PART 1 - GENERAL

1.01 REFERENCES AND STANDARDS
The generator set covered by these specifications shall be designed, tested, rated, assembled and installed in strict accordance with all applicable standards below:
- CSA C22.2 No14
- CSA 282
- CSA 100
- EN61000-6
- EN55011
- FCC Part 15 Subpart B
- ISO8528
- IEC61000
- UL508
- UL2200
- UL142
- Designed to allow for installed compliance to NFPA 70, NFPA99 and NFPA 110

1.02 WORK INCLUDED
A. Installation
The work includes supplying and installing a complete integrated generator system. The system consists of a diesel generator set with related component accessories and automatic transfer switches specified under a separate section.
B. Fuel System
The CONTRACTOR shall provide a full tank of diesel fuel at the completion of the project.
C. System Test
A complete system load test shall be performed after all equipment is installed. Guidelines in the Start-up Section.
D. Requirements, Codes and Regulations
The equipment supplied and installed shall meet the requirements of the NEC and all applicable local codes and regulations. All equipment shall be of new and current production by a MANUFACTURER who has 25 years of experience building this type of equipment. Manufacturer shall be ISO9001 certified.

1.03 SUBSTITUTION
Proposed deviations from the specifications shall be treated as follows:
A. Substitution Responsibility
The power system has been designed to the specified manufacturer's electrical and physical characteristics. The equipment sizing, spacing, amounts, electrical wiring, ventilation equipment, fuel, and exhaust components have all been sized and designed around CATERPILLAR supplied equipment. Equal equipment from an alternate manufacturers including Onan, Kohler, or Generac meeting the requirements of the specifications will be considered.

1.04 SUBMITTALS
A. Engine-generator submittals shall include the following information:
   1. Factory published specification sheet.
   2. Manufacturer's catalog cut sheets of all auxiliary components such as battery charger,
control panel, enclosure, etc.
3. Dimensional elevation and layout drawings of the generator set, enclosure and transfer switchgear and related accessories.
4. Weights of all equipment.
5. Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.
6. Interconnect wiring diagram of complete emergency system, including generator, switchgear, day tank, remote pumps, battery charger, control panel, and remote alarm indications.
7. Engine mechanical data, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, fuel consumption, etc.
8. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
9. Generator resistances, reactances and time constants.
10. Generator locked rotor motor starting curves.
11. Manufacturer's documentation showing maximum expected transient voltage and frequency dips, and recovery time during operation of the generator set at the specified site conditions with the specified loads.
12. Manufacturer's and dealer's written warranty.

1.05 SYSTEM RESPONSIBILITY
A. Generator Set Distributor
The completed engine generator set shall be supplied by the Manufacturer's authorized distributor only.

B. Requirements, Codes and Regulations
The equipment supplied and installed shall meet the requirements of NEC and all-applicable local codes and regulations. All equipment shall be new, of current production. There shall be one source responsibility for warranty; parts and service through a local representative with factory trained service personnel.

C. Automatic Transfer Switch
The automatic transfer switch specified in another section shall be supplied by the generator set manufacturer in order to establish and maintain a single source of system responsibility and coordination.

1.06 WARRANTY
A. Two Year Standby (ISO 8528-1: ESP) Generator Set Warranty. The manufacturer's standard warranty shall in no event be for a period of less than two (2) years from 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.

1.07 PARTS AND SERVICE QUALIFICATIONS
A. Service Facility
The engine-generator supplier shall maintain 24-hour parts and service capability within 75 miles of the project site. The distributor shall stock parts as needed to support the generator set package for this specific project. The supplier must carry sufficient inventory to cover no less than 80% parts service within 24hrs and 95% within 48 hours.

B. Service Personnel
The dealer shall maintain qualified factory trained service personnel.
PART 2 - PRODUCT SPECIFICATIONS

2.01 GENERAL REQUIREMENTS

A. Genset Requirements
The generator set shall be a Caterpillar C15, Standby Duty rated at 250.0 ekW, 312.5 kVA, 1800 RPM, 0.8 power factor, 480 V, 3-Phase, 60 hertz, including radiator fan and all parasitic loads. Generator set shall be sized to operate at the specified load at a maximum ambient of 110F (43.3C) and altitude of 1,000.0 feet (304.8 m).
Standby Power Rating:
Power is available for the duration of an emergency outage
Average Power Output = 70% of standby power
Load = Varying
Typical Hours/Year = 200 Hours
Maximum Expected Usage = 500 hours/year
Typical Application = Standby

B. Material and Parts
All materials and parts comprising the unit shall be new and unused.

C. Engine
The engine shall be diesel fueled, four (4) cycle, water-cooled, while operating with nominal speed not exceeding 1800 RPM. The engine will utilize in-cylinder combustion technology, as required, 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 T3

D. Engine Governing
The engine governor shall be a 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 +/- 6 RPM. 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.

