SECTION 26 32 13 – DIESEL ENGINE GENERATORS (EMERGENCY ELECTRICAL POWER SUPPLY)

PART 1: GENERAL

1.01 Scope of Standard

A. This standard provides general guidance concerning the specific preferences of Texas State University for Diesel Engine Generators (Emergency Electrical Power Supply).

B. Texas State University recognizes that project conditions and requirements vary, thus precluding the absolute adherence to the items identified herein in all cases. However, unless there is adequate written justification, it is expected that these guidelines will govern the design and specifications for Texas State University projects.

1.02 Reference Documents

A. Work shall be in compliance with the applicable portions of NFPA-30, 37, 99, and 110.

B. The equipment and installation shall meet the requirements of all applicable sections of NEMA Standards Publication MG 1, latest revision.

C. Definitions of rating criteria shall be in accordance with ANSI Standard IEEE 100.

D. The engine-generator set manufacturer shall verify the unit's KW/KVA rating after derating for the range of temperatures expected and the ambient temperature and altitude of installation as specified herein.

E. A torsional analysis shall be calculated by the manufacturer of the engine-generator set to verify freedom from torsional stresses within plus or minus 10% of rated speed, with results submitted to the Owner for approval as specified herein.

F. The Total Harmonic Distortion (THD v) for the output voltage, from no load to full linear load, shall not exceed 5% and no single harmonic shall exceed 3%.

G. The Telephone Influence Factor (TIF) shall be less than 50 per NEMA MG 1.

Furnish and install all of the necessary equipment, hardware and labor for a complete on-site generated electric power supply for the Emergency Electrical System. The complete System shall be factory painted Sherwin Williams 6108 Latte. All Equipment and labor shall meet the below listed specifications.

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PART 2: PRODUCTS

2.01 Engine and Equipment

Acceptable Manufacturers: Caterpillar, Cummins

A. Standby/Emergency Power System

1. Diesel engine: the motor/generator unit shall be rated as a stand-by service for handling 120% of critical loads. (Critical loads being defined as life saving systems (fire alarm), elevators and any other loads specified on building plans). Further criteria for the system are a 0.8 power factor, three phase, 60 cycle. System shall be package equipment consisting of:

2. Engine mounted start/stop control system.

3. Mounted accessories as specified

4. 250 gallon, double-walled storage tank mounted between skids.

5. System shall be built, tested and shipped by manufacturer of alternator so there is one source of supply and responsibility. Performance of electrical plant series shall be certified by Independent Testing Laboratory as to plants full power rating, stability and voltage and frequency response.

6. Engine shall be diesel fueled four cycle, water-cooled, with mounted radiator, fan and water pump. A rating of continuous horsepower at the operating speed of no more than 1800 RPM shall be developed to drive the generator continuously without overload. Full pressure lubrication shall be supplied by gear oil pump. Engine shall have an oil filter with replaceable element; oil cooler and fuel pump. Engine speed shall be governed by a hydraulic governor to maintain alternator output. Engine shall have a 24-volt, DC, battery charging alternator with transistorized voltage regulator. Starting shall be by volt, solenoid shift start.

7. Cooling system shall consist of a water cooled radiator, blower type fan, temperature control valve, engine water inlet and outlet connected to the radiator and an engine driven jacket circulating pump. Provide combination of water and ethylene glycol anti-freeze solution to protect the radiator to 0 degrees.

8. Alternator shall be brushless, 4 pole revolving field type with rotating rectifier exciter and solid-state voltage regulator. Stator shall be directly connected to the engine flywheel housing, and rotor shall be driven through a semi-flexible driving flange to insure permanent alignment.

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Voltage regulation shall be within plus or minus 2% of rated voltage from no load to full load. Instantaneous voltage dip shall be less than 20% of rated when full loaded and rated power factor is applied to alternator. Recovery to stable operation is defined as operation with terminal voltage remaining constant, within plus or minus 1% of rated voltage. A rheostat shall provide minimum of plus or minus 5% of voltage adjustment from rated value. Temperature rise shall be within rating as defined by NEMA MG1-22.40.

9. Motor generator unit shall be mounted on a welded structural steel base, which shall provide suitable mounting room for a 250-gallon minimum, double-walled fuel storage tank. Set base on spring isolators. Motor/generator shall be enclosed in a weatherproof metal housing.

10. Accessories needed for proper operation of the plant shall be furnished. These shall include critical muffler with side inlets complete with flexible connections to engine and condensate traps in riser and gravity type flapper exhaust caps, 24 volt starting circuits, battery cables, battery rack, and all interconnecting piping between day tank and engine.

