



STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

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June 2, 2016

**ADDENDUM NUMBER TWO**

**RFQ # 7550595**

**TITLE: Improvements to the Emergency Power, Pastore Center, Regan Building, DOA**

**Closing Date and Time: 6/14/16 at 1:30 PM**

**Per the issuance of this ADDENDUM # (2), 18 pages and 3 drawings, including this cover sheet.**

**Specification Change /Addition / Clarifications**

Listed are questions we received for this Invitation to Bid. Please include this information when submitting your Bid Response.

1. **Q.** Drawing E-5 proposed One- Line shows ATS-LSI, Panels LS4 and LS2 and a 15 KVA transformer, but doesn't show their location on any floor plans?  
**A.** *See revised plans.*
2. **Q.** Will the temporary generator be used for shut downs? And do we need to refuel it?  
**A.** *Yes temporary generator and fuel.*
3. **Q.** The 750 KVA transformer being removed is it to be moved to a location on site or taken away by the contractor?  
**A.** *Contractor shall transport to the Pastore power plant storage area.*



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4. Q. Liquidated Damages? How Much?  
A. **There are no liquidated damages for this bid.**
  
5. Q. Is the owner removing fuel from above ground tank for the existing Generator  
A. **No this will be the responsibility of the contractor to carefully remove.**
  
6. Q. How much of the exhaust system is being removed  
A. **The complete exhaust system and roof shall be patched as required.**
  
7. Can you provide a campus wide one line M.V. diagram showing feeder C & D  
A. ***We can provide to successful bidder.***
  
8. Q. Can you provide size of temp Generator for Hospital change over  
A. ***Yes, that is indicated on revised bid documents***
  
9. Q. Bid form has allowances and alternate's, unit prices not shown on plans.  
A. **The vendor is not required to complete the line items for Allowance, Alternates or Unit Prices. These items are not applicable to this bid.**

## **ADDENDUM 2**

### **PRE BID QUESTIONS/RESPONSES**

Q1. When is the preferred time to schedule shutdowns.

Response: Shutdowns presently are preferred on Wednesday. However this could change. All shutdowns should be schedule through DOA manager. Temporary generator shall be on site to provide backup power.

Q2. Feeder to 2400 Volt transformers identification.

Response: See revised drawings. System has been redesigned to provide new transformer pad and feeder to minimize switch over issues.

Q3 Is a temporary generator required for shutdowns.

Response: Temporary generator is required for shut downs. Generator for shutdowns shall be 600 kW. Generator to temporarily feed transfers switches being fed from existing generator shall be 400 kW.

Q4. Are all existing generator auxiliaries to be removed.

Response: Contractor is responsible for removal of the following generator auxiliaries:

- a. 1000 gallon above ground fuel tank and associated fuel.
- b. Remote radiator.
- c. Exhaust muffler.

Generator fan and louver shall remain. Relocate cooling thermostat for exhaust fan and louver operation.

Patching of roof shall be included.

Q5. What is the contractor required to do with the 750 kva transformer being removed.

Response: The transformer shall be transported to Powerhouse where it shall be stored.

Q6. Drawing E-5 proposed one line shows ATS-LS1, panels LS4 and LS2 and a 15 kVA transformer, but does not show location on any floor plans.

Response: Refer to revised drawing E-3 location has been shown within the electric room.

### **DRAWING CHANGES**

The following drawings are being replaced/reissued, E-3, E-4 and E-5.

## SPECIFICATIONS

Section 16614 replace with new Section 16614.

Section 16321 Paragraph 2.05 delete A. and B. and insert the following.

### A. Vacuum Fault Interrupters

The transformer shall incorporate a vacuum fault interrupter for overcurrent protection only, such that the major dielectric media is never contaminated by circuit interruption arc products. The device shall interrupt all fault currents up to its maximum rated current of 12,500 (15, 25 or 35 kV) RMS amperes symmetrical. The interrupter shall be manually resettable, with no consumable parts (i.e. fuses). The maximum interrupting time from issuance of a trip signal from the electronic control shall be 2 cycles.

To maximize safety to the operator, the interrupter shall incorporate a trip-free mechanism to prevent the possibility of holding the interrupter mechanism closed under a faulted circuit condition.

