatically sound again if another alarm condition develops. "ON/OFF" switch is not acceptable.

8. Provide a break glass type “Emergency Shut Off” station in a weatherproof enclosure on the exterior of the unit.

L. REMOTE MONITORING
1. Provide dry contacts (Normally Closed, Open on Alarm) at a terminal strip for the following user connected individual remote alarms:
   a. Common Trouble (All trouble indicators including “Not in Auto and remote “Ground Fault”).
   b. Primary Tank or Fuel Line Leak.
   c. Engine Running.
   d. Low Fuel Level.

2.8 DIESEL FUEL MONITORING SYSTEM

A. Fuel monitoring panel (FMP): Panel shall be Pneumercator #LDE-700, Farmingdale, New York or approved equal. Panel shall contain the following components:
   1. NEMA 1 enclosure.
   2. Digital display of tank level in gallons.
   3. Low-level LED.
   4. High-level LED.
   5. Leak detection LED’s (two required, one for main tank and one for double walled fuel lines).
   6. Two SPDT dry relay contacts for remote reporting of alarm conditions to the EMCS system.
   7. (Optional for critical generators) Provide a LON type analog fuel level sensor interface for continuous remote monitoring of the fuel tank level.

B. Sensors: Fuel leak and level sensors shall be Pneumercator or approved equal as follows:
   1. Leak sensor: Pneumercator #9-902 or approved equal.
   2. Fuel level sensor: Pneumercator #2-412 or approved equal (insert fuel tank level remote monitoring sensors and LON type analog connection required to coordinate with remote monitoring section above).

2.9 CABLE ENTRY:
A. Provide a terminal box arranged to accept conduit connections stubbed up through the pad. Provide sufficient wire bending space and terminals for compression type connectors. Construction shall comply with NEMA and IP44 for protection against solid bodies greater that 1 mm and water splashing. It shall include three rigidly mounted bus-bar of tin-plated copper with terminals and one isolated neutral bus-bar, all suitable for the termination of the generator output feeder, size and quantity as noted on the Drawings.

2.10 ACCESSORIES

A. Wiring and Conduit: Engine generator control wiring shall be multi-strand, plastic insulated cable resistant to heat, abrasion, oil, water, antifreeze and diesel fuel. Each cable shall be heat stamped throughout the entire length to identify the cable's origin and termination. Cables shall be enclosed in nylon flexible conduit that is slotted to allow easy access and moisture to escape. Reusable bulkhead fittings shall be used to attach the conduit to generator mounted junction boxes.

1. Provide all termination with spade or ring crimp type terminals. All termination points on terminal blocks shall be permanently and neatly labeled.

B. Grounding:

1. Provide factory installed, code sized grounding conductor from the generator ground pads to the engine generator frame and to a grounding lug in the load termination junction box sized to accept the number of ground conductors in the feeder conduits as indicated on the Drawings. Provide factory installed grounding lug, adjacent to the load termination junction box and a code sized grounding conductor from the generator neutral. The lug shall be used for field connection to the grounding electrode conductor as indicated on the Drawings.

C. Nameplates: The alternator shall have a non-corrosive stainless steel nameplate with not less than the minimum information called for in NEMA publication number MG1.

2.11 MAIN LINE CIRCUIT BEAKER: (TO BE PROVIDED UNLESS OTHERWISE SPECIFIED)

A. Provide one generator mounted, three-pole molded case circuit breaker as a load circuit interrupting and protection device. It shall operate both manually for normal switching function and automatically during overload and short circuit conditions.
B. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection.

C. Provide standard lugs on the load side of the circuit breaker. Mount in a code sized junction box with sufficient room for incoming cables. Provide high-pressure crimp type cable lugs and Belleville washers on studs for feeder termination. Provide one, form C, auxiliary contact rated 120 VAC, 10 amps to annunciate as "NOT-IN-AUTO" at the control panel and at the remote annunciator panel when the breaker is in the open or tripped position.

2.12 LOAD BANK CIRCUIT BREAKER:

A. Provide one generator mounted, three-pole insulated case circuit breaker for connection of a portable load bank. Provide a “load dump” trip feature to disconnect the load bank if the generator is activated for emergency service. The circuit breaker shall operate both manually for normal switching function and automatically during overload and short circuit conditions.

