SECTION 16210

ENGINE DRIVEN EMERGENCY POWER SUPPLY SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work required under this section of the specifications consists of the installation of the complete Engine Driven Emergency Power Supply System. All materials and devices which are an integral part of this system shall be provided under this section of the specifications.

B. Definition: The Emergency Power Supply System (EPSS) shall consist of one or more engine driven generator sets, each of which contains an engine directly coupled to an electric generator, together with the necessary switchgear, controls, accessories, transfer devices, and fuel supply to provide electric power for the duration of any failure of the normal power supply.
   1. Automatic Transfer Switch (ATS): An automatic transfer switch is self-acting equipment for transferring one or more load conductor connections from one power source to another.

1.3 QUALITY ASSURANCE

A. The following specifications and standards are incorporated into and become a part of this specification by reference.
   1. National Fire Protection Association (NFPA):
      a. NFPA-37 Combustion Engines
      b. NFPA-70 National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701 and 702,
      c. NFPA-99 Essential Electrical Systems for Health Care Facilities
      d. NFPA-110 Emergency and Stand-By Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.
   2. Institute of Electrical and Electronics Engineers (IEEE) Standards:
      a. IEEE 446 IEEE Recommended Practices for Emergency and Standby Power Systems for commercial and industrial applications.
      b. IEEE 472 Voltage Surge Withstand Capabilities
   3. National Electric Manufacturers Association (NEMA) Standards:
      a. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.
      b. ICS1-109 Test and Test Procedures for Automatic Transfer Switches
      c. ICS 10-2005 Part 1 A.C. Automatic Transfer Switch
   4. Underwriters Laboratories Inc. (UL) Publications:

a. UL 1008 Automatic and Non-Automatic Transfer Switches
b. UL508. The entire control system of the generator set shall be UL 508 listed and labeled.
c. UL142 – Sub-base Tanks
d. UL 1236 – Battery Chargers
e. UL2200 – The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

5. American National Standards Institute (ANSI):
   a. C37.90a Voltage Surge Withstand Capability
6. Environmental Protection Agency (EPA):
   a. EPA/530-SW-85-009 Leaking Underground Storage Tanks (LUST)
7. The control system for the generator set shall comply with the following requirements.
   a. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
   b. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements Part 2: Industrial
   c. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
   d. FCC Part 15, Subpart B.
   e. IEC8528 part 4. Control Systems for Generator Sets
   f. IEC Std 801.2, 801.3 and 801.5 for susceptibility, conducted and radiated electromagnetic emissions.
8. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation and service, in accordance with ISO 9001.

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable:
   1. Engine Driven Generator Sets:
      a. Caterpillar
      b. Cummins/Power Generation
      c. MTU
      d. Kohler
   2. Transfer Switches:
      a. ASCO 7000 series
      b. Cummins/Power Generation BTPC
   3. Sub-Base Fuel Tanks by engine manufacturer or approved 3rd party supplier.

C. Equipment Dimensions:
   1. Dimensions indicated on the drawings are maximum allowable and shall not be exceeded. Where equipment of acceptable manufacturers listed exceeds the maximum dimensions, products of such manufacturers shall not be acceptable.

D. Coordination:
   1. The installing contractor shall review shop drawings submitted under this and other sections, as well as other divisions, to insure coordination between work required among different trades. Coordinate the installation sequence with other contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with architectural and structural features,

equipment installed under other sections of the specifications, and electrical equipment to insure access and to insure clearance minimums are provided.