The vacuum fault interrupter shall act as a three-phase group operated circuit breaker. The trip mechanisms for each phase shall be [~~select: mechanically linked and the electronic control shall be set so that an overcurrent condition on any one phase shall simultaneously trip all three phases.~~ A single operating handle, shall be provided for manual opening, reset and closing. The operating handle(s) shall be mounted on the front plate of the tank in close relation to the VFI being controlled and shall have three distinct operating positions corresponding to the vacuum fault interrupter positions of closed, open, or tripped. A pointer attached to the handle shall be provided for ready identification of the handle's position. The handle shall be designed for operation with a lineman's hotstick and have a push to close / pull to open / pull to reset operation requiring no more than 75 lbs. of force and 60 degrees of movement for complete operation. Except when equipped with the optional motor operator, when the vacuum fault interrupter is tripped by automatic action of the VFI control, the operating handle shall drop to an intermediate position between its closed and open positions, to provide indication that it is tripped. The operating handle assembly shall include provisions to padlock the handle in the open position.

**B.****Electronic Trip Control**

- 1.1. Overcurrent sensing shall be accomplished with an electronic trip control that shall be Cooper Power Systems type Tri-Phase Control with Ground (TPG) control.
- 1.2. The control shall use internally mounted 1000:1 bushing current transformers (CTs) to sense line current and shall also provide the control operating power, eliminating the effects of system voltage conditions. The control shall be self-contained and includes the following:
  - 1.2.1. Meet the specified time-current curve immediately upon energization.
  - 1.2.2. No "warm-up", initialization, or arming time delays adjustments shall be necessary.
  - 1.2.3. No minimum load requirement or battery back-up device shall be necessary to meet the specified time-current characteristics.
  - 1.2.4. The control shall have a minimum operating temperature range of -30 °C to +65 °C with no more than a ±5% variation in time-current response characteristics from its response at +25 °C.
- 1.3. The standard control shall provide minimum phase overcurrent trip settings that are field selectable (in 10 amp increments) from 20 amps to 1290 amps. Trip settings may be changed while the transformer is energized (so service is not interrupted). An instantaneous trip feature shall be provided as a standard feature of the control. Instantaneous trip shall be a field selectable multiple of 1X, 3X, 5X,...15X times the phase overcurrent trip settings or it may be selected to be disabled. The instantaneous trip feature shall provide a fixed 0.025-second response time characteristic.

SECTION 16614 - DIESEL GENERATOR SETS ARCHITECTURAL FORMAT – 750KW ADD#2

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets suitable for use in mission critical applications with the features as specified and indicated. Engine generators will be used as the Standby power source for the system, but shall be capable of providing reliable power with no run-time limitations while the primary source of power is unavailable.

1.3 DEFINITIONS

- A. Emergency 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 (P<sub>pp</sub>) over 24 hours of operation shall not exceed 70 percent of the ESP unless otherwise agreed by the RIC engine manufacturer.
- B. Limited Time running Power (LTP): Per ISO 8528: The maximum power available, under the agreed operating conditions, for which the generating set is capable of delivering for up to 500 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers.
- C. Continuous Operating Power (COP): Per ISO 8528: The maximum power which a generating set is capable of delivering continuously whilst supplying a constant electrical load when operated for an unlimited number of hours per year under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer.
- D. 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 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.
  3. Sound test data, based on a free field requirement.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.
1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
  2. Wiring Diagrams: Control interconnection, Customer connections.
- C. Certifications:
1. Submit statement of compliance which states the proposed product(s) is certified to the emissions standards required by the location for EPA, stationary emergency application.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Source quality-control test reports.
1. Certified summary of prototype-unit test report. See requirements in Part 2 "Source Quality Control" Article Part A. Include statement indicating torsional compatibility of components.
  2. Certified Test Report: Provide certified test report documenting factory test per the requirements of this specification, as well as certified factory test of generator set sensors per NFPA110 level 1.
  3. List of factory tests to be performed on units to be shipped for this Project.
  4. Report of exhaust emissions and compliance statement certifying compliance with applicable regulations.
- B. Warranty:
1. Submit manufacturer's warranty statement to be provided for this Project.

#### 1.6 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 100 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. Comply with NFPA 37 (Standard For the Installation and Use of Stationary Combustion Engines and Gas Turbines).
- E. Comply with NFPA 70 (National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702).

- F. Comply with NFPA 110 (Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system.
- G. Comply with UL 2200.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  - 1. Ambient Temperature: 0.0 deg C (32.0 deg F) to 25.0 deg C (77.0 deg F).
  - 2. Relative Humidity: 0 to 95 percent.
  - 3. Altitude: Sea level to 361.0 feet (152.0 m).