2.13 LOAD BANK CONNECTION:

A. Provide a dead front load bank connection panel connected to the load side of the load bank circuit breaker with Cooper/Crouse-Hinds Cam-Lock® E1016 Series, 400 amp female connectors, one per phase (brown, orange, yellow or all black and marked: Aф, Bф, Cф, and one ground (green).

2.14 ENGINE GENERATOR SET MOUNTING:

A. The engine-generator set shall be mounted with integral vibration isolation on a structural steel base for direct anchoring to concrete pad. If spring isolators are recommended by the manufacturer, they shall be factory installed between the base of the generator set and the top of the sub-base fuel tank. The entire assembly shall be braced to withstand seismic forces calculated for UBC, Seismic Zone 4 with importance factor $I_P = 1.5$.

1. The vibration isolators shall have a minimum rated deflection of 1" and shall be selected based on the actual load at each mounting point of the unit ultimately installed. Springs shall have a minimum additional travel of 50% of rated deflection and shall have a seismic withstand capability of 1.0 "G" acceleration in all directions. Furnish unit complete with non-skid neoprene acoustical isolation pad, pre-drilled anchor bolt holes and mounting nuts. Supplier shall submit earthquake mounting design data.
2. Vibration isolators shall be Mason Industries, Inc. or approved equal.

B. Seal the sub-base fuel tank at the pad to avoid corrosion and accumulation of debris under the tank.

C. Locate the anchor holes so they are accessible and will accommodate the installation of drilled-in anchor bolts.

2.15 ENCLOSURE:

(FOR UNITS BELOW 800KW)

A. The complete diesel engine generator set, including generator control panel, engine starting batteries and fuel oil tank, shall be enclosed in a factory assembled, sound attenuated enclosure mounted on the fuel tank base.

1. A weather resistant, sound attenuated enclosure of steel with electrostatically applied powder coated baked polyester paint. The enclosure shall have a resulting sound level of ___db @____ft with the genset running under full load. It shall consist of a roof, side walls, and end walls. Fasteners shall be either zinc plated or stainless steel.

2. Enclosure Sound Attenuation: Acoustical foam shall be provided between all supports and inside doors and sound baffles on air intake and air discharge.

3. The color of the enclosure shall be black, Kelly Moore 1245-407 acrylic low sheen “carbon” or equal. Submit paint chip for approval prior to fabrication

(FOR UNITS ABOVE 800kW)

B. The entire engine generator set, including batteries, battery charger, fuel tank, engine generator control panel, space heaters, DC and AC lights and duplex outlet, shall be housed in a sound attenuated, weather-protective, housing. All steel parts shall be chemically cleaned, treated and painted to provide a rust resistant finish. All mounting hardware shall be galvanized steel.

C. Sound Attenuation: dBa level: 75 dBa at 23-ft (confirm)

1. Air intake: Locate at enclosure rear; air enters through sound attenuators.
2. Radiator air discharge: Exit enclosure through a 90-degree sound attenuated discharge plenum.

3. Insulation material: Mineral wool. Secured to enclosure interior surfaces causing a galvanized perforated liner.

4. Insulate enclosure roof, side panels and doors.

5. Do not insulate louvered openings.

D. Provide vertical cooling air discharge.

E. Provide a receiver with absorbent material for crankcase ventilation discharge. The unit shall not drip or discharge oil in any manner.

F. Openings in the enclosure shall be well secured, fully lockable, and tamper resistant including the fuel filler. The weatherproof housings shall have hinged lockable access doors on all sides for complete access. Provide a latch for each door to insure adequate closing pressure to seal against weather.

G. Provide two 50 watt, 24-volt DC, industrial-grade, enclosed and gasketed dome lights, connect to batteries. Provide two 120 VAC industrial grade enclosed and gasketed 100 watt incandescent lights. Locate one of each over the engine generator and one of each over the control panel. Provide one 0 - 60 minute, no-hold manual timer switch for each group. Mount the switches by the control panel.

