263200 PACKAGED GENERATOR ASSEMBLIES

Part 1 – GENERAL

1.1 Description

A. This section details the guidelines and expectations for the design and install of emergency generator power systems on Johns Hopkins University Homewood Campus. 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 and approval from the JHFRE Engineering and Energy Department, it is expected that these guidelines will govern the design and specifications.

B. Every building should have a diesel-powered emergency generator for all life and safety requirements in the event of power loss. Emergency egress should not be dependent on either central battery inverters or individual battery-powered equipment/lights.

C. Emergency generators shall be sized to accommodate the projected load with 25% additional spare capacity. Calculations must be provided to show the projected loading on the generator with emphasis on ensuring that the generator does not get overburdened due to the inrush currents of the starting equipment.

1.2 Submittals

A. Product data for each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.

2. Time-current characteristic curves for generator protective device.

B. Shop Drawings shall have detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

2. Typical Wiring Diagrams: power, signal and control wiring.

C. Source quality-control test reports.

1. Certified summary of prototype-unit test report.

2. Certified Test Reports: for components and accessories that are equivalent, but not identical, to those tested on prototype unit.

a. CSA C22.2 No14

b. CSA 282

c. CSA 100

d. EN61000-6

e. EN55011

f. FCC Part 15 Subpart B

g. ISO8528

h. IEC61000

i. UL508

j. UL2200

k. UL142

1.3 Quality Assurance

A. All generators must be diesel driven engine generators with onsite fuel storage to provide a minimum of 24 hours of run time at full load.

B. All work must meet NEC standards and materials must be UL Listed.

C. The following features shall be included in a packaged engine-generator set for emergency power supply:

1. Battery charger

2. Engine generator set

3. Muffler

4. Remote annunciator

5. Starting battery

6. Outdoor enclosure

D. The standby electric power system shall include an electric generating set rated for continuous standby service. The complete operable standby system, factory tested and ready for installation, shall be a package of new equipment consisting of:

1. A diesel engine driven electric generating set to provide standby power.

2. An engine-alternator control console resiliently mounted on the generating set. Shall include complete engine start-stop control, solid state monitoring system, and mainline Circuit Breakers rated at 100 ampere 3 pole and 125 ampere 3 pole.

3. An automatic transfer switch to initiate automatic starting and stopping of the engine and switching of the load.

4. 24-Hour Sub-Base Fuel Tank with Rupture Basin.

5. Outdoor Generator Sound Attenuated Enclosure rated at 72 dBA.

6. Unit-mounted cooling system.

7. Unit-mounted control and monitoring.

8. Performance requirements for sensitive loads.

E. Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability.

1. Ambient Temperature: 5° F to 95° F.

2. Relative Humidity: 0% to 95%.

3. Altitude: Sea level to 1000'.

F. Two years from the date of Substantial Completion.

1. The manufacturer's standard warranty shall in no event be for a period of less than two years from the date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall be limited to 500 hours annually for the system warranty by both the manufacturer and servicing distributor. Submittals received without written warranties as specified will be rejected in their entirety.

1.4 Delivery and storage

A. Material deliveries and storage areas to be approved by Owner.

B. Material storage to comply with manufacturer's recommendations.

Part 2 – PRODUCTS

2.1 Preferred manufacturers of generators: Kohler, Caterpillar and Cummins.

A. Maintenance Material Requirement:

1. Fuses: One for every ten of each type and rating, but no fewer than one of each.

2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.

3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

4. Tools: Each tool listed by part number in operations and maintenance manual.

2.2 Engine-Generator Set

A. Factory assembled and tested

B. Mounting Frame: maintain alignment of mounted components without depending on concrete foundation and have lifting attachments.

C. Capacities and Characteristics:

1. Power Output Ratings – Nominal ratings as indicated with capacity as required to operate as a unit as evidenced by records of prototype testing.

2. Output Connections – Three-phase, four wire.

3. Nameplates: For each major system component to identify manufacturer's name & address and model & serial numbers of component.

2.3 Engine

A. Rated Engine Speed: 1800 rpm

B. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm

1. The engine will utilize in-cylinder combustion technology to meet applicable EPA non-road mobile regulations and/or the EPA NSPS rule for stationary reciprocating compression ignition engines. Additionally, the engine shall comply with the State Emission regulations at the time of installation/commissioning. Actual engine emissions values must be in compliance with applicable EPA emissions standards per ISO 8178 – D2 Emissions Cycle at specified ekW/bHP rating. Utilization of the "Transition Program for Equipment Manufacturers" (also known as "Flex Credits") to achieve EPA certification is not acceptable. The in-cylinder engine technology must not permit unfiltered exhaust gas to be introduced into the combustion cylinder. Emissions requirements/certifications of this package: EPA TIER 3.

C. Lubrication System: The following items are mounted on engine or skid.

1. Filter and Strainer: Rated to remove 90% of particles 5 micrometers and smaller while passing full flow.

2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.

3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons or special tools.