#### 1.8 WARRANTY

- A. Base Warranty: Manufacturer shall provide base warranty coverage on the material and workmanship of the generator set for a minimum of twenty-four (24) months for Standby product from registered commissioning and start-up.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: The basis for this specification is Cummins Power Generation equipment, approved equals are Caterpillar and Kohler and will be considered if equipment performance is shown to meet or exceed the requirements herein.

#### 2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
  - 1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.
- C. Capacities and Characteristics:
  - 1. Power Output Ratings: Electrical output power rating for Standby operation of not less than 750.0kW, at 80 percent lagging power factor, 277/480, Series Wye, phase, 4 -wire, 60 hertz.
  - 2. Alternator shall be capable of accepting maximum 2944.0 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.

3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component. The engine-generator nameplate shall include information of the power output rating of the equipment.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 0.5 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 5 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.
3. Steady-State Frequency Operational Bandwidth: 0.25 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: Not more than 15 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 10 seconds.
6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.
7. Sustained Short-Circuit Current: For a 3-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 8 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.
8. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements.
9. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.

2.3 ENGINE

- A. Fuel: ASTM D975 #2 Diesel Fuel
- B. Rated Engine Speed: 1800RPM.
- C. Lubrication System: The following items are mounted on engine or skid:
  1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
  2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
  3. 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.

- D. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions
- E. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
- F. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.
- G. Cooling System: Closed loop, liquid cooled
1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 40 deg C.
  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 overflow tank: 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. Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.
- H. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure.
- I. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.
- J. Starting System: 12 or 24V, as recommended by the engine manufacturer; electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
  2. Cranking Cycle: As required by NFPA 110 for level 1 systems.
  3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.
  4. Battery Compartment: Factory fabricated of metal with acid-resistant finish.

5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.
6. Battery Chargers: Unit shall comply with UL 1236, provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:
  - a. Operation: Equalizing-charging rate based on generator set manufacturer's recommendations 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 minus 20 deg C to plus 40 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
  - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
  - d. 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 contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
  - e. Provide LED indication of general charger condition, including charging, faults, and modes. Provide a LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.
  - f. Enclosure and Mounting: NEMA, Type 1, wall-mounted cabinet.

## 2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Sub Base-Mounted Fuel Oil Tank: Provide a double wall secondary containment type sub base fuel storage tank. The tank shall be constructed of corrosion resistant steel and shall be listed and labeled. The fuel tank shall include the following features:
  1. Capacity: Fuel for 24 Hour(s) continuous operation at 100 percent rated power output.
  2. Tank rails and lifting eyes shall be rated for the full dry weight of the tank, genset, and enclosure.
  3. Electrical stub up(s)
  4. Normal & emergency vents
  5. Lockable fuel fill
  6. Mechanical fuel level gauge
  7. High and low level switches to indicate fuel level
  8. Leak detector switch
  9. Sub base tank shall include a welded steel containment basin, sized at a minimum of 110% of the tank capacity to prevent escape of fuel into the environment in the event of a tank rupture.
  10. Fill port with overfill prevention valve (OFPV)
  11. 5 gallon fill/spill dam or bucket
  12. Tank design shall meet the regional requirements for the Project location

## 2.5 CONTROL AND MONITORING

- A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.
- B. 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. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. 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 the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- D. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.
- E. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
  - 1. AC voltmeter (3-phase, line to line and line to neutral values).
  - 2. AC ammeter (3-phases).
  - 3. AC frequency meter.
  - 4. AC kW output (total and for each phase). Display shall indicate power flow direction.
  - 5. AC kVA output (total and for each phase). Display shall indicate power flow direction.
  - 6. AC Power factor (total and for each phase). Display shall indicate leading or lagging condition.
  - 7. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
  - 8. Emergency Stop Switch: Switch shall be a red "mushroom head" pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
  - 9. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
  - 10. DC voltmeter (alternator battery charging).
  - 11. Engine-coolant temperature gauge.
  - 12. Engine lubricating-oil pressure gauge.

