SECTION 16640

DIESEL-DRIVEN STANDBY ELECTRIC GENERATING SYSTEM

PART 1 - GENERAL

1.01 INTENT

A. It is the intent of these specifications to secure for the purchaser a generator set of the latest commercial design, together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein. Major system components including the generator set, fuel tank, maintenance agreement, and the automatic transfer switch specified in section 16641, shall be provided by one equipment supplier who shall be responsible for the compatibility of the components and warranty for all items. The equipment supplied and the installation shall meet the applicable requirements of the latest editions of the following codes and regulations:

1. California Administration Code (CAC)
   - CAC Title 24 — State of California Administration Code, Title 24, Building Standards
   - CAC Title 19 — State of California Administration Code, Title 19, Public Safety

2. Code of Federal Regulations (CFR)
   - CFR 1910 — Occupational Safety and Health Standards

3. Electrical Generating Systems Association (EGSA)
   - EGSA 100B — Performance Standard for Engine Cranking Batteries Used with Engine Generator Sets
   - EGSA 100C — Performance Standard for Battery Chargers for Engine Starting Batteries and Control Batteries
   - EGSA 100D — Performance Standard for Generator Overcurrent Protection 600 Volts and Below
   - EGSA 100E — Performance Standard for Governors on Engine Generator Sets
   - EGSA 100F — Performance Standard for Engine Protection Systems
   - EGSA 100G — Performance Standard for Generator Set Instrumentation, Control and Auxiliary Equipment
   - EGSA 100M — Performance Standard for Multiple Engine Generator Set Control Systems
   - EGSA 100S — Performance Standard for Transfer Switches for Use with Engine Generator Sets
   - EGSA 100T — Diesel Fuel Systems for Engine Generator Sets with Above Ground Steel Tanks

4. International Conference of Building Officials (ICBO)
   - ICBO UBC — Uniform Building Code

5. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
   - IEEE 115 — Synchronous Machines

IEEE 126	Speed governing of internal Combustion Engine-Generator Units
IEEE 421.1	Definitions for Excitation Systems for Synchronous Machines
IEEE C37.2	Electrical Power System Device

6. National Electrical Manufacturers Association (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 volts Maximum)
NEMA AB 1	Molded Case Circuit Breakers and Molded Case Switches
NEMA MG 1	Motors and Generators
NEMA PB 2	Dead front Distribution Switchboards
NEMA/ICS 1	Industrial Control and Systems
NEMA/ICS 2	Controllers, Contactors and Overload Relays, Rated not more than 2000 Volts AC or 750 Volts DC
NEMA/ICS 2-447	Standard for Automatic Transfer Switches
NEMA/ICS 6	Industrial Control and Systems Enclosures

7. National Fire Protection Association (NFPA)

NFPA 20	Centrifugal Fire Pumps
NFPA 30	Flammable and Combustible Liquids Code
NFPA 37	Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	National Electrical Code
NFPA 70B	Electrical Equipment Maintenance
NFPA 99	Health Care Facilities
NFPA 101	Life Safety Code
NFPA 110	Emergency and Standby Power Systems

8. Underwriters Laboratories Inc. (UL)

UL 142	Steel Above Ground Tanks
UL 429	Electrically Operated Valves
UL 489	Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 1008	Automatic Transfer Switches
UL 1236	Battery Chargers for Charging Engine-Starter Batteries
UL 2200	Stationary Engine Generator Assemblies

9. Regional Codes and Regulations
   County of Riverside Noise Ordinance
   Air Pollution Control District Rules and Regulations for South Coast Air Quality Management District

B. All equipment shall be new, of current domestic production of a national firm which manufacturers the engine-generator set as a matched unit, and whose quality control program complies with ISO Standards and that is certified to ISO-9001. The manufacturer together with its authorized local representative shall have full responsibility for the performance of the generator set and its accessories. Unit shall be designed for outdoor installation.

C. Supplier shall maintain a parts and service facility within 65 miles of the installation site, employ factory trained technicians, and offer 24-hour emergency service. Supplier shall be the authorized dealer of a manufacturer offering standard production equipment built and prototype tested in accordance with NFPA 110, and shall be authorized to administer the warranty for all components of the emergency generator system specified herein.

1.02 SUBMITTALS

A. Submittals shall be provided in sufficient detail to demonstrate compliance with these specifications. As a minimum, the submittal shall be bound, provided with an index to cross-reference the submittal item and page location, marked to indicate the specific item to be provided, and include the following data. Specifically identify any deviation to the specification with an explanation.

1. Bill of Material, covering all equipment submitted.

2. Qualifications of the engine-generator manufacturer and of the authorized distributor. ISO-9001 certification. 24-Hour emergency service capability.

3. Manufacturer's published rating sheet. NFPA-110 prototype test verification. Altitude and temperature derating procedures. Frequency and voltage regulation. Cooling system capability. Full rated load pickup capability. UL 2200 compliance verification. Verification of seismic certification.

4. Installation requirements: radiator airflow and back pressure capacity, combustion air requirement, fuel consumption, fuel circulation, heat rejection, exhaust flow, exhaust back-pressure calculations, battery requirements. Floor layout dimensional data with provision for cable entry and termination.

5. Engine performance data. Configuration, cubic inch displacement, rated RPM, type of aspiration, voltage of electrical system, oil and coolant capacities, exhaust volume and temperature.