2.02 GENERATOR

A. Generator Specifications
The synchronous three phase generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling. The generator shall meet performance class G2 of ISO 8528. The excitation system shall enable the alternator to sustain 300% of rated current based on the 125C (Class H) or 105C (Class F) rise rating for ten seconds during a fault condition and shall improve the immunity of the voltage regulator to non-linear distorting loads. The excitation system shall be of brushless construction and be independent of main stator windings (either permanent magnet or auxiliary windings).
B. Voltage Regulator

Digital Voltage Regulator

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.

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.

C. Motor Starting

Provide locked rotor motor starting capability of 1,055.6 skVA at 30% instantaneous voltage dip as defined per NEMA MG 1. Sustained voltage dip data is not acceptable.

2.03 CIRCUIT BREAKER

A. Circuit Breaker Specifications

Provide a generator mounted circuit breaker, molded case, one 200 amp trip, 3 pole and one 100 amp trip, 3 pole, NEMA 1/IP22. Breaker shall utilize a solid state trip unit. The breaker shall be UL/CSA Listed and connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box, which is isolated from vibrations induced by the generator set. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.

2.04 CONTROLS - GENERATOR SET MOUNTED

Provide a fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine manufacturer. The control shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls via SAE J1939.

A. Environmental

The generator set control shall be tested and certified to the following environmental conditions.

1. -40°C to +70°C Operating Range
2. 95% humidity non-condensing, 30°C to 60°C
3. IP22 protection for rear of controller; IP55 when installed in control panel
4. 5% salt spray, 48 hours, +38°C, 36.8V system voltage
5. Sinusoidal vibration 4.3G's RMS, 24-1000Hz
7. Shock: withstand 15G

B. Functional Requirements

The following functionality shall be integral to the control panel.

1. The control shall include a 33 x 132 pixel, 24mm x 95mm, positive image, transflective LCD display with text based alarm/event descriptions.
2. Audible horn for alarm and shutdown with horn silence switch
3. Standard ISO labeling
4. Multiple language capability
5. Remote start/stop control
6. Local run/off/auto control integral to system microprocessor
7. Cooldown timer
8. Speed adjust
9. Lamp test
10. Push button emergency stop button
11. Voltage adjust
12. Voltage regulator V/Hz slope - adjustable
13. Password protected system programming
   a. Digital Monitoring Capability
14. The controls shall provide the following digital readouts for the engine and generator.
15. All readings shall be indicated in either metric or English units

**Engine**

1. Engine oil pressure
2. Engine oil temperature
3. Engine coolant temperature
4. Engine RPM
5. Battery volts

**Generator**

1. Generator AC volts (Line to Line, Line to Neutral and Average)
2. Generator AC current (Avg and Per Phase)
3. Generator AC Frequency
4. Generator kW (Total and Per Phase)
5. Generator kVA (Total and Per Phase)
6. Generator kVAR (Total and Per Phase)
7. Power Factor (Avg and Per Phase)
8. Total kW-hr
9. Total kVAR-hr
10. % kW
11. % kVA
12. % kVAR

**C. Alarms and Shutdowns**

The control shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by a time, date, and engine hour stamp that are stored by the control panel for first and last occurrence:

**Engine Alarm/Shutdown**

1. Low oil pressure alarm/shutdown
2. High coolant temperature alarm/shutdown
3. Loss of coolant shutdown
4. Overspeed shutdown
5. Overcrank shutdown
6. Low coolant level alarm
7. Low fuel level alarm
8. Emergency stop depressed shutdown
9. Low coolant temperature alarm
10. Low battery voltage alarm
11. High battery voltage alarm
12. Control switch not in auto position alarm
13. Battery charger failure alarm
Generator Alarm/Shutdown
1. Generator Over Voltage
2. Generator Under Voltage
3. Generator Over Frequency
4. Generator Under Frequency
5. Generator Overcurrent

Voltage Regulation (available only with adjustable voltage regulator)
1. Loss of excitation alarm/shutdown
2. Instantaneous over excitation alarm/shutdown
3. Time over excitation alarm/shutdown
4. Rotating diode failure
5. Loss of sensing
6. Loss of PMG

D. Inputs and Outputs
Programmable Digital Inputs
The Controller shall include the ability to accept eight (8) total with six (6) programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.

Programmable Relay Outputs
The control shall include the ability to operate eight (8) total with six (6) programmable relay output signals, integral to the controller. The output relays shall be rated for 2A @ 30VDC and consist of six (6) Form A (Normally Open) contacts and two (2) Form C (Normally Open & Normally Closed) contacts.

Programmable Discrete Outputs
The control shall include the ability to operate one (1) discrete output, integral to the controller, which is capable of sinking up to 300mA.