1.4 SUBMITTALS

A. Refer to the SHOP DRAWINGS, PRODUCT DATA AND SAMPLES Section for required procedures.

B. Manufacturer's Product Data:
   1. Submit material specifications and installations data for products specified under Part 2 - Products to include:
      a. Engine driven generator sets
      b. Transfer switches
      c. Sub-base fuel tanks

C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract drawings. Submittals containing less than the information listed below will be rejected.
   1. Shop drawings for the engine driven generator sets shall contain not less than the information listed as follows:
      a. Certification that the engine driven generator set(s) furnished will serve electrical loads indicated including motor starting loads as listed in this specification (note provide complete motor data such as starter type listed in specifications with max voltage and freq. performance required) with type(s) of starting indicated.
      b. Stand-by rating of engine driven generator set(s) including voltage and phase.
      c. Frequency and voltage regulation with maximum voltage dip and time of recovery to stable operation.
      d. Output voltage adjustment range in percentage of rated plant voltage.
      e. Alternator type and method of connection to prime mover.
      f. Components contained in alternator instrument panel.
      g. Rating of engine at operating speed, engine cycle and number of cylinders.
      h. Type of engine lubrication system and verification of components specified.
      i. Type of engine governor.
      j. Components contained in engine instrument panel.
      k. Fuel consumption at ¼, ½, ¾ and full load.
      l. Starting batteries including ampere hour rating.
      m. Verification that all accessories specified is to be provided. This includes day tank with capacity indicated, cold weather starting aid with rating and voltage indicated, exhaust system with muffler type indicated, and outdoor housing (where applicable) with verification of space available within housing for batteries.
      n. Alternator data sheet with complete data including reactance values.
      o. Circuit breaker type, rating, A.I.C. rating and cable capacity of lugs.
   2. Shop drawings for the transfer switch shall contain not less than the information listed as follows:
      a. List of accessories contained in the control panel.
      b. Withstand rating in RMS symmetrical amperes.

D. Quality and Service:

1. All materials and parts of the EPSS shall be new and unused. Each component shall be of current manufacture from a firm regularly engaged in the production of such equipment. Units and components offered under these specifications shall be covered by the manufacturer's parts and labor warranty for a minimum of five (5) years from date of Owner acceptance of the project on a new machine, a copy of which shall be included in the shop drawings submittal.
2. Submittals will be accepted only on engine driven generator sets and transfer switches which can be properly maintained and serviced without requiring the Owner to stock spare parts or wait longer than twenty-four hours for service. Submittals shall include the nearest location of permanent parts outlet from which parts may be obtained and written assurance that trained service personnel will be available on twenty-four hour's notice. Units with service centers more than 100 miles from project site will not be accepted.

E. Record Drawings
1. Include in each set three sets of operating, maintenance, and parts manuals covering all components for the EPSS. Each supplier shall provide instructions to the Owner in operation and maintenance of his equipment, both in written form and with on-site personnel for a minimum of four hours.
2. A schedule of each motor, indicating actual horsepower and means of starting, connected to the EPSS shall be provided to the Owner with the record drawings.

PART 2 - PRODUCTS

2.1 ENGINE DRIVEN EMERGENCY POWER SUPPLY (EPS)

A. Engine
1. The engine driven emergency power supply (EPS) shall be an internal combustion diesel driven prime mover. The generator set shall have the following characteristics:
   a. 450 KW Capacity
   b. 563 KVA Capacity
   c. 480Y/277 Volts
   d. 60 Hertz
   e. 0.8 Power Factor
   f. 3 Phase
   g. 4 Wire
2. Maximum one-step load at 0.8 P.F. is 124.3 KW (step 2). The load to be served by this generator set consists of 41 KW non-inductive load plus 330 total motor horsepower. The motors shall be started as shown in the following table:

Sequence Step No.	Load Name	Quantity	HP/KW/KVA	Code Letter	Starting Method
Step 1	Initial Load	1	32.2KVA	-	-
	AC MCC Rm	2	3.16 KVA	-	-
	AC Lab Area	1	2.49KVA	-	-
	EF Pump Rm	1	1Hp	G	FVNR
	EF-2A & 2B	2	1Hp	G	FVNR
	EF-4A, 4B, 4C	3	0.5Hp	G	FVNR
Step 2	HSP-3, Well 7	2	75Hp	G	VFD

Step 3	RO feed pump #1, #2	2	50Hp	G	VFD
Step 4	RO Feed Pump #3	1	50Hp	G	VFD
Step 5	InterStage Booster Pump	3	10Hp	G	FVNR