6. Exhaust emission data provided on the current application form for the air quality agency having jurisdiction. Exhaust and crankcase emission control equipment devices.

7. Battery set and battery charger.

8. Generator performance data. Motor and load starting capability verification. Temperature rise and insulation classification. Short circuit sustaining capability. Over-voltage safety shutdown. Decrement curve for specific voltage specified.

9. Output circuit breaker size, manufacturer, model, and trip curve for 10 second short-circuit capability.

10. Control panel features and performance. Meters and gauges. Safety alarm and shutdown devices. Cranking control. Indicator lamps and horn. Control switches. Rodent protection.

11. Exhaust silencer attenuation rating.

12. Jacket water heater system, including isolation valves.

13. Fuel system. Alarm and indicator devices. Dimensional data. Shutoff valves, fuel strainer, and flexible hose. Fuel purifier.

14. Fuel storage system. Compliance with UL-142. Alarm and indicator devices. Dimensional data. Fuel capacity and hours of operation possible. Seismic restraint devices and calculations for fuel tank.

15. Weather enclosure, with sound attenuation.

16. Seismic restraint devices. Agency pre-qualification. Dimensional data. Seismic restraint calculations. Seismic certification of the generator set, fuel tank, and enclosure.

17. Automatic transfer switch performance data. Agency acceptance. Withstand current rating. Standard and optional features included. Dimensional data.

18. Schematic and wiring diagrams for all major components. Interconnection diagram for all major components.

19. Testing procedure.

20. Warranty certificate and administration authorization.

21. Two-year maintenance services agreement. Verification of insurance coverage.

1.03 RATING

A. Unit shall be rated at 250 KW, 0.8 PF, 313 KVA, for continuous standby operation during any utility power failure. Rating shall be verified by published specification sheets of its nationally recognized manufacturer. Generator set shall be capable of accepting rated load in one step in accordance with NFPA-110 Para. 3-5.3.1.

B. System voltage shall be 277/480, 3 phase, 4 wire, 60 Hertz, with full load current capacity of 376 amps.

C. Generator set design specified here is based upon Kohler Co. Generator Set Model 250REOZJD/4UA10 as supplied by Bay City Electric Works, Lakeside/Riverside, California. Equipment of equal quality and performance by Caterpillar or Cummins will be considered by the engineer until 7 days prior to bid date. Acceptance by the engineer for bid purposes in no way relieves the contractor from meeting the performance features specified herein.

1.04 ENGINE

A. The engine shall be 4-cycle, direct connected to the generator by a semi-flexible coupling, and both shall be mounted on a common sub-base. The engine shall have sufficient power to produce the specified rating when operating at generator synchronous speed with all accessories required for normal operation including exhaust, fuel, cooling, and battery charging systems. Maximum engine speed shall be 1800 RPM. The engine shall have a pressure lubrication system and replaceable element oil filter. The engine oil drain shall be piped to the outside of the skid base and provided with a stainless steel ball-valve to facilitate draining.

B. The engine shall be equipped with a fuel system suitable for operation on DF-2 diesel fuel with a sulfur content not to exceed 0.05 percent by weight. Fuel system shall include an engine driven transfer pump, replaceable filter, fuel purifier, and flexible fuel lines. Fuel system shall comply with the requirements of NFPA-37 and NFPA-110 Paragraph 5-9.

1. Diesel fuel purifier system shall be the heavy-duty centrifugally driven type and shall be furnished in addition to the filtration system furnished by the engine manufacturer. The purifier system shall be designed to help prevent the formation of rust in the fuel. The unit shall be rated to remove particles of and 95 percent of solid type contaminants in the fuel. The unit furnished shall be located in the fuel system as the first protective device after the fuel leaves the fuel tank. Unit

furnished shall have an electric heater element to help prevent diesel fuel gelling in winter operation. The heater shall be rated at a maximum of 100 watts and be the 24-volt DC type to operate only when the engine is running. Power source for the heater shall be the engine's 24-volt system. The system furnished shall not require the replacement of any type of filter element or any other internal parts. System shall be RCI diesel fuel purifier, or equal.

2. Provide flexible fuel lines rated for duty at 300 degrees Fahrenheit and 100 psi.

C. The engine cooling system shall be designed to provide adequate cooling at 250kW rating in ambient temperatures up to 122 degrees Fahrenheit. The system shall system shall meet the performance requirements of NFPA-110 Para. 5-8.1. Provide a low water level shutdown device.

D. The engine governor shall maintain frequency within a +/-0.25 percent band under steady state conditions and isochronous from no-load to full load. Regulation shall be as defined by IEEE Std 126-1959/83. Governor performance shall comply with EGSA 100E.

E. Starting shall be by means of a solenoid operated positive engagement gear driven electric starter for operation on 12 or 24 volt D.C. Note the cycle-crank requirement specified within the generator control panel. Provide a primary and a secondary means of cranking termination in accordance with NFPA-110 Para. 3-5.4.2.

F. Engine protective devices shall meet the performance requirements of EGSA 100F and shall include the following:

1. Overcrank - lockout
2. Low oil pressure - preliminary alarm
3. Low oil pressure - shutdown
4. High water temperature - preliminary alarm
5. High water temperature - shutdown
6. Low water temperature - alarm
7. Low water level - shutdown
8. Overspeed - shutdown
9. Low fuel level - alarm

G. Provide vibration isolators installed between the base assembly and the foundation.

H. Engine crankcase emissions shall be filtered to prevent oil mist from contaminating the engine space and to comply with Air Pollution Control District requirements for visible emissions. Filters shall be of the closed cycle type. Filter shall be sized for the allowable crankcase back pressure established by the engine manufacturer.