E. Maintenance
All engine, voltage regulator, control panel and accessory units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control:
1. Engine running hours display
2. Service maintenance interval (running hours or calendar days)
3. Engine crank attempt counter
4. Engine successful starts counter
5. 20 events are stored in control panel memory
6. Programmable cycle timer that starts and runs the generator for a predetermined time. The timer shall use 14 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:
   a. Day of week
   b. Time of day to start
   c. Duration of cycle

F. Remote Communications
Remote Communications
The control shall include Modbus RTU communications as standard via RS-485 half duplex with configurable baud rates from 2.4k to 57.6k.

Remote Monitoring Software
The control shall provide Monitoring Software with the following functionality
1. Provide access to all date and events on generator set communications network
2. Provide remote control capability for the generator set
3. Ability to communicate via Modbus RTU or remote modem

G. Local and Remote Annunciation
Local Annunciator (NFPA 99/110, CSA 282)
Provide a local, control panel mounted, annunciator to meet the requirements of NFPA 110, Level 1.
1. Annunciators shall be networked directly to the generator set control
2. Local Annunciator shall include a lamp test pushbutton, alarm horn and alarm acknowledge pushbutton
3. Provide the following individual light indications for protection and diagnostics
   a. Overcrank
   b. Low coolant temperature
   c. High coolant temperature warning
   d. High coolant temperature shutdown
   e. Low oil pressure warning
   f. Low oil pressure shutdown
   g. Overspeed
   h. Low coolant level
   i. EPS supplying load
   j. Control switch not in auto
   k. High battery voltage
   l. Low battery voltage
   m. Battery charger AC failure
   n. Emergency stop
   o. Spare
   p. Spare

Remote Annunciator (NFPA 99/110, CSA 282)
Provide a remote annunciator to meet the requirements of NFPA 110, Level 1.
1. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.
2. Ability to be located up to 800 ft from the generator set

2.05 COOLING SYSTEM
A. The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 110 F* ambient air entering the room or enclosure (If an enclosure is specified). The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

2.06 FUEL SYSTEM
A. Fuel System
The fuel system shall be integral with the engine. In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine. All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted. Flexible fuel lines shall be minimally rated for 300 degrees F and 100 psi.

B. Fuel Sub Base Tank
Provide a double wall sub-base tank constructed to meet all local codes and requirements. A fuel tank base of 24-hour capacity shall be provided as an integral part of the enclosure. It shall be contained in a rupture basin with 110% capacity. The tank shall meet UL142 standards. A locking fill cap, a mechanical reading fuel level gauge, low fuel level alarm contact, and fuel
tank rupture alarm contact shall be provided.

2.07 STARTING SYSTEM

A. Starting Motor
   A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.

B. Jacket Water Heater
   Jacket water heater shall be provided and shall be sized to insure that genset will start within the specified time period and ambient conditions.

C. Batteries
   Batteries - A lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system.

D. Battery Charger
   Battery Charger - A current limiting battery charger shall be furnished to automatically recharge batteries. The charger shall be dual charge rate with automatic switching to the boost rate when required. The battery charger shall be mounted on the genset package or inside the genset enclosure/room.

2.08 ENCLOSURE

A. STANDARD WEATHERPROOF ENCLOSURE
   The complete diesel engine generator set, including generator control panel, engine starting batteries and fuel oil tank, shall be enclosed in a factory assembled, weather protective enclosure mounted on the fuel tank base.
   1. A weather resistant enclosure of steel with electrostatically applied powder coated baked polyester paint. It shall consist of a roof, side walls, and end walls. Fasteners shall be either zinc plated or stainless steel. Handles shall be key lockable, all doors keyed alike, and hinges shall be zinc die cast or stainless steel. Access doors shall be hinged and can be lifted off after opening 90 degrees. Intake openings shall be screened to prevent the entrance of rodents or pests.
   2. Lube oil and coolant drains shall be extended to the exterior of the enclosure and terminated with drain valves. Cooling fan and charging alternator shall be fully guarded to prevent injury.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's recommendations, the project drawings and specifications, and all applicable codes.

B. After installation and all testing, the fuel tank shall be completely filled.

3.02 START-UP AND TESTING

A. Coordinate all start-up and testing activities with the Engineer and Owner. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:

B. Perform a 4 hour load bank test at a 1.0 PF at full nameplate rating. Load bank, cables and other equipment required for this test to be supplied by the genset supplier.

3.03 OPERATION AND MAINTENANCE MANUALS

A. Provide two (2) sets of operation and maintenance manuals covering the generator, switchgear, and auxiliary components. Include final as-built wiring interconnect diagrams and recommended preventative maintenance schedules.

CONSTRUCTION DOCUMENTS PACKAGE
REVISED 08-APR-16
3.04 TRAINING

A. On-Site Training
   Provide on-site training to instruct the owner's personnel in the proper operation and
   maintenance of the equipment. Review operation and maintenance manuals, parts manuals,
   and emergency service procedures.