3. The rated net horsepower of the engine at the generator synchronous speed, with all accessories, shall not be less than that required to product the KW specified in paragraph 1 above. The horsepower rating shall take into account generator efficiency and all accessory losses such as fans, battery charger, etc. The generator set shall be capable of producing the specified KW (without overload) for the duration of the power outage, under the following ambient conditions:
   a. Altitude: 500 feet above mean sea level.
   b. Air temperature at engine intake: 100 degrees F.
   c. Humidity Range: 20 - 100%.
4. Included with the shop drawing submittal shall be the manufacturer's estimate of supply fuel and oil consumption for the engine. The engine shall have an oil filter with replaceable elements, a lube oil cooler, and an oil reservoir.
5. The engine shall be equipped with a suitable governor (engine speed control) to maintain frequency within limit specified below by controlling engine and generator speed. Manufacturer shall indicate in submittal data whether mechanical, hydraulic, electrical, or hybrid governors are provided.
   a. Type: Isochronous 0.25% maximum
   b. Stability: 0.25% maximum steady state frequency variation at any constant load from no load to full load.
   c. Regulation: 5% maximum frequency deviation between no-load steady state and full load steady state.
6. The engine shall be electric start, provided with a solenoid energized motor with either positive engagement or clutch drive to the engine. The engine starting batteries shall be lead-acid recombination type, with individual cell construction. Block batteries will not be accepted. The voltage shall be as called for by the engine manufacturers with quantity of cells as follows:
   a. 12 volt ..... 10 cells
   b. 24 volt ..... 20 cells
   c. 32 volt ..... 27 cells
7. Cranking capacity shall be calculated to 0.85 VPC final voltage and shall be capable of turning the engine at its rolling current for a minimum of 3 minutes (180 seconds). Operating temperature shall be 50°F. minimum and 90°F. maximum indoors and 32°F. minimum for outdoor housed units. Exterior installations shall contain heaters as required to maintain the minimum specified temperature powered from the building emergency system. Capacity in the batteries shall be provided for any solenoids or other accessories required by NFPA 110 to be operated from the EPS batteries. In addition to the above, minimum amp hour capacity at the eight-hour rate shall be as follows:
   a. 351 - 500 KW = 100 AH
8. The engine starting batteries shall be sealed lead-acid recombination type. Batteries shall be rack mounted inside the weatherproof plant housing to minimize the distance from the batteries to the starter. Amperage shall have a

rating of no less than 20 amps. Provide battery straps and heater per NFPA 110.

9. A float type battery charger, compatible with the batteries selected, shall be furnished at the engine which shall maintain the starting batteries at full charge.
10. It shall have an equalize rate and a float rate charging system. An ammeter and voltmeter shall indicate the charge rate and the circuit shall be protected by either fuses or circuit breakers. The charger or charging circuit shall be so designed that it will not be damaged during the engine cranking cycle, for example, by a current limiting charger or a crank disconnect relay. It shall also be capable of recharging a discharged battery in 12 hours while carrying normal loads. The charger shall be equipped with alarm relays as required for remote annunciation equipment.
11. The engine shall be liquid cooled. The type of liquid cooling system shall be unit mounted radiator - consideration shall be given for air temperature rise across the engine in addition to ambient. Minimum capacity shall be rated for 104°F. minimum engine ambient temperature plus air temperature rise across the engine.
    a. Provide an electric heater, thermostatically controlled, in the engine coolant system as a cold weather starting aid. Heater shall be for operation on 120 volt single phase A.C. for 2500 watt units and below and on 208 volt single phase A.C. for all other units and shall be permanently connected to a circuit from the building electrical system. Heater shall maintain 70°F. to 90°F. Provide isolation valves or quick connect couplings for jacket water heater.
12. Air Supply/Exhaust System
    a. Cleaner: An air cleaner and silencer shall be furnished, located and mounted as recommended by the engine manufacturer.
    b. Exhaust: An exhaust system of suitable size, configuration, and material in accordance with engine manufacturer's recommendations shall connect the exhaust outlet of the engine to a silencer. The type of silencer shall meet the requirements of engine manufacturers and shall be 68dB. The silencer shall be located inside of the outdoor enclosure.
    c. The exhaust system including silencer shall be of such size that back pressure on the system will not exceed the back pressure permitted by the engine manufacturer's recommendation. A flexible connection shall be mounted at the engine exhaust outlet and the discharge end shall be protected against entry of precipitation. Piping and silencer within reach of personnel or with 8'-0" of finished floor or grade shall be protected by screening and shall be insulated with thermal blankets. All exhaust piping shall be gas tight.
13. The engine instrument panel shall be mounted at the engine and shall contain the following:
    a. Oil pressure gauge to indicate lubricating oil pressure.
    b. Temperature gauge to indicate cooling medium temperature.
    c. Hour meter to indicate total actual running time.
    d. Battery charging meter to indicate satisfactory performance of battery charging means.
    e. Other instruments as recommended by the manufacturer for proper maintenance.