H. One 120 VAC duplex outlet with weatherproof cover. Connect to 120 volt AC light circuit.

I. Provide “Emergency Stop” weatherproof, oil tight break glass, operator with Hammer on the exterior of the enclosure.

J. The enclosure shall be shipped with and attached to the unit so that additional installation is not required.

K. The weatherproof housing roof shall have built-in supports of sufficient size and quantity to completely support the exhaust silencer(s).

L. The weatherproof housings shall be provided with lifting eyes.

M. The color of the enclosure shall be black, Kelly Moore 1245-407 acrylic low sheen “carbon” or equal. Submit paint chip for approval prior to fabrication.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Contractor shall thoroughly examine Project site conditions for acceptance of engine generator installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 PREPARATION

A. Insure all conduit stub-ups for bottom entry into engine generator are in place and located as required per Shop Drawings.

B. Where noted on the Drawings provide a 4-inch high concrete housekeeping pad beneath equipment. Coordinate actual sizes of equipment base with approved Shop Drawings and extend pad 4 inches in all directions beyond overall dimension of base. Provide reinforcing bars as required structurally within pad to insure proper support of equipment.

3.3 INSTALLATION

A. Entire installation shall be according to manufacturer’s instructions, a copy of which shall be submitted the Project Manager in advance of installation.

B. Generator set with integral base tank shall be located at least 10-ft. from any building; notify Project Manager if the Drawings show otherwise or if a conflict is discovered in the field.

C. Maintain clearance from exhaust piping to combustible materials according to the UMC.

D. Engine generator set shall be anchored and braced to withstand seismic forces.

E. Engine generator power conduits and conductors: Contractor shall remove bottom of main load termination junction box and stub-up conduits directly into box. Provide ground bonding bushings with insulated throats and code sized grounding conductor from each conduit to engine generator ground terminals.

3.4 FIELD START-UP AND TESTING

A. After installation equipment shall be subjected to an eight-hour test at unity power factor to show that it is free of defects and will start and transfer load automatically. Use a load bank for full load test and use actual connected loads to verify proper operation of the system.

B. Perform a field pressure test of the sub-base tank before fuel is added.
C. Provide a Final Acceptance Test, coordinated by the Contractor, and performed in the presence of the Santa Clara County Fire Marshal, the University Fire Marshal, the County Hazardous Materials Official, and the Project Manager.

D. Manufacturer's field service: Contractor shall arrange and pay for the services of a factory-authorized service representative to supervise the initial start-up, pretesting and adjustment of the emergency generator. Minor adjustments, if required, shall be performed by the services representative before the Engineer’s witnessed test.

E. Independent testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing, calibration and inspection required herein. Independent Testing Agency shall meet the requirements as outlined in Section 16010: Basic Electrical Requirements. Testing Agencies objectives shall be to:

1. Assure engine generator installation conforms to specified requirements and operates within specified tolerances.

2. Field test and inspect to insure operation in accordance with Manufacturer's recommendations and Specifications.

3. Prepare final test report including results, observations, failures, adjustments and remedies.

4. Apply label on engine generator upon satisfactory completion of tests and results.

5. Verify ratings and settings and make final adjustments.

6. Verify operation of remote monitoring at EMCS.

F. Engineer witnessed testing: Allow a period of 4 hours per engine generator for Engineer review and final check. This review shall be done when the engine generator is de-energized, therefore plan accordingly.

G. At least three weeks prior to any testing notify the Engineer so that arrangement can be made for witnessing tests, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the Engineer's witnessed test.

H. The Contractor shall supply a suitable and stable source of electrical power to each test site including full-load rated load banks and cables. The Testing Agency shall specify the specific power requirements.

I. Contractor shall verify with Mechanical Engineer, prior to energizing building emergency loads, that all time delays and building/energy
management system programs for controlling large emergency mechanical motor loads are set. This is to insure that those large motors will be sequentially added to the engine generator, after a time delay and to prevent an out-of-phase condition during transfer to emergency power.