D. Engine Fuel System

1. Main Fuel Pump shall be mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

2. Relief-Bypass Valve shall automatically regulate pressure in fuel line and returns excess fuel to source.

E. Coolant Jack Heater shall be electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

F. Governor – Adjustable isochronous with speed sensing.

1. The engine governor shall be an electronic Engine Control Module (ECM) with 24-volt DC Electric Actuator. The ECM shall be enclosed in an environmentally sealed, die-cast aluminum housing which isolates and protects electronic components from moisture and dirt contamination. Speed droop shall be adjustable from 0 (isochronous) to 10%, from no load to full rated load. Steady state frequency regulation shall be +/- 0.25%. Speed shall be sensed by a magnetic pickup off the engine flywheel ring gear. A provision for remote speed adjustment shall be included. The ECM shall adjust fuel delivery according to exhaust smoke, altitude and cold mode limits. In the event of a DC power loss, the forward acting actuator will move to the minimum fuel position.

G. Cooling System – Closed loop, liquid cooled with radiator factory mounted on engine generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: solution of 50% ethylene-glycol-based antifreeze and 50% water with anticorrosion additives as recommended by engine manufacturer.

2. Size of Radiator: adequate to contain expansion of total system coolant from cold start to 110% load condition.

3. Expansion Tank: constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.

4. Temperature Control: self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

5. Coolant Hose: flexible assembly with inside surface of nonporous rubber and outer covering of aging, ultraviolet, and abrasion-resistant fabric.

6. Rating: 50psig maximum working pressure with coolant at 180°F and non-collapsible under vacuum.

7. End Fittings: flanges or steel pipe nipples with clamps to suit piping and equipment connections.

H. Muffler/Silencer – critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25dBA at 500Hz.

I. Starting System – 12V electric with negative ground.

1. Components: shall be sized so they will not be damaged during a full engine cranking cycle with ambient temperature at maximum specified in manufacturer's environmental conditions.

2. Cranking Motor: heavy-duty unit that automatically engages and releases from engine flywheel without binding.

3. Cranking Cycle: as required by NFPA 110 for system level specified.

4. Battery: adequate capacity within ambient temperature range specified in for environmental conditions to provide specified cranking cycle at least twice without recharging.

5. Battery Cable: size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.

6. Battery Compartment: factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50° F regardless of external ambient temperature within range specified in manufacturer's environmental conditions. Include accessories required to support and fasten batteries in place.

7. Battery-Charging Alternator: factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

8. Battery Charger: current-liming, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from -40° F to 140° F to prevent overcharging at high and undercharging at low temperatures.

c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10%.

d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contract that provide a battery-charger malfunction indication at system control and monitoring panel.

f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

g. Voltage Regulation:

1. The digital voltage regulator shall be microprocessor based with fully programmable operating and protection characteristics. The regulator shall maintain generator output voltage within +/- 0.25% for any constant load between no load and full load. The regulator shall be capable of sensing true RMS in three phases of alternator output voltage, or operating in single phase sensing mode. The voltage regulator shall include a VAR/Pf control feature as standard. The regulator shall provide an adjustable dual slope regulation characteristic in order to optimize voltage and

frequency response for site conditions. The voltage regulator shall include standard the capability to provide generator paralleling with reactive droop compensation and reactive differential compensation.

2. The voltage regulator shall communicate with the Generator Control Panel via a J1939 communication network with generator voltage adjustments made via the controller keypad. Additionally, the controller shall allow system parameter setup and monitoring, and provide fault alarm and shutdown information through the controller. A PC-based user interface shall be available to allow viewing and modifying operating parameters in a Windows-compatible environment.

2.4 Fuel Oil Storage

A. Comply with NFPA 30.

B. Base-Mounted Fuel Oil Tank: factory installed and piped, complying with UL 142 fuel oil tank. Features shall include the following:

1. Provide a double wall sub-base tank constructed to meet all local codes and requirements. A fuel tank base shall be provided as part of the enclosure. It shall be contained in a rupture basin with 110% capacity. The tank shall meet UL142 standards.

2. A locking fill cap.

3. Tank level indicator.

4. Vandal-resistant fill cap.

5. Containment: integral rupture basin with a capacity of 150% of nominal capacity of tank.

6. Leak Detector: locate in rupture basin and connect to provide audible and visual alarm in the event of day-tank leak.

7. Tank Capacity: as recommended by engine manufacturer for an uninterrupted period of 24 hours operation at 100% of rated power output of engine-generator system without being refilled.

8. Low-Level Alarm Sensor: liquid-level device operates alarm contacts at 25% of normal fuel level.

9. Piping Connections: factory-installed fuel supply and return lines from tank to engine, local fuel fill, vent line, overflow line, and tank drain line with shutoff valve.

10. Provide a full fuel tank for all testing and top off at completion of testing.

2.5 Control and Monitoring

A. Automatic Starting System Sequence of Operation: when mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator set shutdown. When generator set is running, specified system or equipment failures or derangements

automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Configuration: operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator set vibration.