11. Provide tank type insertion block heaters, 2500 watt, 208 volt, single phase.

12. Provide lead/acid storage batteries; heavy-duty, diesel starting type. Battery voltage shall be compatible with starting system. Battery set shall be of sufficient capacity to provide for 1-1/2 minutes total cranking time without recharging. Battery rack and necessary cables and clamps shall be provided. Batteries shall be isolated to prevent continuous discharge and reduce possibility of batteries discharging to point of battery cell destruction.

13. Provide current limiting battery charger to automatically recharge batteries. It shall include overload protection, silicone diode full wave rectifier, voltage surge suppressor, D.C. ammeter and fused A.C. input. A.C. input voltages shall be same as generator output voltage. Amperage output shall be not less than 5 amperes.

2.02 Alternator and Control

Acceptable Manufacturers: Onan, Kohler, Cummins

A. The AC alternator shall be a synchronous generator, four pole, revolving field, drip proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with a flexible disc.

B. The armature shall have skewed laminations of insulated electrical grade steel, two-thirds pitch winding. The rotor shall have an amortisseur (damper) winding, with layer wound mechanically wedged construction. The rotor shall be dynamically balanced. Surge suppressers shall be connected in parallel with the field winding. Use of field discharge resistance shall not be acceptable. Systems using three-wire solid-state devices shall mount the unit in a stationary location.

C. The insulation system components shall meet NEMA MG1 standard temperature limits for Class H insulation. Actual temperature rise measured by the resistance method at full load of KW/KVA shall not exceed 80° C with a 40° C ambient.

D. The alternator characteristic shall be matched to the torque characteristics of the engine in such a manner that with full load connected to the generator terminals, the generator can utilize all the available engine power without exceeding it at all speeds up to and through synchronous speed.

E. The alternator bearing shall be electrically insulated from the generator end bell to block potentially damaging shaft currents caused by imprecise manufacturing tolerances or variations in electrical steel.

F. The alternator shall be equipped with heaters operating on 12O or 208 VAC to control moisture condensation. Power for heaters shall be automatically turned off when unit is running.

G. The AC output leads of the alternator shall be brought out to a main molded case thermal-magnetic circuit breaker of suitable voltage and continuous and interrupting current rating. The circuit breaker shall be UL listed and accessible through removable plates on either side of a sheet metal output box DD. A control unit shall be installed and shall include an alternator field excitation circuit breaker of suitable continuous duty and interrupting ratings; AC ammeter and 3 phase selector switch; AC voltmeter and selector switch for all phase-to-phase and phase-to-neutral voltages; frequency meter; voltage adjust rheostat with +/- 5% adjustment; automatic voltage regulator; and necessary wiring and interconnections in accordance with the wiring methods set forth elsewhere in these Specifications.

2.03 Engine Exhaust System (Not mounted on housing)

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2.04 Emergency System

A. General

1. The emergency system shall consist of an emergency panel fed from an automatic transfer switch which shall have a normal feeder from the new facility and an emergency feeder from Texas State University's existing 480 volt, 4 wire grounded wye emergency system. This system shall be provided even if no emergency power source is currently available.

2. Emergency power shall be provided for the following:
   All stairwell lighting
   Fixtures in corridors and public areas that are considered "night lighting"
   Elevator lighting
   Egress lighting
   Fire Alarm System
   Communication system
   Sump pumps
   Stairwell pressurization fans

3. Emergency power shall be provided for one elevator motor in each bank of elevators in high rise buildings as defined by the National Fire Codes. A keyed selector switch shall be located on the ground floor allowing rescue personnel to select any elevator in the bank.

4. If due to size and location, emergency power is not available from Texas State University ~~San Marcos'~~ emergency power system or by generator set, provide individual equipment, i.e. light fixtures with individually mounted battery packs.

5. All buildings shall have a U.L. approved "Master Label" lightning protection system.

6. Fire pumps shall be connected to the emergency system per applicable codes.

2.05 Instrumentation and Controls

A. Engine instrument panel shall contain an oil pressure gauge, water temperature gauge, battery charge rate ammeter, manual starting pushbutton and speed control. Alternator instrument panel shall be wired, tested and shock mounted on the electric emergency/standby electric plant by the manufacturer of the alternator. It shall contain running time meter, AC volt meter, voltage adjusting

rheostat, AC ammeter with phase selector switch, dry contacts, and remote alarms wired to terminal strips and panel lights.

B. Provide two remote alarm annunciators designed for either surface or flush mounting indicating alarm functions described in next item. Annunciator shall be sheet metal steel enclosures with removable front panels. Face of front panel shall have visual signals, audible alarms, toggle switch marked normal and off, and lamp test push button. Annunciator shall be factory wired to a terminal block and have terminals labeled.

C. Set shall be provided with necessary external contacts and factory wiring to a labeled terminal block so that following items can be connected to central alarm stations.

