(Specifications based on CUMMINS Power Generator MODEL # C80DC – 80kw/100kva)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B.

1.2 SUMMARY

A. Section includes packaged diesel engine generators for emergency use with the following features:
   1. Diesel engine.
   2. Generator overcurrent and fault protection.
   3. Generator, exciter, and voltage regulator.
   4. Outdoor engine generator enclosure.
   5. Finishes.
   6. Automatic transfer switch

B. Related Requirements:
   1. Section 2.13 “Automatic Transfer Switches" for transfer switches, including sensors and relays to initiate automatic-starting and stopping signals for engine generators.

1.3 DEFINITIONS

A. EPS: Emergency power supply.

B. Standby Power (ESP): Per ISO 8528: The maximum power available during a variable electrical power sequence, under the stated operating conditions, for which a generating set is capable of delivering in the event of a utility power outage or under test conditions for up to 200 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers. The permissible average power output (Ppp) over 48 hours of operation shall not exceed 70 percent of the ESP unless otherwise agreed by the RIC engine manufacturer.

C. Operational Bandwidth: The total variation, from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

2. Include thermal damage curve for generator.

3. Include time-current characteristic curves for generator protective device.

4. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.

5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.

6. Include airflow requirements for cooling and combustion air in cubic feet per minute at 0.8 power factor, with air-supply temperature of 95, 80, 70, and 50 deg F. Provide Drawings indicating requirements and limitations for location of air intake and exhausts.

7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactance, and short-circuit current capability.

B. Shop Drawings:
1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Identify fluid drain ports and clearance requirements for proper fluid drain.

4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and supported equipment. Include base weights.

6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Source Quality-Control Reports: Including, but not limited to, the following:
   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.
   3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
   4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
   5. Report of sound generation.
   6. Report of exhaust emissions showing compliance with applicable regulations.
   7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

C. Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For engine generators to include in emergency, operation, and maintenance manuals.
   1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
   2. Operating instructions laminated and mounted adjacent to generator location.
   3. Training plan.
   4. Log of training attendees
   5. Fuel Certifications
   6. Delivery receipts for generator tank fills

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 60 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

D.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Comprehensive and cover parts, labor and travel for five (5) years from date of Substantial Completion. Warranty deductibles will not be allowed!

PART 2 - PRODUCTS

PART 3 -

3.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product as indicated on manufacturer drawings. Furnish generator in a sound attenuated, skin-tight, aluminum type, enclosure system with sub-base diesel fuel tank as specified within this specification. Comparable product by one of the following manufacturers below.

B.
   1. Cummins
   2. Kohler
   3. Generac

C. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

D.

3.2 PERFORMANCE REQUIREMENTS

A. B11 Compliance: Comply with B11.19.

B. NFPA Compliance:
   1. Comply with NFPA 37.
   2. Comply with NFPA 70.
   3. Comply with NFPA 110 requirements for Level 1 EPSS.

C. UL Compliance: Comply with UL 2200.

D. Engine Exhaust Emissions: Comply with EPA Tier 3 requirements and applicable state and local government requirements.

E. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator, including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

F. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability as per basis of design generator.
   1. Ambient Temperature: 0 to 122 deg F.
   2. Relative Humidity: Zero to 95 percent.
   3. Altitude: Sea level up to 5,000 feet.

3.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

A. Design basis on the Cummins Power Generation Model C80D6C

B. Factory-assembled and tested, water-cooled engine, with brushless generator and accessories.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Service Load: 100 kVA.

E. Power Factor: 0.8, lagging.

F. Frequency: 60 Hz

G. Voltage: 208 VAC.

H. Phase: Three-phase, four-wire delta.

I. Governor: Adjustable isochronous, with speed sensing.

J. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
   1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and engine generator center of gravity.

K. Capacities and Characteristics:
   1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries, with capacity as required to operate as a unit as evidenced by records of prototype testing.

   2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components.

L. Engine Generator Performance:
   1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage, from no load to full load.

   2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.

   3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency, from no load to full load.

   4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

   5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.

   6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

   7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.