C. Indicating and Protective Devices and Controls:

1. AC voltmeter
2. AC ammeter
3. AC frequency meter
4. DC voltmeter (alternator battery charging)
5. Engine-coolant temperature gage
6. Engine lubricating-oil pressure gage
7. Running
8. Ammeter-voltmeter, phase-selector switch(es)
9. Generator-voltage adjusting control
10. Start-stop switch
11. Over-speed shutdown device
12. Coolant high-temperature shutdown device
13. Coolant low-level shutdown device
14. Oil low-pressure shutdown device
15. Fuel tank derangement alarm
16. Generator overload

D. Supporting Items: include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.

E. Remote Communications

1. The control shall include provisions for future BAS communications as standard via RS-485 half duplex with configurable baud rates from 2.4k to 57.6k.

F. Common Remote Audible Alarm – signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Engine high-temperature shutdown

2. Lube-oil, low-pressure shutdown

3. Overs-speed shutdown

4. Remote emergency-stop shutdown

5. Engine high-temperature pre-alarm

6. Lube-oil, low-pressure pre-alarm

7. Fuel tank, low-fuel level

8. Low coolant level

G. Remote Alarm Annunciator –An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface or flush-mounting type to suit mounting conditions indicated. Unless otherwise specified, annunciator should be placed in the main electrical room that it is designed to feed.

2.6 Generator Over-current and Fault Protection

A. Generator Circuit Breaker: molded-case, electronic-trip type, 100% rated, complying with UL 489.

1. Tripping Characteristics: adjustable long-time, short-time delay and instantaneous.

2. Trip Settings: selected to coordinate with generator thermal damage curve.

3. Mounting: adjacent to or integrated with control and monitoring panel.

2.7 Generator, Exciter, and Voltage Regulator

A. Comply with NEMA MG 1.

B. Drive: generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over-speed up to 125% of rating, and heat during operation at 110% of rated capacity.

F. Enclosure: drip proof.

G. Instrument Transformers: mounted within generator enclosure.

H. Voltage Regulator: solid-state type, separate from exciter, provide performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5% adjustment of output-voltage operating band.

I. Windings: two-thirds pitch stator winding and fully linked damper winding.

J. Sub-transient Reactance: 12% maximum.

2.8 Vibration Isolation Devices

A. Provide pad type vibration isolators. Quantity as recommended by the generator set manufacturer.

2.9 Outdoor Weather-Protective Sound Attenuating Housing

A. The generator set shall be provided with a sound-attenuated housing which allows the generator set to operate at full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 72 dBA at any location 23' from the generator set in a free field environment. Housing configuration and materials used may be of any suitable design which meets application needs except acoustical materials used shall be oil and water resistant. No foam materials shall be used unless demonstrated to have the same durability/life as fiberglass.

B. The enclosure shall include hinged doors for access to both sides of the engine and alternator and the control equipment. Key-locking and pad-lockable door thatches shall be provided for all doors. Door hinges shall be stainless steel.

C. The enclosure shall be provided with an exhaust silencer which is mounted inside of the enclosure and allows the generator set package to meet specified sound level requirements. Silencer and exhaust shall include a rain-cap and rain-shield.

D. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color. All surfaces of all metal parts shall be primed and painted.

2.10 Finishes

A. Outdoor Enclosures and Components: manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.11 Source Quality Control

A. Project-Specific Equipment Tests: before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.

2. Full load run.

3. Maximum power.

4. Voltage regulation.

5. Transient and steady-state governing.

6. Single-step load pickup.

7. Safety shutdown.

Part 3 – EXECUTION

3.1 Life Safety Generators

A. An AC generator will be used for emergency power instead of any form of battery pack. The generator will be load tested by the manufacturer or manufacturer's approved representative in accordance with the manufacturer's instruction and NFPA 110 to 100% of the generator capacity. The test will be performed in the presence of MD Fire Marshal and JHFRE representative and the test procedure documentations will be provided to the Marshall and JHFRE at least one week in advance.

B. Any new building or structure 75’ or higher, measured from the lowest level of fire department vehicle access to the floor of the highest normally occupied space used for human occupancy of the structure, is subject to the high-rise building standards. The emergency power system shall be of sufficient capacity to provide service for, but not limited to, the following:

1. Fire Alarm System

2. Exit & Emergency Lighting

3. Fire Protection Equipment

4. Smoke Management System

5. Elevators

6. Fire Department Voice Communication System

7. Fire Pumps

8. Sump Pumps

C. If an Emergency Power System is not required to be installed, but a Smoke Management system is provided for the building, then a Type 60, Class 2, Level 2 power system shall be installed to provide power to the smoke management system only.

D. Whenever floors are added to an existing building, which previously was not a high rise, causing the building to become a high rise, the building shall comply with the 75 feet height rule.

E. Walkways, parking lots, exit signs, and egress lighting will be on basic emergency service.

3.2 Non-life Safety Generators

A. Additional generators for any equipment not deemed life safety or permit-required will be at the owner's request or through program documents. Generator cost and maintenance will be the responsibility of the owner. This generator would serve as back-up capacity for mechanical and departmental systems as required.

B. Any non-life safety generator is subject to load-shedding when necessary.