f. Manual stop/start controls: All instruments, controls, and indicating lights shall be properly identified. All wires shall be individually identified and must agree with the wiring diagram provided. All wiring shall be harnessed or flexibly enclosed. Terminals on all terminal blocks shall be individually identified.

B. Generator

1. The generator shall be an engine-driven single or two bearings type, synchronous, brushless, and conforming to applicable standards. It shall be connected to the engine flywheel by means of a flexible type coupling for single bearing generators and elastic coupling for two bearing generators.
2. The generator shall be rated for 40°C ambient industry standard. Class of insulation shall be NEMA Class H. The voltage regulation shall be plus or minus 0.5% from no load to full load with plus or minus 5% speed change and a 15°C. rise in ambient. The generator voltage dip from no load to full load shall not exceed 35%.
3. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.
4. Provide 120 volt condensation heater in windings.

C. Voltage Regulation

1. The generator shall be equipped with a volts-per-hertz type voltage regulator to maintain voltage within limits specified below:
   a. Stability: 2% maximum voltage variation at any constant load from no load to full load.
   b. Regulation: 4% maximum voltage deviation between no load steady state and full load steady state.
   c. Transient: 20% voltage dip or overshoot on one-step application or removal of 0.8 power factor full load.

D. Generator Self-Protection

1. The generator controller shall be capable of self-protection such that it will prevent damage to the alternator in the event of a fault or transient. Provide circuit breaker on the generator for load bank testing.

E. Start and Stop Controls

1. Automatic starting and stopping controls shall be furnished to start the engine automatically when the normal electrical power fails or falls below specific limits and to stop the engine automatically after the normal power supply resumes. The signal for starting or stopping the engine shall be sensed through an auxiliary contact in the automatic transfer switch. The controls shall be capable of operating at 50% of normal DC system supplied voltage.
2. The cranking cycle shall be initiated by manual start, loss of normal power at any transfer switch clock exerciser, or the manually operated test switch at the ATS.
3. Crank control and the time delay relays shall provide a minimum of 4 crank attempts of at least 7 seconds each, separated by appropriate rest periods. A sensing device shall automatically disconnect the starting circuit when the engine has started. If the engine has not started at the completion of the starting

program, the overcrank signal shall indicate. The engine starting controls shall be locked out and no further starting attempts shall take place until the overcranking device has been manually reset.

4. A selector switch shall be incorporated in the automatic engine start and stop controls. It shall include an "off" position that prevents manual or automatic starting of the engine; a "manual" position that permits the engine to be started manually by the pushbutton on the control cabinet and run unloaded; an "automatic" position that readies the system for automatic start or stop on demand or the automatic load transfer switches or of the programmed exerciser.
5. A remote manual stop station similar to a break-glass station shall be provided at the location indicated on the drawings and shall be tied into the engine controls to stop the engine when activated. Provide laminated plastic label with 1/4" minimum engraved letters to read "EMERGENCY GENERATOR SHUTDOWN". Background to be red and core to be white. Exterior installations shall be NEMA 3R enclosure.