1.05 BATTERY SET

A. A lead acid battery set shall be provided and installed in a base mounted rack provided with seismic restraints. Provide battery cables as required for the installation. System voltage shall match that of the starter. Cold-cranking amperage capacity shall conform with the requirements of SAE Standard J-537 for zero degrees Fahrenheit. Performance of the battery system shall comply with EGSA 100B.

1.06 BATTERY CHARGER

A. An automatic float/equalize type battery charger shall be provided, for installation within the generator room. Connections to the battery shall be solid wired (clip-on type clamps not acceptable). Input voltage shall be 120 volts AC. Charger shall be UL listed. Output capacity shall be a minimum of 10 amps. Battery charger shall meet the performance requirements of EGSA 100C, and shall include the characteristics required by NFPA-110 Para. 3-5.4.6. DC voltage regulation shall be within +/-1 percent from no load to full load and over an AC input line voltage variation of +/-10 percent.

B. Features of the charger and/or generator controller shall include the following:

1. Automatic "float-to-equalize" operation, with individual potentiometer adjustments.

2. "Power on" lamp to indicate when charger is operating.

3. DC voltmeter and DC ammeter, 5 percent full scale accuracy.

4. Reverse polarity protection.

5. AC input and DC output fuse protection.

6. Automatic current limiting protection.

7. Battery charger failure alarm contacts, set to close if AC power is lost to charger.

8. Low and high battery voltage alarm contacts, set to close if battery voltage drops below 90 percent or rises above 110 percent of rated.

C. Battery charger enclosure shall be hermetically sealed construction and arranged for convection cooling.

1.07 GENERATOR

A. The generator shall be 4-pole, revolving field, with rotating brushless or static exciter. It shall have a solid state voltage regulator, 3-phase sensing, capable of maintaining voltage within +/-0.25% percent at constant load from 0-100 percent of rating with 0.5 percent drift due to temperature variation. Voltage regulator shall be of the volts-per-hertz type and NFPA-110 requirement for 100% load pickup shall be met. The regulator shall be sealed from the environment and isolated from the load to prevent tracking when connected to SCR loads. Voltage regulator shall meet the performance standards of EGSA 100R.

B. Generator shall be self-ventilated of drip-proof construction with amortisseur rotor winding and skewed for smooth voltage waveform. The insulation material shall meet the NEMA standard (MGI-22.40 and 16.40) for Class H and be vacuum impregnated with epoxy varnish to be fungus resistant per MIL I-24092. Temperature rise shall be as defined by NEMA standard (MG1-22.40 and 22.85) and shall not exceed 130 degree C.

C. On application of any load up to 100 percent of the rated load, the instantaneous voltage dip shall not exceed 20 percent and shall recover to steady state conditions within five second. The generator shall be capable of sustaining a minimum of 300% of rated current for at least 10 seconds under a 3 phase symmetrical short by inherent design or by the addition of an optional current boost system. The generator, having a single maintenance free bearing, shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel. Peak motor starting capacity shall be at least 785 kVA when measured at 480 volt with a 35% voltage dip.

D. A resettable line current sensing circuit breaker with inverse time versus current response shall be furnished and shall not automatically reset preventing restoration of voltage if maintenance is being performed. This breaker shall protect the generator from damage due to its own high current capability and shall not trip within the 10 seconds specified above to allow selective tripping of down-stream fuses or circuit breakers under a fault condition. Circuit breaker shall be sized at 400 amp frame and 400 amp trip. Circuit breaker shall be installed in the generator terminal box and be easily operable when the operator is at the control panel. Circuit breaker shall include provision for a lock out device in the de-energized position to comply with NFPA 70E.

E. Provide generator over-voltage protection for sensitive loads that will shut the unit down when voltage exceeds 115 percent of rated for longer than 1 second.

1.08 GENERATOR CONTROLLER

A. A solid State Controller shall be vibration isolated above the generator. The microprocessor control board shall be moisture proof and capable of operation from 40c to 85c. Relays will only be acceptable in high current circuits. Generator set instrumentation, control and auxiliary equipment shall meet the performance standards of EGSA 100G.

B. Circuitry shall be of plug-in design for quick replacement. Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall include:

1. Fused DC circuits.

2. Complete two-wire start/stop control which shall operate on closure of a remote contact.

3. Speed sensing and a second independent starter motor disengagement systems shall protect against the starter engaging with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.

4. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.

5. Programmable cranking cycler, for 1-6 cycles of crank times between 1-60 seconds. Set at 3 cycles of 15-second ON and OFF cranking periods.

6. Overcrank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.

7. Engine cool down timer factory set at five minutes to permit unloaded running of the standby set after transfer of the load to normal.

8. Three-position (Automatic - OFF - TEST) selector switch. In the test position, the engine shall start and run regardless of the position of the remote starting contacts. In the automatic position, the engine shall start when contacts in the remote control circuit close and stop five minutes after those contacts open. In the off position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault lamp shall also be accomplished by putting the switch to the off position.