   8. Start Time: Comply with NFPA 110, Type 10 system requirements.

3.4 DIESEL ENGINE

A. The engine shall be designed specifically for generator set duty. The engine shall be diesel fueled, compression ignited type, 4-cycle, cast iron, in-line 4 cylinders, turbocharged and aftercooled, with forged steel crankshaft and connecting rods. Minimum engine displacement shall be 272 in^3 (4.5liters) and have a minimum gross engine power output of 129 kW_M / (173 BHP) or better.

B. Lubrication System: Engine or skid mounted.
   1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
   2. Engine oil heater.
   3. 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.
   4. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

C. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and with UL 499.

D. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.
   1. Radiator: Designed adequate for operation at 122F/50C ambient temperature.
   2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
   3. Size of Radiator: Adequate to contain expansion of total system coolant, from cold start to 110 percent load condition.
   4. 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.
   5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
   6. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.
      1. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
      2. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
   7. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.

8. Fan: Driven by multiple belts from engine shaft.

9. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

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

E. 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 25 dB at 500 Hz.

F. Air-Intake Filter: Normal duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

G. Starting System: 12V electric, with negative ground.
1. Components: Sized so they are not damaged during a full engine-cranking cycle, with ambient temperature at maximum specified in "Performance Requirements" Article.

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: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times 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 metal with acid-resistant finish and thermal insulation. A thermostatically controlled heater shall be arranged to maintain battery above 50 deg F regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.

7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.

8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 70-A minimum continuous rating.

9. Battery Charger: 6Amp rated current-limiting, automatic-equalizing, and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236

10.

3.5 DIESEL FUEL-OIL SYSTEM

A. Comply with NFPA 30.

B. Main fuel pump: Mounted on engine to provide primary fuel flow under starting and load conditions.

C. Relief-Bypass Valve: Automatically regulates pressure in the fuel line and returns excess fuel to the source.

D. Fuel Filtering: Provide high performance, all-in-one, fuel/water separator filter that is mounted between the supply line of the fuel tank and the diesel engine.

E. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:
   1. Fuel-Tank Capacity: 353 gallons
   2. Generator set runtime at 48 hours at full load.
   3. Leak detection in interstitial space.
   4. Low fuel switch, set at 40%.
   5. Tank level indicator, mechanical type fuel level gauge
   6.

3.6 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 engine generator. When the mode-selector switch is switched to the on position, the engine generator starts. The off position of the same switch initiates engine generator shutdown. When the engine generator is running, specified system or equipment failures or derangements automatically shut down the engine generator and initiate alarms.

B. Provide minimum run time control set for 30 minutes, with override only by operation of a remote emergency-stop switch.

C. Comply with UL 508A.

D. 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 engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.

E. Control and Monitoring Panel:

1. Digital controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.

2. Instruments: Located on the control and monitoring panel and viewable during operation.

    a. Engine lubricating-oil pressure gage.
    b. Engine-coolant temperature gage.
    c. DC voltmeter (alternator battery charging).
    d. Running-time meter.
    e. AC voltmeter, for each phase connected to a phase selector switch.
    f. AC ammeter, for each phase connected to a phase selector switch.
    g. AC frequency meter.
    h. Generator-voltage-adjusting rheostat.

3. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication as required by NFPA 110 for Level 1 system, including the following:

    a. Cranking control equipment.
    b. Run-Off-Auto switch.
    c. Control switch not in automatic position alarm.
    d. Overcrank alarm.
    e. Overcrank shutdown device.
    f. Low water temperature alarm.
    g. High engine temperature pre-alarm.
    h. High engine temperature.
    i. High engine temperature shutdown device.
    j. Overspeed alarm.
    k. Overspeed shutdown device.
    l. Low-fuel main tank.
        1. Low-fuel-level alarm shall be initiated when the level falls below that required for operation for the duration required for the indicated EPSS class.
    m. Coolant low-level alarm.
    n. Coolant low-level shutdown device.
    o. Coolant high-temperature prealarm.
    1. Coolant high-temperature alarm.
    2. Coolant low-temperature alarm.
    3. Coolant high-temperature shutdown device.
    4. EPS load indicator.
    5. Battery high-voltage alarm.
    6. Low-cranking voltage alarm.
    7. Battery-charger malfunction alarm.
    8. Battery low-voltage alarm.
    9. Lamp test.
    10. Contacts for local and remote common alarm.
    11. Low-starting air pressure alarm.
    12. Low-starting hydraulic pressure alarm.
    13. Remote manual-stop shutdown device.
    14. Air shutdown damper alarm when used.
    15. Air shutdown damper shutdown device when used.
    16. Generator overcurrent-protective-device not-closed alarm.