F. Instrumentation

1. Remote and local engine control and safety panel shall be provided, containing the following:
   a. Automatic remote start capability.
   b. "Manual-Off-Auto" switch.
   c. Controls to shut down and lock out the prime mover under the following conditions: failure to start after specified cranking time, overspeed, low lubricating oil pressure, high engine temperature and operation of remote manual stop station.
   d. Battery powered individual alarm indication to annunciate visually at the control and safety panel the occurrence of any condition itemized below; contacts or circuits for a common audible alarm signaling locally and remotely the occurrence of any itemized conditions listed below. Test switch shall be provided to test the operation of all lamps.
      1) Indicator Function, Level 1 (At Battery Voltage):

	Control Panel Mounted Visual Indication	Shutdown of EPS	Remote Audible
a) Overcrank	X	X	X
b) Low Water Temp. < 70°F (21°C)	X		X
c) High Engine Temp. Pre-alarm	X		X
d) High Engine Temp.	X	X	X
e) Low Lube Oil Pressure Pre-alarm	X		X
f) Low Lube Oil Pressure	X	X	X
g) Overspeed	X	X	X
h) Low Fuel Main Tank	X		X
i) EPS Supplying Load	X		X
j) Control Switch Not In Auto	X		X

Pos.			
k) Battery Charger Malfunctioning	X		X
l) Low Voltage in Battery	X		X
m) Lamp Test	X		X
n) Contacts for Local & Remote			
o) Common Alarm	X		
p) Audible Alarm Silencing Switch			
q) Remote Emergency Stop	X		
r) Ground Fault Indication (400KW and greater)	X		X
s) Fuel in containment	X		X

2) Controls to shutdown the prime mover upon removal of initiating signal or manual emergency shutdown.
3) A.C. voltmeter with selector switch off position and positions for phase to phase and phase to neutral.
4) A.C. ammeter with selector switch with positions for each phase.
5) Frequency meter -- digital electronic type.
6) Voltage adjusting to allow plus or minus 5% voltage adjustment.
7) Manual reset circuit breaker.
8) Water temperature gauge.
9) Manual stop/start control.
10) Elapsed time meter.
11) Panel lights.
12) Indicator lights for signals from engine instrument panel.
13) Light to indicate switch has been left in the "off" position.
14) Light to indicate remote start.

2. All instruments, controls, and indicating lights shall be properly identified. All wires shall be individually identified and must agree with the wiring diagram provided. All wiring shall be harnessed or flexibly enclosed. Terminals on all terminal blocks shall be individually identified. All instrumentation must be isolated from engine generator set vibration.

G. Enclosures and Connections:
1. All electrical enclosures, i.e., terminal cabinets, wire ways, circuit breaker enclosures, etc., shall be of adequate size to provide minimum bending radius as required by the NEC and measured from the terminals directly to the opposite wall of the enclosure, for the size conductor actually terminated within or passing through the enclosure.
2. All factory provided enclosures shall have gasket and finish appropriate for the environment in which the unit is to be mounted. All wiring, wiring harness, etc., shall be protected from the elements, such as direct sunlight, moisture, etc. or shall be UL listed for direct exposure to the applicable elements. Include written documentation of the above with the shop drawing submittal.

H. Provide flexible fuel connections at supply at return piping. Flexible hoses shall be steel reinforced type. Provide solenoid valve in series with gate valve in supply line.

Solenoid valve shall be powered from generator batteries and shall be open only when generator is running.

2.2 TRANSFER SWITCH

A. Transfer switch shall be rated at not less than as indicated on the drawings at rated voltage. Transfer switch shall be rated and marked for total system load.

B. Transfer switch serving 480V three phase four wire loads shall be four poles with a switched neutral. Neutral contacts must be on the same shaft as the associated main contacts and have the same continuous current rating and withstand current rating. Neutral contacts shall break last and make first.

C. Transfer switch shall be the automatic type.

D. Transfer switch shall be floor mounted in a NEMA 1 enclosure. Enclosure shall have hinged door with three point latching and factory installed key locking enclosure door.

E. Operation shall be inherently double-throw whereby all contacts move simultaneously. Electrical spacing shall be equal to or exceed those listed in Table 15.1 of UL-1008. Only those main contact structures specifically designed for transfer switch service shall be acceptable. An overload or short circuit shall not cause the switch to go to a neutral position. A manual operating handle shall be provided. All main contacts shall be silver alloy type protected by arc quenchers and, for switches rated 600 amps and larger, by arching contacts. Operating transfer time shall be 1/10 second or less on switches rated 600 amps and above.

F. All switch and contacts, coils, springs and control elements shall be removable from the front of the transfer switch without removal of the switch panel from the enclosure and without disconnecting power conductors or drive linkages. Control and sensing relays shall be continuous duty industrial type with minimum contact rating of ten amps.

G. Transfer switch shall be rated to withstand in RMS symmetrical amperes not less than the available symmetrical RMS amperes when protected by the circuit protective device on the line side of the transfer switch. Withstand rating of switch shall be based on switch contacts not welding under fault conditions. Provide switch with current limiting fuses to increase current withstand rating when switch is not rated for fault duty.

H. The control panel for each automatic transfer switch shall contain the following accessories:
   1. Adjustable 0.5 to 6 second time delay on starting of EPS to override momentary power dips and interruptions of the normal services. Time delay shall be factory set at 1 second.
   2. Time delay on transfer to emergency adjustable from 0 to 60 seconds, factory set at 0 seconds.
   3. Test switch on enclosure door to simulate failure of the normal power source. ATS shall transfer load to the EPS.
   4. Push button to bypass time delay on re-transfer to normal.
   5. Close differential voltage sensing shall be provided on all phases of the normal power supply. The pickup voltage shall be adjustable from 85% to 100% of

nominal and the dropout voltage shall be adjustable from 75% to 98% of the pickup value. The transfer to emergency will be initiated upon reduction of normal source to 85% of nominal voltage and re-transfer to normal shall occur when normal source restores to 95% of nominals.

6. Independent single phase voltage and frequency sensing of the emergency source. The pickup voltage shall be adjustable from 85% to 100% of nominal. Pickup frequency shall be adjustable from 90% to 100% of nominal. Transfer to emergency upon normal source failure when emergency source voltage is 90% or more of nominal and frequency is 95% or more of nominal.
7. A time delay on re-transfer to normal source. The time delay shall be automatically bypassed if the emergency source fails and normal source is available. The time delay shall be field adjustable from 0 to 25 minutes and factory set at 15 minutes.
8. An unloaded running time delay for emergency generator cool-down, factory set at 5 minutes.
9. An inphase monitor shall be provided on switch (es) designated as equipment load switch (es) on the drawings. The monitor shall control transfer/re-transfer operation between live sources so that closure on the alternate source will occur only when the two sources are approaching synchronism so that inrush currents do not exceed normal starting currents. The monitor shall function over a frequency difference range of up to $\pm$ 2.0 Hz. with a maximum operating transfer time of one-sixth of a second. If the voltage of the load-carrying source drops below 70%, the inphase function shall be automatically bypassed. The monitor shall not require interwiring with the generator controls, or active control of the governor. A switch with controlled contact adjustable transition time is acceptable in lieu of an inphase monitor.
10. Pilot light for indicating switch in normal position (include fuses and auxiliary contact).
11. Pilot light for indicating switch in emergency position (include fuses and auxiliary contact).
12. An exerciser for exercising standby power plant on a weekly basis shall be provided in the transfer switch. Exerciser shall be set to exercise standby plant for one half hour per week under load. Time of plant exercise shall be set in field. Exerciser timer shall have reserve power back-up, either by battery or spring-wound clock, to ride through power outages to the switch.
13. Auxiliary contact (gold plated) which closes when normal source fails. (Closed after override delay of 0.5 to 6 seconds).
14. Auxiliary contact (gold plated) which opens when normal source fails. (Opens after override delay of 0.5 to 6 seconds).
15. Auxiliary contacts on same shaft as main contacts (closed on normal.)
16. Auxiliary contacts on same shaft as main contacts (closed on emergency).