13. Running-time meter.
  14. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjust these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.) Th
  15. Fuel tank derangement alarm.
  16. Fuel tank high-level shutdown of fuel supply alarm.
  17. AC Protective Equipment: The control system shall include over/under voltage, reverse kVAR, reverse kW, over load (kW) short circuit, over current, loss of voltage reference, and over excitation shut down protection. There shall be a ground fault alarm for generator sets rated over 1000 amps, overload warning, and overcurrent warning alarm.
  18. Status LED indicating lamps to indicate remote start signal present at the control, existing shutdown condition, existing alarm condition, not in auto, and generator set running.
  19. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.
  20. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.
  21. Data Logging: The control system shall log the latest 20 different alarm and shut down conditions, the total number of times each alarm or shutdown has occurred, and the date and time the latest of these shutdown and fault conditions occurred.
  22. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).
- F. Remote Alarm Annunciator: Comply with NFPA 110. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition.

## 2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Overcurrent Protection: The generator set shall be provided with a 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 device 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 that the protective system is fully operational as manufactured. Protector shall perform the following functions:
1. Initiates a generator kW overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
  2. Under single phase or multiple phase fault conditions, or on overload conditions, indicates an alarm conditions when the current flow is in excess of 110% of rated current for more than 10 seconds.

3. Under single phase or multiple phase fault conditions, operates to switch off alternator excitation at the appropriate time to prevent damage to the alternator.
4. The operator panel shall indicate the nature of the fault condition as either a short circuit or an overload.
5. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot greater than 120% of nominal voltage.
6. The protective system provided shall not include an instantaneous trip function.

## 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
- D. Temperature Rise: 125 / Class H environment.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.
- G. Enclosure: Drip-proof.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.
- I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding. Alternators operating at voltage higher than 690VAC shall be provided with form-wound stator coils.
- J. Subtransient Reactance: 12 percent maximum, based on the rating of the engine generator set.

## 2.8 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Sound Attenuated Aluminum housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.
- B. Construction:
  1. Louvers: Equipped with bird screen to permit air circulation when engine is not running while excluding birds and rodents.
  2. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance. Rain lips over all doors.

3. Exhaust System:
    - a. Muffler Location: Within enclosure.
  4. Hardware: All hardware and hinges shall be stainless steel.
  5. Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.
  6. A weather protective enclosure shall be provided which allows the generator set to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water.
  7. Provide load bank incorporated into unit.
- C. Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 40 deg C.
1. Motorized Louvers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating. Dampers shall be of a “fail open” design to allow airflow in the event of failure.
- D. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 76 dBA measured at any location 7 m from the engine generator in a free field environment.
- E. Electrical Provisions
1. Compliance with NEC: Package shall comply with the requirements of the National Electrical Code for all wiring materials and component spacing.
  2. Provide an internally mounted and wired electrical distribution panel to serve the engine generator and enclosure; including:
    - a. 100 amp distribution panelboard connected to a 120/240VAC utility service by the installer.
    - b. Two duplex GFI receptacles, one inside the enclosure, and a weatherproof receptacle on the outside of the enclosure.
    - c. Factory wired normal AC service from the panelboard to the engine coolant heater, alternator heater, and battery charger.
    - d. Interior Lights with Switch: Two three-way switches controlling three AC lamps mounted in vapor tight and gasketed fixtures
  3. External Electrical Connections: All power and control interconnections shall be made within the perimeter of the enclosure.
- F. Site Provisions:
1. Lifting: Complete assembly of engine generator, enclosure, and sub base fuel tank (when used) shall be designed to be lifted into place as a single unit, using spreader bars.
- 2.9 VIBRATION ISOLATION DEVICES
- A. Vibration Isolation: Generators installed on grade shall be provided with elastomeric isolator pads integral to the generator, unless the engine manufacturer requires use of spring isolation.
- 2.10 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Manufacturer's standard color or as directed on the drawings.

## 2.11 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set 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. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected to actual prototype tests to validate the capability of the design under the abnormal conditions noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
  - 1. Test engine generator set manufactured for this Project to demonstrate compatibility and functionality.
  - 2. Full load run.
  - 3. Maximum power.
  - 4. Voltage regulation.
  - 5. Steady-state governing.
  - 6. Single-step load pickup.
  - 7. Simulated safety shutdowns.
  - 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation, application, 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.

### 3.2 ON-SITE ACCEPTANCE TEST

- 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. Tests shall include:
  - 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 hour full load (resistive) 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 2 hours. Coordinate timing and obtain approval for start of test with site personnel. Fuel costs shall be borne by the contractor. Tank shall be filled after testing.

### 3.3 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 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

### 3.5 SERVICE AND SUPPORT

- A. The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of \$3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including engines, alternators, control systems, paralleling electronics, and power transfer equipment.
- B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within 100 of the site.
- C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

END OF SECTION