J. Prefunctional testing:

1. Provide Testing Agency with Contract Documents and Manufacturer instructions for installation and testing.

2. Visual and mechanical inspection:
   a. Compare nameplate information and connections to Contract Documents.
   b. Inspect for physical damage, defects, alignment and fit.
   c. Inspect correct anchorage and grounding.
   d. Inspect air baffles, filter media and cooling fans.
   e. Check tightness of all control and power connections.
   f. Check that all covers, barriers and doors are secure.
   g. Confirm correct application of Manufacturer’s recommended lubricants.
   h. Perform mechanical operational tests in accordance with Manufacturer's instructions.

3. Pretesting:
   a. Insulation resistance tests of buses, components, feeders and branch circuit conductors and control circuits.
   b. Continuity tests of circuits.
   c. Start-up test (no load):
      1) With prime mover in a "cold start" condition and all building emergency loads at normal operating level, initiate a normal power failure by opening all switches or breakers supplying the normal power to the building or facility. Test load shall be that load which is served by the emergency power system.
      2) Observe and record the time delay on start.
3) Observe and record the cranking time until the prime mover starts and runs.

4) Observe and record the time required coming up to operating speed.

5) Record voltage and frequency overshoot.

6) Perform phase-rotation test to determine compatibility with load requirements.

7) Observe and record time required achieving steady-state condition with all switches transferred to the emergency position.

8) Record voltage, frequency and amperes for each phase.

9) Verify correct functioning of governor and regulator.

10) Verify function and temperature regulation for battery and engine heaters.

11) Record prime mover oil pressure, water temperature and battery charge rate at 5-minute intervals for the first 15 minutes and at 15-minute intervals thereafter.

12) Perform vibration baseline test. Plot amplitude versus frequency for each main bearing cap.

13) Continue load test with building load for one hour, observing and recording load changes and the resultant effect on voltage and frequency.

14) Return normal power to the building or facility, record the time delay on retransfer to normal for each automatic transfer switch (set for 30 minutes) and the time delay on prime mover cool-down period (set at 5 minutes) and shutdown.

15) After completion of the start-up test the engine generator set shall be allowed to cool for 5 minutes.

4. Electrical tests:

   a. Full-load test:
1) A load shall be applied for an eight hour full-load test. Provide load banks of sufficient size to provide a load equal to 100 percent of the generator's KW rating.

2) Upon reaching 90% of rated voltage and 95% of rated frequency the transfer switch(es) shall transfer the 100 percent full-load to the engine/generator set.

3) Record the data listed in start-up test items 5), 6), 7), and 8) above at first load acceptance and every 15 minutes thereafter until the completion of the eight hour test.

4) After seven and one half-hours close all switches or breakers serving the transfer switches to allow an automatic engine generator cool-down period and shutdown.

5) This full load test shall not result in activation of the high temperature pre-alarm or high temperature shutdown.

b. Cycle crank test: Utilize any method recommended by the Manufacturer to prevent the prime mover from running. Put the control switch into the "RUN" position to cause the prime mover to crank. Verify the three 15 second crank/15 second rest cycles and the subsequent overcrank lockout alarm. Immediately reset the lockout alarm and repeat the test to verify that the batteries supported the six: 15-second crank, 15-second rest periods (90 seconds of cranking). Record battery DC voltage as indicated on the battery charger at beginning and end of test.

c. Alarm/shutdown safety check:

1) General: Verify and record that all alarms and indicating lights function at both the remote annunciator panel and the control panel. Verify and record proper lockout/resets.

2) Verification of the following alarms shall be done by manually closing the relay contacts with the engine stopped.

   a) Low water temperature.

   b) Pre-high engine water temperature.
c) High engine water temperature.
d) Pre-low engine oil pressure.
e) Low engine oil pressure.
f) Overspeed.
g) Low fuel level.
h) Battery charger malfunction (Current failure alarm relay in the battery charger).
i) Low DC voltage in the batteries (Disconnect in the battery lead).
j) Fuel leak.
k) Low coolant level.

3) Perform the following verifications with the engine stopped.

a) Disconnect AC power to battery charger to verify "Battery Charger Malfunction" indicating lights.

b) Place control switch in the "off/reset" position to verify "NOT-IN-AUTO" flashing red indicating lights.

c) Open generator output circuit breaker to verify flashing red "NOT-IN-AUTO" indicating lights.

d) Ground fault alarm indicating lights using the test switch.

d. Emergency stop safety check:

1) Open engine generator output circuit breaker. Place generator control switch in "RUN" position.