I. Bypass Isolation Switch

1. The bypass isolation switch shall have the same specification requirements as the automatic transfer switch portion of this specification except as described below:
    a. The automatic transfer and bypass-isolation switch shall be provided to manually permit convenient electrical bypass and isolation of the automatic transfer switch. Bypass of the load to either the normal or emergency power source with complete isolation of the ATS shall be possible regardless of the status of the ATS. The bypass-isolation switch shall

permit proper operation by one person through the movement of a maximum of two handles at a common dead front panel. The entire system shall consist of two elements: The automatic transfer switch and the bypass-isolation switch furnished completely factory interconnected and tested.

b. The operating speed of the bypass switch contacts shall be the same as the automatic transfer switch and independent of the speed of operation of the bypass handle.

c. The automatic transfer and bypass-isolation switch shall be the product of one manufacturer and be completely factory interconnected and tested so that only the service and load connections to the bypass-isolation switch are required for field installation. All interconnections between the transfer switch, bypass switch and isolation switch shall be by silver-plated copper bus bar. A visual position indicator shall be provided to indicate bypass-isolation switch positions, and availability of normal and emergency sources. A prominent and detailed instruction plate shall be furnished for convenient operation.

d. The automatic transfer and bypass-isolation switch shall provide manual bypass of the load and isolation of all service and load terminals of the automatic transfer switch to permit periodic testing, maintenance, and service of the automatic transfer switch.

e. The bypass-isolation switch shall be capable of bypassing the load to either source. Provisions shall be made to assure continuity of auxiliary circuits necessary for the proper operation of the system.

f. The isolation handle shall provide for automatic operation, testing, or removal of the automatic transfer switch. The Test position shall permit electrical testing of the automatic transfer switch without disturbing the load. The open position shall completely isolate the transfer switch from both lines and load without actual removal of the line or load conductors, and allow its removal for inspection, adjustment and maintenance. The transfer switch shall be arranged for drawout operation to facilitate its removal. Also, while in the Test or Open positions, the bypass switch shall function as a manual transfer switch to allow load transfer to either source of power regardless of the position or condition of the transfer switch, including the condition when the automatic transfer switch is removed, and without reconnecting the load terminals of the automatic transfer switch.

2.3 FUEL SUPPLY

A. A double wall fuel storage tank with sufficient fuel capacity to allow the EPS to operate continuously at full rated load for 24 hours minimum (1000 gallons) shall be located in the skids below the generator set and shall be complete with all piping and fittings connected. No galvanized material shall be used in the tank or fueling system. The tanks shall be vented to atmosphere. A fuel level gauge shall be located as indicated on the drawings. The system shall be supplied to deliver an adequate amount of fuel to the engine from the storage tank. Pipe sizes shall be no smaller than the minimum recommended by the engine manufacturer to avoid fuel flow restriction. The engine supply and return line shall be equipped with a length of flexible fuel lines, unions, and gate valves. No copper lines are acceptable. Provide the storage tank full of fuel at the time of building acceptance by the Owner.

B. Provide a set of normally open contacts in fuel level indicating “LOW FUEL” in fuel tank. Interconnect with remote low fuel alarm specified earlier in this section.

C. Provide leak detection monitoring system with a set of normally open contacts in secondary compartment of double wall tank space to indicate presence of fuel.

D. Provide audible/visual alarm so that if tank is above 90% full, alarm sounds. Provide silence switch and engraved sign reading “DISCONTINUE FILLING IF ALARM SOUNDS.”