F. Provide engine start and integrity monitoring meeting the requirements of the NEC2017, 700.10(D)(1). Transfer switch engine start circuit shall be monitored by the generator set's Control Panel and annunciated locally, and on the remote annunciator panel. Feature should be built-in as part of the generator set controller. Systems that utilize multiple modules at the generator and ATS are not accepted!

G. Common Remote Panel with Common Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel. Remote panels shall be powered from the engine generator battery.

H. Remote Alarm Annunciator: Provide an LED indicator light complying with NFPA 110, Level 1 systems requirements. Panel 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. Remote panel must be powered from the engine generator battery source.

1. Overcrank alarm.
2. Coolant low-temperature alarm.
3. High engine temperature prealarm.
4. High engine temperature alarm.
5. Low lube oil pressure alarm.
6. Overspeed alarm.
7. Low-fuel main tank alarm.
8. Low coolant level alarm.
9. Low-cranking voltage alarm.
10. Contacts for local and remote common alarm.
11. Audible-alarm silencing switch.
12. Air shutdown damper when used.
13. Run-Off-Auto switch.
14. Control switch not in automatic position alarm.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel-supply alarm.
17. Lamp test.
18. Low-cranking voltage alarm.

19. Generator overcurrent protective device not closed.

I. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

J.

3.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
   1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Circuit Breaker: Molded-case, electronic (LSi) trip type; 100 percent rated; complying with UL 489.
   1. Tripping Characteristic: Designed specifically for generator protection.
   2. Trip Rating: Matched to generator's full output rating.
   3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
   4. Mounting: Adjacent to or integrated with control and monitoring panel.

C. Generator overcurrent protecting relay: Provided an UL Listed/CSA Certified protective device that is coordinated with the alternator provided to prevent damage to the generator set on any possible overload or overcurrent condition external to the machine. The protective relay shall be listed as a utility-grade protective device under UL category NRGU. The control system shall be subject to UL follow-up service at the manufacturing location to verify the protective system is fully operational as manufactured. Protector shall be able to perform the following functions equal to AmpSentry™ as supplied with the Cummins PowerCommand 2.3 control panel.
   1. The protective system provided shall not include an instantaneous trip function.
   2. Provides single and three phase fault current regulation so that downstream protective devices have the maximum current available to quickly clear fault conditions without subjecting the alternator to potentially catastrophic failure conditions.
   3. Provide single and three phase fault current regulation (3x current) for downstream tripping/motor inrush management. Thermal damage curve (3-phase short) or fixed timer (2 sec for 1-phase short, or 5 sec for 2-phase short).
   4. Alternator protection overcurrent features shall include:
      a) **High AC voltage shutdown (59):** Output voltage on any phase exceeds preset values. Time to trip is inversely proportional to amount above threshold. Values

adjustable from 105-125% of nominal voltage, with time delay adjustable from 0.1-10 seconds. Default value is 110% for 10 seconds.

b) **Low AC voltage shutdown (27):** Voltage on any phase has dropped below a preset value. Adjustable over a range of50-95% of reference voltage, time delay 2-20 seconds. Default value is 85% for 10 seconds. Function tracks reference voltage. Control does not nuisance trip when voltage varies due to the control directing voltage to drop, such as during a V/Hz roll-off during synchronizing.

c) **Under frequency shutdown (81u):** Generator set output frequency cannot be maintained. Settings are adjustable from 2-10 Hz below reference governor set point, for a 5- 20second time delay. Default: 6 Hz, 10 seconds. Under frequency protection is disabled when excitation is switched off, such as when engine is operating in idle speed mode.

d) **Over frequency shutdown (81o):** Generator set is operating at a potentially damaging frequency level. Settings are adjustable from 2-10 Hz above nominal governor set point for a 1-20 second time delay. Default: 6 Hz, 20 seconds, disabled.