2) After engine generator is running for 2 minutes press the emergency stop button. Verify and record engine shutdown.

3) Close the engine generator output breaker.
e. Allow for final load bank testing, as specified above, after receipt of the approved pre-final test results from the Electrical Engineer. This final testing is to be done in the presence of the Owner. Give two weeks prior notice to commencement.

K. Functional performance testing:

1. Open all switches or breakers serving the normal power terminals on the automatic transfer switches to initiate the transfer to emergency power sequence and record the following:
   a. Time delay between the loss of normal power to the ATS and the start of the generator.
   b. Total elapsed time between the loss of normal power to the ATS and restoration of power to the ATS from the generator.
   c. Generator output amps, voltages, and KW values.

2. Close all switches or breakers serving the normal power terminals on the automatic transfer switches to initiate the transfer back to utility power sequence and record the following:
   a. Total elapsed time between the restoration of normal power to the ATS and transfer from generator to normal power.
   b. Engine cool down time.

L. In the event that the system fails to function properly during the testing as a result of inadequate pretesting or preparation. The Contractor shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and the Engineer's hourly rate.

M. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.

N. Contractor shall submit the Testing Agency's final report to the Engineer for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

3.5 FUEL AND OIL
A. Provide sufficient fuel for testing and leave the tank full at the conclusion of the tests. Use a good quality fuel as recommended by the engine manufacturer.

B. Provide all recommended lubricants.

3.6 SIGNS

A. Provide a permanent, engraved sign at the main switchboard indicating type and location of the emergency power source. The wording shall be substantially as follows: EMERGENCY POWER SERVICE IS PROVIDED TO AN AUTOMATIC TRANSFER SWITCH SERVING PANELS (provide panel identification) FROM AN EMERGENCY GENERATOR LOCATED AT (provide location).

B. Provide a permanent placard identifying the fuel tank contents in 1” letters as: COMBUSTIBLE LIQUID – DIESEL FUEL and provide a NFPA 704 diamond identification (10”x10”) sign for diesel fuel (Health Hazard 0, fire Hazard 2, Reactivity 0).

C. Provide one standard sign: “NO SMOKING OR OPEN FLAME”

D. Provide Stanford Generator identification number (EGD-nnn). Apply for generator number through Stanford Utilities.

3.7 REMOTE MONITORING BY CAMPUS EMCS:

A. The four alarm points described in sections 2.7.L and 2.8.A shall be monitored by the Campus Energy Management and Control System (EMCS). Provide cable, conduit, and connections for EMCS except that termination of the Contractor installed cable at the EMCS panel will be by Stanford. Coordinate connection and testing of the alarms with the Project Manager.

B. Wiring: connect Alarm Points at generator set for EMCS with one 18 AWG, eight pair overall shielded cable, Belden 1057A. Cables shall be continuous and without splices between the generator set and the EMCS panel. Do not ground drain wires at generator set panel. See drawing ES-12.

C. Wire Labels: All instrument and output device wiring shall be labeled at both ends and within 2” of the end at the generator set panel. Labels are required for pairs, and not for individual conductors. Labels shall be machine printed with indelible ink on heat shrinkable plastic tubing (Brady Sleeve Wiremaker Label WMS-211-319). Label information will be provided by Project Manager.

3.8 FIRE EXTINGUISHER:
A. Contact the Project Manager and arrange for the installation of a fire extinguisher in a weatherproof enclosure, furnished and installed by Stanford. The extinguisher shall be rated 2A:20-BC and installed within 30-ft. of the generator.

3.9 CLEANING

A. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean both the interior and exterior of engine generator per Manufacturer's approved methods and materials. Remove paint splatters and other spots, dirt and debris.

B. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

3.10 TRAINING

A. Factory authorized service representative shall conduct a 4 hour training seminar for Owner's Representatives upon completion and acceptance of system. Instructions shall include safe operation, maintenance and testing of equipment with both classroom training and hands-on instruction.

B. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION