



**E-54 Regional Lift Station - RFCSP
Solicitation Number: CO-00537
Job No.: 22-2502**

**ADDENDUM 6
November 4, 2022**

To Respondent of Record:

This addendum, applicable to project referenced above, is an amendment to the proposal, plans and specifications and as such will be a part of and included in the Contract Documents. Acknowledge receipt of this addendum by entering the addendum number and issue date on the space provided in submitted copies of the Respondent Questionnaire.

RESPONSES TO QUESTIONS

QUESTION 1:

Specification Section 16231 2.01 D.2 specifies the generator sub-base tank to be sized for 48 hours at 100% load, however, Sheet E2.00 1-line diagram calls for 24 hour sub-base tank capacity. Please clarify which is correct as this will affect the generator lead times.

RESPONSE: The generator sub-base tank shall have 24-hour capacity at 100% load. See Changes to the Specifications #1.

QUESTION 2:

Please take a look at this bid item. It is a LS but there is no quantity in the specs or plans to determine the lump sum.

RESPONSE: Special Provision to Standard Technical Specification Item No. 865 (Bypass Pumping Small Diameter Sanitary Sewer Mains) outlines measurement and payment specifications for this line item. Although Specification Item No. 865 requires the contractor to provide his own proposed bypass plans including set up(s), pumps, pipe, plugs, transmitters and any other items for successful bypass pumping for review, the plans provide suggested bypass plans and anticipated flows to assist the contractor in planning and pricing. In addition, Specification Section 01105 (Sequence of Construction) provides suggested sequencing for the contractor to establish his small diameter bypass pumping plan.

CHANGES TO THE SPECIFICATIONS

1. Remove Specification Section 16231: Packaged Engine Generator Systems and replace with revised version attached to this addendum.

ADDENDUM

This Addendum, including these (2) pages, is seventeen (17) pages with attachments in its entirety.

Attachments:

Section 16231 – Packaged Engine Generator Systems



Kim Keefer 11/3/2022

Kim Keefer, P.E.
Pape-Dawson Engineers, Inc.

SECTION 16231**PACKAGED ENGINE GENERATOR SYSTEMS****PART 1 GENERAL****1.01 SCOPE OF WORK**

- A. Packaged engine generator systems shall include but are not limited to:
 - 1. Engine generator set.
 - 2. Weatherproof sound attenuated enclosure.
 - 3. Fuel sub-base tank.
 - 4. Battery and charger.
 - 5. Exhaust silencer.
 - 6. Spring isolators.

1.02 RELATED WORK

- A. Division 01 – General Provisions
- B. Division 16 – Electrical

1.03 SUBMITTALS

- A. Shop Drawings
 - 1. Furnish shop drawings showing plan and elevation views with overall and interconnection point dimensions, weight, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
 - 2. Furnish product data showing dimensions, weights, ratings, interconnection points and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, and day tank.
 - 3. Furnish generator data sheets including weights, excitation currents, per unit reactance's (subtransient, transient, synchronous, negative sequence and zero sequence), motor starting capabilities (kVA), time constants (subtransient, transient, open circuit and DC) and winding resistances. Submit expected performance data for the engine generator set.
 - 4. Furnish generator connection diagram.
 - 5. Submit computer analysis for generator loading, motor starting, critical speed and vibratory stress. Analysis that fails to meet sizing and starting requirements will be rejected.
 - 6. Furnish enclosure sound performance data.
 - 7. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the Specifications.
- B. Certifications and shop Tests
 - 1. Submit a letter certifying full and complete compliance with the Specifications, Drawings and other project requirements. The letter shall list any exceptions or deviations from specified requirements, if any and reasons for same. Exceptions or deviation shall also be clearly marked in a separate color in submittals.
- C. Operations and Maintenance Manuals

1. Provide operation and maintenance manual. Furnish instructions for installation, maintenance, normal operation and emergency operation.