C. An engine and generator instrument panel shall be installed on the unit with vibration isolators, and include the following:

1. Instruments
   AC Voltmeter, digital, 2% accuracy
   AC Ammeter, digital, 2% accuracy
   VM/AM phase selector switch
   Frequency meter, digital, 0.5% accuracy
   DC Voltmeter, digital, 2% accuracy
   Generator kilowatts, digital
   Generator kilowatt hours, digital
   Generator load power factor, digital
   Engine water temperature, digital, 2% accuracy
   Engine oil pressure, digital, 2% accuracy
   Running time meter

2. Indicator Lamps And Alarm Contacts
   Overcrank (red)
   High water temperature (red)
   Low oil pressure (red)
   Overspeed (red)
   Anticipatory low oil pressure (yellow)
   Anticipatory high water temperature (yellow)
   Low water temperature (yellow)
   Emergency stop (red)
   "Not in auto" (flashing red)
   System ready (green)
   Battery charger fault (red)
   Low battery volts (red)
   Low fuel level (red)
   Generator running
   Kilowatt overload
   Overcurrent
   Under frequency

3. Controls
   Lamp test switch
   Voltage adjusting rheostat, + or - 5 percent range
   Panel lamps (2)

4. Alarm horn, with silence switch, to meet the requirements of NFPA 110. Note: Silencing this horn after one fault, i.e. low fuel, shall not prevent it from sounding again should a different fault condition occur.

D. Complete control panel shall be "rodent proofed" to prevent damage to components by small rodents.

1.09 EXHAUST SYSTEM

A. A critical degree silencer shall be provided and installed within the weather enclosure. Supplier shall furnish back pressure calculations for the installation, including the discharge piping, verifying that engine limitation is not exceeded. Silencer shall be arranged for horizontal mounting with bottom (side) inlet and end outlet. Provide a stainless steel bellows type flexible exhaust connector at the engine exhaust outlet. Provide suitable raincap. A "Critical Degree" silencer is considered to be one capable of attenuating engine exhaust noise component to 85 dba at 10 feet in a free-field environment.

1.10 JACKET WATER HEATER

A. A jacket water heater, thermostatically controlled, shall be installed on the engine. Heater shall be 2500 watts and shall operate on 120 volt single phase input. Heater shall be mounted on the generator base rails and provided with flexible hoses to the engine. Flexible hoses shall be rated at 300 degrees F. and 100 PSI. Provision shall be made for isolation of the jacket water heater with 3/4 inch NPT ball-valves installed at the engine side of the flexible hoses. Provide a disconnect safety switch, or disconnect plug, to isolate the heating element from the electrical source for maintenance purposes.

1.11 FUEL STORAGE SYSTEM AND ENCLOSURE

A. Provide a sub-base mounted fuel storage tank capable of supporting the generator set at 250 kW rated load for 12 hours. Minimum tank capacity shall be 222 gallons. Provide access via removable end plate for electrical conduit for the circuit breaker, battery charger and jacket water heater power, and control wiring from below. Tank shall be built and labeled in accordance with UL-142. Mounting feet shall provide clearance between bottom of tank and foundation.

B. Tank features shall include:

1. 4 inch filler neck and locking cap

2. Engine supply and return openings and draw tubes

3. Emergency vents per UL for both primary and secondary containment with approved caps.

4. Tank leak port

5. Fuel level indicator gauge, direct reading type

6. Low fuel level alarm switch, set at 8 remaining hours capacity [illegible] contact to alarm light in the generator control panel

7. Secondary containment, totally closed design, by double wall construction. Provide alarm contact for "liquid in containment basin." Wire contact to alarm light in the generator control panel.

C. Provide a weather protective enclosure with hinged and removable side panels to allow inspection and maintenance. Material shall be a minimum of 18 gauge pre-painted G60galvanized high strength low alloy steel. Primer shall be GASF urethane and finish paint shall be BASF Super system paint. Enclosure, with hinges, latches, and hardware, shall have successfully completed a 500 hour salt spray test in compliance with ASTM B117. The roof shall be peaked to prevent collection of moisture. Ventilation louvers shall be adequate to permit operation of the generator set at full load at the high ambient temperature specified without opening any doors. The enclosure doors shall have a common keyed latch. Provide two (2) sets of keys. Enclosure and engine exhaust system shall be sound attenuated to limit noise level when operating at full load to a maximum of 73.3 dB(A) log average at 23 feet in any horizontal direction from the center of the unit. Attenuation shall include exhaust manifold and silencer blankets of the removable/reusable type. Intake and discharge of cooling air shall be through top mounted openings that are covered for weather protection. The engine exhaust silencer shall be installed inside the enclosure and shall not be visible from the outside. Provide acoustical material on internal walls and surfaces of the enclosure. External holes and openings in the enclosure shall be covered with galvanized or coated mesh to prevent entry of birds and rodents.

1.12 SEISMIC RESTRAINT AND CERTIFICATION

A. The generator set shall be anchored directly to the concrete slab. Generator set supplier shall provide anchor bolts as selected by the seismic restraint calculations.

B. Provide calculations signed by an engineer registered in the State of California verifying compliance with California Administrative Code Title 24 for Zone 4. These calculations shall be a part of the submittal data provided.

C. The generator set, enclosure, and base fuel tank shall be seismically certified in accordance with the IBC-2000, IBC-2003, and IBC-2006 International Building Codes. Provide a seismic certificate of compliance as part of the submittal package. Provide specific anchor locations, size, type, and load requirement guidelines on a generator seismic installation drawing provided by the manufacturer. Provide a seismic certification label on the equipment and seismic anchor plates.