1. Electric plant operating (Generating)

2. Electric plant failed to start (over crank)

3. Low lube oil pressure (low oil pressure)

4. Excessive water temperature (Hi engine temperature)

5. Low water jacket temperature (low engine temperature)

6. Engine overspeed

7. Low fuel supply (low fuel)

8. Low battery voltage (low battery volt)

D. Complete engine start control switch operates on closing contact and stop control operates on opening contacts. Cranking limiter shall be provided to open starting circuit in approximately 45 seconds if plant is not started within that time. Electric plant controls shall also include a three-position selector switch with the following positions: RUN-STOP-REMOTE. High water temperature, low oil pressure, and over speed trips shall be provided. Signal lights and alarm terminals shall indicate when safety device has operated.

E. Central alarm station annunciator shall be equipped with dry contact output and wired to subject building energy management system.

2.06 Operating Sequence and Instructions

A. Sequence of operation shall begin upon failure of normal source of power; engine shall be automatically cranked and brought up to full operating speed required by

the generator. Cranking motor circuit shall be instantly broken when the engine starts. Within 10 seconds generator shall be brought up to operating speed, generator voltage shall operate an automatic line transfer switch, transferring load from the normal source of supply and connecting emergency load. Upon restoration of normal source of supply, sequence of operation shall be reversed, stopping the engine and restoring the line transfer switch to normal operating position, disconnecting load from the emergency generator, set will continue to operate for a cool down period of 20 minutes after restoration of normal source of supply. Should engine fail to start at once, cranking cycle shall cease and 12-volt bell alarm shall be energized to indicate malfunctioning of system. Control set shall automatically stop engine in event cooling water temperature becomes too high, if oil pressure drops below a predetermined pressure, or if engine over speeds. Upon failure of engine for any reason, an indicating lamp will operate, indicating condition under which engine was shut down. Also, alarm bell signal shall be energized. Automatic line transfer switches and emergency change over mechanism, which is to be installed is not part of the engine generator set, will be described elsewhere in these specifications.

B. Operating instructions: shall be provided and installed in a suitable metal frame with cover glass making the display weather proof. Operating instructions for the emergency/standby generator shall be complete.

C. After completing of system installation, manufacturer's representative shall demonstrate to the owner or owner's representative, operation of the system. Manufacturers representative shall certify in WRITING, to the Owner, that work was supervised, approved, and in accordance with these specifications.

2.07 Circuit Protection

A. Provide main line molded case circuit breaker of rated amperes and install as load circuit interrupting and protective device. It shall operate both manually for normal switching functions and automatically during overload and short circuit conditions. Trip for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short-circuit protection. Circuit breaker shall meet standard established by NEMA, NECA, and UL codes. Generator/exciter field circuit breakers do not meet above electrical standards and are unacceptable for line protection.

2.08 Automatic Load Transfer Switch

Acceptable Manufacturers: Cummins, Kohler, Onan, ASCO (in order of preference)

A. An automatic transfer and bypass isolation-switch shall be provided to manually permit convenient electrical bypass and isolation of the automatic transfer switch that could not otherwise be tested and maintained without interrupting the load.

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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 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 by-pass-isolation switch, furnished completely factory interconnected and tested.

B. Each switch shall be electrically operated and mechanically held in each direction by a single solenoid mechanism momentarily energized from the source to which the load is to be transferred. Switch shall be inherently double-throw with both sets of main contacts moving simultaneously. Mechanical or electrical interlocking of single-throw devices such as circuit breakers, or motor starters is not acceptable. Disarrangement of any part or failure of any coil shall not permit a neutral position and shall not permit both sides to be closed at the same time. Molded plastic parts shall not be a part of the driving mechanics. The mechanical interlocks and driving mechanism shall be electrically dead.

C. Switches shall not consist of adapted devices which were not originally intended to repeatedly open and close on load current to 600 percent of rated at 0.40-0.50 power factor in accordance with test procedures of U.S. Standard # 508 Tenth Edition (Industrial Control Equipment).

D. Main contacts shall be silver-alloy protected by ARC barriers and ARC quenchers. All sizes shall have separate Arcing contactors.

E. Switches shall meet or exceed the following standards using the original set of main contacts for all requirements. These requirements shall be met without cleaning and/or adjusting between any of the tests. All switching shall be performed at the rate of 6 operations per minute between two 480 VAC sources which are 120 degrees out of phase. The time of transfer in either direction shall not exceed 1/15 second and the power factor for all tests shall be 0.40-0.50. One operation shall be considered as transfer of the load from normal to emergency followed by retransfer of the load back to normal.

1. Endurance: Minimum of 6000 operations at 200 percent of rated current.

2. Overload: Minimum of 50 operations at 600 percent of rated current.

3. Temperature Rise: Following the endurance and overload test the temperature rise of the main contactor shall not exceed allowable NEMA standards of 65 degrees C when carry rated current while installed in a non-ventilated enclosure.