e) **Overcurrent warning/shutdown:** Thresholds and time delays are configurable. Implementation of the thermal damage curve with instantaneous trip level calculated based on current transformer ratio and application power rating.

f) **Loss of sensing voltage shutdown:** Shutdown of generator set will occur on loss of voltage sensing inputs to the control.

g) **Field overload shutdown:** Monitors field voltage to shutdown generator set when a field overload condition occurs.

h) **Overload (kW) warning:** Provides a warning indication when engine is operating at a load level over a set point. Adjustment range: 80-140% of application rated kW, 0-120 second delay. Defaults: 105%, 60 seconds.

i) **Reverse power shutdown (32):** Adjustment range: 5-20% of standby kW rating, delay 1-15 seconds. Default: 10%, 3 seconds.

j) **Reverse VAR shutdown:** Shutdown level is adjustable: 15-50% of rated Var output, delay 10-60 seconds. Default: 20%, 10 seconds

k) **Short circuit protection:** Output current on any phase is more than 175% of rating and approaching the thermal damage point of the alternator. Control includes algorithms to protect alternators from repeated over current conditions over a short period of time.

1.

5. AmpSentry Maintenance Mode (AMM): Instantaneous tripping, if AmpSentry Maintenance mode is active (50mS response to turn off AVR excitation/shutdown genset) for arc flash reduction when personnel are near genset in compliance to NEC 240.87(B)(3).

1.

6. Ground Fault: The control system shall include an input for measurement of ground fault current, and protection that is configurable for current level and time delay, as well as trip or alarm. The generator system shall be separately derived, with a single neutral to

7.

3.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG1-32, CSA C22, IEC34 requirements.

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

C. Electrical Insulation: Class H.

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

E. Range: Provide limited range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: Drip proof.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
   1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator, double layer tap winding and fully linked amortisseur winding.

K. Alternator steady state kVA rating of alternator shall be 88 kW / 110 kVA with a maximum temperature rise of 105-degree C based on maximum specified site conditions.

L. Generator shall be capable of accepting maximum 368 kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor applied to the generator set as required per NEMA-MG1. Motor starting kVA performance that is solely based on initial voltage dip percentage, without showing the ability of the generator set to recover minimum 90% known voltage will not be accepted!

M. Subtransient reactance: 11% or better

N. Alternator shall be equal in performance to the Cummins Stamford/AVK model UC3C and shall be manufactured having quality assurance level to BS EN ISO 9001

O.

3.9 OUTDOOR ENGINE GENERATOR ENCLOSURE

A. Description: UL-2200 vandal-resistant, sound-attenuating, weatherproof aluminum-type housing, wind resistant up to 180 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure. Steel type enclosure will not be accepted!
   1. Sound Attenuation Level: 71.2 dBA at 23 feet at full load in a free field environment, or better

B. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads of up to 180 mph.

C. Muffler Location: Within enclosure.

D. Zinc phosphate pre-treatment, e-coat primer and super durable powder topcoat paint to minimize corrosion and color fade.

E. Cambered roof to prevent water accumulation.

F. Non-hydroscopic sound attenuating enclosure lining material.

G. Hinged Doors: Recessed lockable doors on both sides of the unit. Include retainers to hold doors open for easy access.

H. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.

I. Enclosure interior lining: Provide mill-finished, perforated aluminum finishing panels covering all insulation and sound attenuating lining materials.

J. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours with ambient temperature at top of range specified in system service conditions.
   1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

K. Convenience Outlets: Factory-wired GFCI. Arrange for external electrical connection.

L. Site Lifting Provisions: Complete assembly of engine generator, enclosure, shall be designed to be lifted into place as a single unit, using spread bars.

M.

3.10 VIBRATION ISOLATION DEVICES

A. Shall be provided with elastomeric isolator pads integral to the generator unless engine manufacturer requires spring isolator type.

B. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

C.

3.11 FINISHES

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

B.

3.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
   1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine generator 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 units that are not identical to those on tested prototype to demonstrate compatibility and reliability.
   2. Test generator, exciter, and voltage regulator as a unit.
   3. Full-load run.
   4. Maximum power.
   5. Voltage regulation.
   6. Transient and steady-state governing.
   7. Single-step load pickup.
   8. Safety shutdown.
   9. Report factory test results within 10 days of completion of test.
   10.

3.13 AUTOMATIC TRANSFER SWITCH

A. Provide an automatic transfer switch by one of the manufacturers listed below. Transfer switch must be UL-1008 listed and comply with requirements of NPPA-110 level 1.
   1. Cummins Power Generation
   2. ASCO Power Technologies
   3. Russelectric

B. Indicated current ratings:

C. Transfer switch shall be rated at 400 amps at 208/120Vac, 60Hz, 3-poles with solid neutral and be furnished in a NEMA type 1, indoor wall-mounted enclosure.

Main contacts shall be rated for 600 VAC minimum.

Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C (-40 to +140 degrees F), relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000 meters).

D. Manual Switch Operation: The power transfer mechanism shall include provisions for manual operation under load with the enclosure door closed. Manual operation may be electromechanical or mechanical but must be coordinated with control function.

E. Relay Signal: Control shall include provisions for addition of a pre-transfer relay signal, adjustable from 0 to 60 seconds, to be provided if necessary for elevator operation, based on equipment provided for the project.

F. Control Transfer switch control shall be provided with necessary equipment and software to communicate with the genset control, other transfer switches, remote annunciation equipment, and other devices over a high-speed control network.

G. Transfer switch shall be designated as 3-pole shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.

H. Automatic transfer switch control features:
   1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 VAC. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
   2. The transfer switch sensing shall be configurable from an operator panel with a LCD display. Designs utilizing DIP switches or other electromechanical devices are not acceptable.
   3. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.

4. The transfer switch shall provide a relay contact signal prior to transfer or re-transfer. The time period before and after transfer shall be adjustable in a range of 0 to 60 seconds.

5. The control system shall be designed, and prototype tested, for operation in ambient temperatures from - 40 degrees C to + 60 degrees C (- 40 to +140 degrees F). It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.

6. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI

7. In-phase monitor which actively monitors both sources and only allows the transfer switch to transfer when both source 1 and source 2 are within the acceptable phase angle in relation to each other.

I. Transfer Switch Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for operator-controlled functions, and LED lamps for system status indicators. The panel shall also include an alphanumeric display for detailed system information. Panel display and indicating lamps shall include permanent labels.

1. The indicator panel LEDs shall display the following: switch connected to source. Source availability, not in auto (disabled), test/exercise mode is active.

2. Pushbuttons to allow operators to active the following functions: pre-programmed test sequence, override programmed time delays, reset control panel and clearing faults.

3. The alphanumeric digital display shall be LED backlit LCD and be clearly visible in both bright sunlight and no-light conditions.

4. Controller display shall be password protected.

5. Controller functions managed by the control shall include engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 6 seconds (default 1 sec), Transfer normal to emergency (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec). Re-transfer emergency to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 sec), Engine cooldown: 0 to 30 minutes (default 20 min).

6. Undervoltage and over voltage sensing

7. Over and under frequency sensing

8. Voltage imbalance sensing

9. Phase rotation sensing

10. Programmable exerciser

11. Event log

J. Control Interface:
   1. Engine start contacts

   2. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

   3. The transfer switch shall be provided with a network communication card, and configured to allow network-based communication with the transfer switch and other network system components, including the generator set(s) provided for the Project.

   4. Unassigned Auxiliary Contacts: Two normally open, 1-pole, double-throw contacts for each switch position, rated 10A at 240 VAC.

K. Warranty: Transfer switch warranty shall be 5 years comprehensive.

PART 4 - EXECUTION

4.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

4.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation, application, and alignment instructions and with NFPA 110.Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

D. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

E. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.

F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

G. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

4.3 FIELD QUALITY CONTROL

A. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system.

B. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.

C. Installation acceptance tests to be conducted on site shall include a "cold start" test, a two (2) hour full load test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

D. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service and observing proper operation of the system for at least 30 hours. Coordinate timing and obtain approval for start of test with site personnel.

4.4 TRAINING:

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 1 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner present.

4.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: As an alternate pricing to the customer, provide a preventative maintenance service agreement for the first 24 months of service, from in service date. Maintenance shall be performed by a qualified manufacturer's authorized service representative.

Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

END OF SECTION