1.13 TESTING

A. Design prototype test: Components of the emergency system, such as the engine/generator set, transfer switch, and accessories shall not be subjected to prototype test since the tests are potentially damaging. Rather, similar design prototypes and reliability preproduction models, which will not be sold, shall be used for these tests. Upon request, the following certified test records shall be made available:

1. Maximum power (kW).

2. Maximum starting (kVA) at 35% instantaneous voltage dip.

3. Alternator temperature rise by embedded thermocouple and by resistance method per NEMA MG1-22.40 and 16.40.

4. Governor speed regulation under steady-state and transient conditions.

5. Voltage regulation and generator transient response.

6. Fuel consumption at no load, 1/4, 1/2, 3/4, and full load.

7. Harmonic analysis, voltage waveform deviation, and telephone influence factor.

8. Three-phase line-to-line short circuit test.

9. Alternator cooling air flow.

10. Torsional analysis testing to verify that the generator set is free of harmful torsional stresses.

11. Endurance testing.

B. Final production tests: Each generator set shall be factory tested under varying loads with guards and exhaust system in place. Upon request, arrangements to witness this test will be made or a certified test record will be sent prior to shipment. Tests shall include:

1. Single-step load pickup.

2. Transient and steady-state governing.

3. Safety shutdown.

4. Voltage regulation.

5. Rated power and power factor.

6. Maximum power.

C. Site tests: An installation check, start-up and rated load test shall be performed by the manufacturer's local representative. The engineer, SCAQMD, regular operators, and the maintenance staff shall be notified of the time and date of the site test. Coordinate test date with SDAPCD inspection if necessary to allow observation of full test load. The test shall include:

1. The initial startup of the engine-generator set shall be performed by a factory trained representative of the engine generator set manufacturer. He shall furnish and install the recommended engine lubricants and fill the cooling system with a 50% solution of ethylene glycol antifreeze in accordance with the engine manufacturer's recommendations. He shall be present during the load test specified, and at the conclusion of the test shall supply the owner's representative with two (2) complete sets(s) of operation, maintenance, and parts manuals for all equipment. Under this section of the specification, he shall instruct the owner's personnel in the proper operating and maintenance procedures for all components of the standby power system.

2. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. This shall include: engine heaters, battery charger, etc.

3. Start-up under test mode to check for exhaust leaks, path of exhaust gases, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.

4. Automatic start-up by means of simulated power outage to test remote automatic starting, transfer of load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper systems coordination. Engine temperature, oil pressure and battery charger level along with generator voltage, amperes, and frequency shall be monitored throughout the test:

5. Load test system, utilizing contractor furnished resistive load bank, as follows:

1/2 hour	@	1/2 load
1/2 hour	@	3/4 load
2 hours	@	rated load

6. Measure and record the transient frequency and voltage dip, and recovery time to steady state conditions, for the single step application of rated load. Verify compliance with the governor and voltage regulator performance specified in paragraph 4.4 and 7.3. Recording instrument to be of the light beam or direct thermal array type (ink chart type not permitted).

7. Provide a certified copy of site test report showing compliance with specifications and approval of the installation for warranty purposes.

1.14 WARRANTY

A. The equipment supplied under this section shall be covered by a single warranty against defects in material and workmanship for a period of five (5) years or 3000 hours of operation. Warranty shall provide for free replacement or repair of parts for the 5 year (3000 hour) period, and free labor for the first two years. A warranty statement including these features shall be provided as part of the owner's manuals. Warranty shall be administered by the same company that supplied the equipment.

1.15 MAINTENANCE SERVICES

A. Furnish service and maintenance of engine generator for two years from date of Substantial Completion.

B. Generator supplier shall perform the following reliability inspections and maintenance services during regular business hours on a monthly basis during the term that this agreement remains in effect. Services shall be provided at no additional charge to owner for the first two years beginning with final acceptance of the installation. Extension of the agreement for additional years shall be offered by the generator set supplier and shall be at the option of owner.

C. Quarterly reliability inspections will include:

1. Inspect overall appearance and condition of the generator set installation, enclosure, fuel storage, etc.
2. Batteries will be cleaned, electrolyte levels and specific gravity will be checked, and reports made of any action necessary for recharging or replacing.
3. Fuel tank and lines will be inspected for defects. Examine fuel tank pit for existence of liquid. Identify any liquid found and determine the source. Critical fuel levels will be noted and recommendations for refueling will be made when necessary.
4. Fuel will be tested for evidence of water contamination. Fuel will be treated every 6 months to help prevent contamination. See "Additional Services for Annual Laboratory Fuel Analysis."
5. Equipment will be checked for fuel, oil or coolant leaks.
6. Fuel injection and governor system will be checked for proper operation.
7. All fluid levels will be checked and topped-off as necessary. (Fuel not included)
8. Air cleaners will be checked and if necessary recommendations made for replacement.
9. Coolant test will be performed and customer advised of any problems with the cooling system.
10. Owners/operators present will be instructed on operating and upkeep procedures to follow between regular calls by service personnel.
11. Engine block heater and associated plumbing will be checked for proper operation.
12. All belts and cooling system hoses will be checked. Owner will be advised of their condition.
13. Check electrical connections and wiring for any abrasion or chaffing.

D. After all of the above monthly inspections have been completed; service personnel will run equipment, record all operational gauges, check voltage and frequency outputs and engine electrical and mechanical shutdowns.

1. All instruments will be checked for proper operation.

2. Equipment will be checked for abnormal vibration and noises.
3. Service personnel will conduct test under building load, simulating a commercial power failure, providing owner makes such load available and it is practical to run the test concerned.
4. Automatic transfer switch will be inspected; all moving parts will be checked and cleaned if possible. Note: Automatic transfer switches are to be serviced annually.

E. Technician will clean equipment and paint, if necessary, to prevent corrosion and preserve reasonable overall appearance.

F. Report condition of system and, if discrepancies are found, provide a proposal for repairs to insure the stand-by reliability of the equipment.

G. Annual Maintenance Services (once per year) will include the following:

1. Perform reliability inspections as noted above.
2. Change engine lubricating oil and oil filters.
3. Change engine fuel filters.
4. Change air cleaner element.
5. Change water filters when used.
6. Take oil sample and coolant sample for analysis by fluid testing laboratories.
7. Perform a 4-hour resistive load bank test at 100% rated load.
8. Service the automatic transfer switch
9. Dispose of hazardous waste from service in accordance with all legal requirements including the maintenance of records regarding disposal.

H. If there are any problems encountered during the planned maintenance service visit they will be brought to the attention of the owner/operator. Repairs will only be made after proper authorization from owner/operator is given to the technician. Labor will be billed at reduced special contract labor rates depending upon when the service is to be performed.

I. Service organization shall provide proof of the following insurance coverage by furnishing a certificate naming the Owner as additional insured.

Commercial general liability (occurrence basis)
$1,000,000 each occurrence
$1,000,000 personal and injury
$2,000,000 general aggregate
$2,000,000 products

Automobile liability (any auto)
$1,000,000 combined single limit

Umbrella liability (occurrence basis)
$10,000,000 each occurrence
$10,000,000 aggregate

Workers Compensation and employers' liability
$1,000,000 each accident
$1,000,000 disease each employee
$1,000,000 disease policy limit

Inland Marine
$2,000,000

Pollution liability
$2,000,000

J. Service organization shall provide emergency contact information for 24/7/365 emergency response. Service technicians utilized for this site shall be trained in HazMat procedures and certified by the U S Department of Transportation for transportation of hazardous materials. All hazardous materials delivered to the site, or removed from the site, shall be documented and disposed of in accordance with DOT regulations.

END OF SECTION

SECTION 16641

AUTOMATIC TRANSFER SWITCH AND BYPASS-ISOLATION SWITCHES

PART 1 - GENERAL

1.01 CONDITIONS

A. The Requirements of the General Conditions and Special Conditions apply to the Work of this Section as if fully repeated herein.

1.02 WORK INCLUDED

A. Provide Automatic Transfer and Bypass/Isolation Switch to manually permit convenient electrical bypass and isolation of the Automatic Transfer Switch (ATS) that could not otherwise be tested and maintained without interrupting the load. Bypass of the load to either the normal or emergency power source with complete isolation of the automatic transfer switch shall be possible regardless of the status of the automatic transfer switch. The entire system shall consist of two (2) elements: The Automatic Transfer Switch and the Bypass/Isolation Switch furnished completely factory interconnected and tested.

1.03 QUALITY ASSURANCE

A. Reference Standards:

1. National Electrical Manufacturer's Association (NEMA):

   1CS2 Industrial Control Devices and Assemblies

   1CS6 Enclosures for Industrial Controls and Systems

2. Underwriter's Laboratories, Inc. (UL):

   1008 Automatic Transfer Switches

3. 1998 California Electrical Code (CEC):

B. Factory Tests:

1. Test the complete Automatic Transfer Switch and Bypass/Isolation Switch to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the Specification Requirements.

2. Subject the switch to a dielectric strength test in accordance with NEMA Standard ICS 1-109.21.

C. The control panel shall meet or exceed the voltage surge withstand capability in accordance with IEEE Standard 472 (ANSI C37.90a) and the impulse withstand voltage test in accordance with the proposed NEMA Standard ICS 1-109.

1.04 SUBMITTALS

A. Refer to Division 1 and Section 16000.

B. Furnish one copy of installation and operating instruction manual for each switch.

C. Provide certification of compliance with all Requirements of this Specification. The certification shall identify all equipment by serial numbers.

1. Overload and endurance at 480 volts AC per Tables 21.2, 23.1 and 23.2 of UL 1008 when enclosed.

2. Temperature rise tests after the overload and endurance tests to confirm the ability of the transfer switches to carry their rated current within the allowable temperature limits of the insulation in contact with current-carrying parts.

3. Withstand current tests.

4. No welding of contacts. Transfer switch must be operable to alternate source after the withstand current tests.

5. *Dielectric tests at 1960 volts, RMS, minimum after the withstand current test.*

PART 2 - PRODUCTS

2.01 MANUFACTURER: Kohler, Zenith, or Russelectric.

2.02 EQUIPMENT

A. Automatic Transfer Switch:

1. Ratings: Main power switch contacts shall be rated for 600 Volts AC minimum on transfer switches 40 through 1000 amperes; and 480 Volts AC minimum on transfer switches 1200 amperes and above.

2. Transfer switches shall be contactor type (NEMA Type A, IEC Type PC) and shall be rated to carry 100 percent of rated current continuously in the enclosure.