PART 3 - EXECUTION

3.1 EPS INSTALLATION

A. The plant shall be anchored to a concrete base whose overall dimensions shall exceed the outside dimensions of the plant base by 12" in each direction. Base depth shall be 12". Reinforce base with No. 5 bars 12" on center in both directions. Use not less than 6-3/4" galvanized anchor bolts.
   1. Concrete base shall be isolated from adjacent floor slab.

B. The plant shall be on a welded steel base with vibration isolators. Isolators designed specifically for this application, mounted on rubber plates to block high frequency vibrations shall be provided. Isolators shall be designed for the seismic zone requirements in the area where the generator is installed.

C. Provide a laminated sign at the building service entrance equipment indicating type and location of on-site emergency power sources.

D. For exterior installations, the EPS shall be provided in outdoor, weatherproof housing with removable panels for access to equipment. Color shall be as selected by the owner. The starting batteries shall be rack mounted within the housing. Provide manufacturer’s standard maintenance switched lighting system within housing. Enclosure shall be aluminum rated for 150 mph winds.

E. Provide sound attenuating enclosure to provide for 64 db at 7 meters.

F. Extend 120 volt and/or 208 volt emergency power circuits for fuel pump and cold weather starting aids from the building wiring system.

3.2 TRANSFER SWITCH INSTALLATION

A. Floor mounted transfer switch shall be installed with top of switch no more than seven feet above finished floor. Locate transfer switch to provide working clearance and full accessibility as required by the National Electrical Code.

B. Lace and group conductors installed in transfer switch with nylon tie straps. Only one conductor shall be installed under terminals. Form and train conductors in enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond one-eights inch from terminal lug. Conductors shall be installed such that no stresses are transferred to terminal lugs.

C. Mounting and Support
   1. Mounting

a. Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified.
b. Attach enclosure directly to masonry, concrete, or wood surfaces.
c. Do not splice conductors in enclosure. Where required, install junction box or wireway adjacent to transfer switch and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the WIRES AND CABLES section of the specifications and do not exceed.
d. Conductors not terminating in transfer switch shall not extend through or enter transfer switch enclosure.
e. Install push-in knock-out closure plugs in any unused knock-out openings.
f. Free standing transfer switch shall be installed on a four inch high concrete pad, with horizontal base dimension exceeding base dimension of switch by three inches.
g. Cleaning and Adjustment
    1) After completion, clean the interior and exterior of dirt, paint and construction debris.
    2) Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

3.3 TESTING

A. Submit verification letter to Architect indicating successful completion of sequence of operations testing and certification that all functions are operational. Letter to request load testing approval and schedule of proposed test. Prior to load test, written approval must be provided by Architect. Representatives of the generator and transfer switch shall be present. The local authority having jurisdiction shall be given advance notification of the time of the final test in order that he may witness the tests.

B. A failure of any test or any component during a test will require a complete retest program at no additional cost to the Owner.

C. All fuel, lubricants, and other consumables for testing shall be supplied by the building contractor.

D. An on-site acceptance test shall be conducted as a final approval test for all Emergency Power Supply Systems.
    1. The test shall be conducted after completion of the installation with all EPSS accessory and support equipment in place and operating.
    2. Test Results. The EPSS shall perform within the limits specified in the standard NFPA-110, level I.
    3. The on-site installation test shall be conducted as required by the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

3.4 O&M MANUALS

A. At least three sets of an instruction manual(s) for all major components of the EPS shall be supplied by the Manufacturer(s) of the EPS and shall contain:
    1. A detailed explanation of the operation of the system.
    2. Instruction for routine maintenance.
    3. Detailed instructions for repair of the EPS and other major components of the EPS.

4. Pictorial parts list and part numbers.
5. Pictorial and schematic electrical drawings of wiring systems, including operation and safety devices, control panels, instrumentation and annunciators.

3.5 IDENTIFICATION

A. Refer to the ELECTRICAL IDENTIFICATION section of these specifications for identification requirements.

3.6 TRAINING

A. The generator manufacturer shall provide 4 hours of on-site training for owners personnel.

END OF SECTION