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F. All switch and relay contacts, coils, springs, and control elements shall be removable from the front of the transfer switch without disconnection of the drive linkage or power conductors. Sensing and control logic shall be solid state and mounted on plug in printed circuit boards, which are keyed to prevent incorrect installation. Interfacing relays shall be industrial control grade plug in type.

G. Voltage sensing relays located across each phase of the normal source shall detect failure when anyone phase drops below 70% of rated voltage and sense restoration of normal when all phases have returned to 90% or more of normal rated voltage. A voltage-frequency relay shall prevent transfer of the load until the emergency source reaches at least 90% of rated voltage and frequency.

H. The switch shall be rated for all classes of loads including motor, ballast, tungsten and resistance as defined by U.L. Standard # 508, Tenth Edition (Industrial Controls Equipment). The full load continuous duty rating, the normal and emergency source voltage, and the number of poles shall be as shown on the plans.

I. The following accessories and/or features shall be included with the Automatic Load Transfer Switch.

1. Adjustable 1-10 second time delay to override momentary trips in the normal source.

2. Adjustable time-delay on retransfer (up to 25 minutes) of the load to normal with a by-pass circuit to nullify the time-delay in the event the emergency source fails. Shall also include an additional 30-minute unloaded running of the generator before shutdown.

3. Adjustable time-delay transfer of load to emergency. (0-1 minute adj.).

4. A test switch to test the emergency system, keyed to Cutler-Hammer, key # 92239.

5. A handle to permit emergency operation of main poles in either direction.

6. Auxiliary contact (1-NC and 1-NO) to activate and deactivate the engine starting Controls.

7. Auxiliary pilot contact closed when the switch is in the normal position (10AMP).

8. Auxiliary pilot contact closed when the switch is in the emergency position (10AMP).

9. A solid neutral with fully rated terminals.

10. Other accessories or features as may be required for automatic operation and/or as specified elsewhere.

11. Automatic transfer switches serving elevators shall have the following additional accessories:

    a. A signal must be provided to the elevator system 20 seconds before normal power is to be restored to the system. This allows time for each elevator operating on emergency power to make a normal stop at the next available floor thus avoiding trapping passengers between floors.

    b. A signal must be provided to the elevator 20 seconds before switching from normal power to emergency power during the periodic testing of the emergency power plant. This time allows for the elevator to make a normal stop at the next available floor thus avoiding trapping passengers between floors.

    c. Times given in a and b are to be sufficient to cover time from start of elevator door to close until doors open fully at next landing.

J. Automatic transfer switch and by-pass isolation switch shall provide manual by-pass 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 without interrupting power to the load.

K. The by-pass isolation switch shall be capable of bypassing the load to either source. Load by-pass to the automatic transfer switch's connected source shall be affected without load interruption. Provisions shall be made to assure continuity of auxiliary circuits necessary for the proper operation of the system.

L. The isolation handle shall provide three positions: Closed, Test, and Open. 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 for its removal for inspection, adjustment and maintenance. The transfer switch shall be arranged for draw out operation to facilitate its removal. Also while in the test or open position, the by-pass 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.

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M. Each switch shall be provided with an operator's manual providing installation and operating instructions.

N. Acceptable manufacturers are: Kohler, ASCO, or ONAN.

2.09 Switch Gear

A. System shall be guaranteed, (equipment and wiring) free from inherent mechanical or electrical defects for one year from date of acceptance. Manufacturer shall furnish, at no additional cost to owner, a one-year WRITTEN CONTRACT effective from date of acceptance, for maintenance and inspection services of manufacturer's equipment with minimum of two inspections during contract year.

B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all the requirements of this specification. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those specified at the time of submittal shall be included in the certification.

2.10 Standby/Emergency Generator Set

A. Testing of Generator Set: Unit shall be given a complete shop test before shipment. It shall be installed on job site under supervision of manufacturer's representative, and such tests as deemed necessary by these specifications and by the architect, shall run to prove performance of the unit. Owner's authorized representative shall be instructed in the operation and maintenance of the unit. Complete unit, including control and alarm systems shall be certified in writing.

B. Contractor is to provide a full tank (250 gallons) minimum, of diesel fuel prior to acceptance of unit by owner.

C. Acceptable manufacturers: Caterpillar, Cummins.

D. Unit is to be of sufficient size to replace normal power feed to building (s) without limiting use of facilities.

E. Standby/Emergency Generator set shall be located no less than 100 ft. downwind of any fresh air intakes, based on the normal prevailing wind direction in the area.

F. If dictated by Aesthetics or Security and Generator set must be placed in a building style enclosure, enclosure location is as previously specified for emergency generator sets and the enclosure itself must provide internal room around the generator set of five (5) feet on all sides. When in this configuration,

the radiator must be equipped with a vertical deflector to route hot air clear of building and away from air intake.

PART 3: EXECUTION (NOT USED)

END OF SECTION 26 32 13