3. Transfer switches shall be rated for continuous operation in ambient temperatures of -40 degrees C to +50 degrees C, relative humidity of up to 95% (non-condensing), and altitudes of up to 10,000 feet.

4. Where the line side overcurrent protection is provided by a current limiting fuse, transfer switch equipment shall have a minimum withstand and closing rating (RMS symmetrical amperes) at 480 volts of at least 200,000 amps. Where the line side overcurrent protection is provided by a circuit breaker the transfer switch equipment shall have a minimum withstand and closing rating (RMS symmetrical amperes) at 480 volts of at least 50,000 amps. The circuit breaker manufacturer and type shall be as listed by UL and as specified by the transfer switch equipment manufacturer. The rating of the circuit breaker shall not exceed the maximum rating listed by UL and as specified by the transfer switch equipment manufacturer. The withstand and closing rating shall be equal or greater than the available fault currents shown on the drawings. Withstand and closing ratings shall be verified by UL witnessed test and shall be the ratings listed by UL for the transfer switch equipment supplied.

5. The automatic transfer/bypass switch shall be rated for 400 amps, 277/480 volt, 3-phase, 4-wire, 60 Hertz, and be provided in a Nema 1 enclosure for indoor installation.

6. Construction: Transfer switches shall be double-throw construction, positively electrically and mechanically interlocked by a mechanical beam to prevent simultaneous closing (for break before make operation), and mechanically held in both normal and emergency positions.

   a. Transfer switches shall be supplied with a switched neutral pole. The neutral pole shall have the same steady state, withstand and closing ratings as the phase poles of the switch. The neutral pole shall be mounted on a common crossbar with the phase poles and arranged for simultaneous switching of all poles.

   b. Transfer switch shall be equipped with operating handles and contact mechanisms suitable for manual operation under no-load conditions.

   c. Main switch contacts shall be high-pressure silver alloy contacts to resist burning and pitting for long life operation. Contact assemblies shall have arc chutes of heat absorbing material and metal leaves for positive extinguishing of arcs. Arc chutes shall have insulating covers to prevent interphase flashover.

   d. Transfer switches shall have two Form C, 15 Amp 240 Volt AC auxiliary switches on both normal and emergency sides, operated by the transfer switch.

   e. Terminal lugs, UL listed and CSA approved as suitable for copper and aluminum conductors, shall be provided for normal, emergency, and load connections. Wire bend space shall comply with 1998 CEC Article 373.

   f. Transfer switch shall be mounted in a Nema 1 enclosure. The cabinet shall provide CEC required wire bend space at point of entry. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Enclosure construction shall be in accordance with UL and NEMA standards for industrial controls.

B. Automatic Controls:

1. Control shall be solid-state and mounted inside of key-locking front door.

   a. Control disconnect plugs shall be provided to de-energize control circuits to avoid shock hazard while making control adjustments.

   b. The control shall be designed for a high level of immunity to power line surges and transients and tested to IEEE Standard 587-1980. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs.

2. Solid-state undervoltage sensors shall simultaneously monitor all phases of the normal source and all phases of the emergency source. Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase of normal where motor feedback voltages exist. Pick-up setting shall be adjustable from minimum of 85% to maximum of 98% of nominal voltage. Dropout settings shall be adjustable from minimum of 75% to maximum of 98% of pick-up setting with fixed dropout time delay of 0.5 seconds. Voltage sensors shall have provision for field calibration where supply voltage is higher or lower than nominal system voltage.

3. Overvoltage and frequency sensing shall be provided for both the normal source and the emergency source.

a. Adjustable overvoltage sensors with dropout time delay. Close differential adjustment range:

Pickup: Adjustable from 100% to 130% of nominal voltage.
Dropout fixed at 5% above pickup setting.
Dropout time delay adjustable from 0.5 to 132 seconds.

b. Adjustable frequency sensors with dropout time delay. Frequency bandwith adjustment range:

Pickup: Adjustable from +4% to +20% of nominal frequency.
Dropout: 5% of nominal wider than pickup frequency bandwith.
Dropout time delay adjustable from 0.1 to 15 seconds.

4. Controls shall signal the engine-generator set to start upon signal from normal source voltage sensors. Solid-state time delay start, adjustable from 0 to 15 seconds (factory set at 2 seconds) shall avoid nuisance start-ups on momentary voltage dips for momentary interruptions. Start contacts for the engine control shall be gold type, dry contacts wired to a terminal block and compatible with the generator set control equipment furnished.

5. The switch shall transfer the load to the emergency power system after the generator set reaches proper voltage and frequency. Solid-state time delay transfer, adjustable from 0 to 120 seconds (factory set at 2 seconds) shall allow the engine-generator set to stabilize before application of load.

6. The switch shall retransfer the load to the normal source after normal power restoration. Solid-state time delay retransfer, adjustable from 0 to 30 minutes (factory set at 15 minutes), shall allow normal power to stabilize before retransfer and shall allow staggered retransfer of loads to multiple transfer switch systems.

7. Controls shall signal the engine-generator set to stop after load retransfer to normal source. Solid-state time delay stop, adjustable from 0 to 10 minutes (factory set at 5 minutes) shall maintain availability of emergency source in event that normal source fails shortly after retransfer and shall permit engine to run unloaded for cool down before shut down.

8. The operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred. Controls shall provided an automatic retransfer of the load from emergency source to normal source if emergency source fails when normal source is available.

9. Controls shall provide built-in "control mode status indicators", consisting of light emitting diodes to indicate a sequence of functions such as the following:

Source 1 OK
Start Gen Set
Source 2 OK
Transfer Timing
Transfer Complete
Retransfer Timing
Retransfer Complete
Timing for Stop

These indicators shall allow the operator to determine that the controls are properly sequencing and shall assist in determining sequence of any malfunctions that might occur.

10. The control shall include provisions for the following performance features:
    a. Inphase monitor – enable, disable, and phase angle
    b. Password protection with three security levels
    c. Phase rotation sensing and protection
    d. Modbus RTU and Modbus TCP/IP protocols for remote communication
    e. Event history and maintenance records
    f. Area protection

11. Provide solid state exerciser clock to set the day, time, and duration of generator set exercise/test period. Clock shall automatically adjust for daylight saving time and leap year. A 100 hour battery backup power supply shall be provided to maintain clock settings during loss of normal power. Provide a with/without load selector switch for the exercise function.

12. Front Panel Devices: Provide devices mounted on cabinet front consisting of:

    a. Transfer Switch Position Indicator LED's: Normal and Emergency. Provide normal source available and emergency source available indicator LED's.

    b. A password protected selector switch to provide the following functions:

        1) Test - Simulated normal power loss to control unit for testing of generator set, including transfer of load. Controls shall provide for a system test without load transfer. Controls shall include provisions to automatically return the system to the normal power source if the generator set fails during any test or exercise period.

        2) Normal - Normal operating position; restores the load to the normal source after test and after time delays.

        3) Retransfer - Momentary position to override retransfer time delay and cause immediate return to normal source after test or actual outage.

13. Provide LCD displays of:

    a. System status

    b. Line-to-line and line-to-neutral voltage

    c. Source frequency

    d. Active time delays

    e. Preferred source selection

    f. System settings

    g. Event history and maintenance records

    h. exerciser schedule and mode, and time remaining on active exercise

C. Bypass-Isolation Switch:

1. Transfer switches shall be included in a factory assembly with by-pass isolation switch equipment. The bypass-isolation switch shall provide a safe means for manually bypassing the transfer switch from either source (Normal or Emergency) to the load, while under load if necessary, and isolating the transfer switch from both sources for maintenance or repair.

2. Ratings: Bypass-isolation switch equipment shall be UL Listed per Standard 1008; with continuous current rating, voltage and frequency ratings, and withstand and closing ratings equal to the transfer switch ratings at the specified conditions of ambient temperature, humidity, and altitude.

3. Construction: The bypass-isolation and transfer switches shall be mechanically held in each position. Switching mechanisms shall be break before make on all poles, including the neutral pole on four pole switches.

4. Bypass Switch: Shall be a fully rated manually-operated switch, rated for the same loads as the automatic transfer switch. Bypass switch shall provide bypass to either normal or emergency source by use of a door-mounted keyed source selector switch and a permanently mounted external operating handle. An engine start switch will be provided to allow the generator set to be started for bypass to emergency source where necessary. Equipment shall provide manual bypass without load break to the source connected to the load by the transfer switch. Equipment shall provide for manual bypass operation to the source opposite that to which the transfer switch is connected. This shall cause the transfer switch to go automatically to a position disconnected from both sources.

5. Interlocks: Positive mechanical interlocks shall prevent all possible source to source interconnections. The interlock system shall assure a properly sequenced, mechanically guided bypass and isolation action. The equipment shall utilize automatic, solenoid-activated mechanical stops to prevent manually bypassing to a dead source.

6. Isolation: A drawout isolation mechanism shall provide closed door isolation of the transfer switch, using a permanently mounted, external handle. The isolation mechanism shall be interlocked so that either the transfer switch must be bypassed or the transfer switch must be open, before the mechanism will permit isolation of the transfer switch. The isolation mechanism shall provide for three position operation: Connected, Test, and Isolated. In the Connected position, isolation contacts shall be fully engaged and closed, with the transfer switch control cable connected. In the Test position, isolation contacts shall be open and the transfer switch isolation contacts shall be open and the transfer switch control cable connected. The Test position shall allow operational testing of transfer switch and controls without power disruption to the load. In the Isolated position, the transfer switch and control shall be completely isolated from all power sources. In the Isolated position, safety shutters shall close to cover bypass switch power terminals minimizing the possibility of accidental contact with energized parts. In the isolated position, the transfer switch shall be capable of being withdrawn from the cabinet and removed using overhead lifting equipment. When re-installing the transfer switch from isolated to connected position, the isolation mechanism shall not permit connection of the transfer switch unless it is in the open position, and shall automatically open the transfer switch if necessary regardless of the availability of electrical power. When the transfer switch is fully connected and locked in place, the mechanism shall move the transfer switch from the open position to the closed position on the same source as the bypass switch.

7. Enclosure: The enclosure type shall be Nema 1. Enclosure construction shall be welded steel. Wire bend space shall comply with 1998 California Electrical Code for the maximum size and number of conductors the terminal lugs will accept. A key locking handle shall be provided. Front panel mounted controls shall require use of a password.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install in accordance with manufacturer's instructions.

B. Set all field adjustable time delays as directed by using agency.

C. Mount switch to resist lateral seismic forces.

D. Test transfer switch operation as described under Section 16640.

END OF SECTION