1.04 REFERENCE STANDARDS**A. The following standards and codes shall be applicable:**

1. IEEE32 - Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices.
2. NFPA 110 – Standard for Emergency and Standby Power Systems.
3. NFPA 70 - National Electrical Code.
4. NFPA 37 - Standard for the installation and use of Stationary Combustion Engines and Gas Turbines.
5. UL508 - UL Safety Standard for Industrial Control Equipment.
6. UL2085 - UL Standard for Safety Protected Above Ground Tanks for Flammable and Combustible Liquids.
7. ISO8528 - Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets.
8. UL142 - Steel Above Ground Tanks for Flammable and Combustible Liquids.
9. UL2200 - Standard for Safety Stationary Engine Generator Assembly.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in packaged engine generator systems for a minimum period of ten (10) years and at least ten successful working installations of this type equipment.

B. Acceptable Manufacturers

1. Cummins.
2. Caterpillar.
3. Kohler.
4. Generac
5. MTU (Katolight)
6. The listing of specific manufacturer above does not imply acceptance of their products that do not meet the specified rating, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

C. Services of Manufacturer’s representative

1. Training
 - a. Provide one day of 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. Date shall be coordinated with Owner two weeks minimum prior to anticipate session.
2. Demonstration
 - a. Provide system demonstration to Owner and Engineer.

- b. Simulate power outage by interrupting normal source and demonstrate that system operates to provide power that all controls are operative and that units operate satisfactorily in the event of interruption of normal power.
- c. Schedule the demonstration a minimum of two (2) weeks in advance.
- D. Supplier Qualifications: Authorized local distributor of engine generator manufacturer with staffed service facilities within 50 miles of project site.
- E. The engine-generator supplier shall maintain 24-hour parts and service capability within 250 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.
- F. Generator package shall be factory assembled and prototype tested.
- G. Units shall fit into the space available with adequate clearance for service as determined by the Engineer. Submitted units, which do not meet these criteria, shall be rejected. Do not assume that all of the manufacturers listed as acceptable manufacturers will provide a unit that will fit in the space allocated. Selection of acceptable manufacturers is not based on whether the manufacturer's standard stock unit will fit into every space allocated.

1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS

A. Generator Set Performance

1. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
2. Steady-State Voltage Modulation Frequency: Less than one Hz.
3. Transient Voltage Performance: Not more than 15 percent variation for 100 percent step-load. Voltage recovers to remain within the steady-state operating band within 5 seconds.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there are no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 5 percent variation for a 100 percent step-load increase or decrease. Frequency recovers to remain within the steady-state operating band within 5 seconds.
7. Output Waveform: The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic and no 3rd order harmonics or their multiples. . The telephone influence factor, determined according to NEMA MG 1, does not exceed 50.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at the system output terminals, the system will 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 winding insulation or any other generator system component.
9. The generator set shall be provided with a 100% rated circuit breaker sized to carry the rated output current of the generator set. Circuit breaker to be located inside the generator enclosure and designed to protect the generator.

10. Starting Time: The unit shall be capable of reaching full rated voltage and frequency and accepting full rated load in one step within 10 seconds after receiving a start signal, under the ambient conditions specified herein.
11. Transient Overspeed Response: During recovery from transients caused by step load increases or decreases, or resulting from 100 percent load rejection, the speed of the diesel generator shall not reach the overspeed shutdown setpoint.
12. The generator shall be capable of starting and running the following loads with an instantaneous voltage dip not to exceed 15%. Size the generator based on starting all pumps motors across the line and the last pump across the line with all other loads running. Using an oversized alternator to reduce the generator kW rating below the required minimum is prohibited.
13. The generator shall be able to start and run the following loads: As shown on the one-line diagram.

B. Ratings

1. The generator set shall be rated for standby duty at a minimum of **(SEE ONE LINE DRAWING for Generator Sizing in KW/KVA)** 1800 RPM, 0.8 power factor, 480/277 VAC, 3 phase, 4 wire, 60 hertz including radiator fan and all parasitic loads.
2. The generator set shall be sized to operate at the specified load at a maximum ambient of 122° F or 50° C and altitude of 1000 feet.
3. Standby duty operation is defined per the following operational guidelines:
 - a. Power is available for the duration of an emergency outage.
 - b. Average Power Output = 70% of standby power.
 - c. Load = Varying.
 - d. Typical Hours/Year = 200 Hours.
4. Maximum Expected Usage = 500 hours/year.

1.07 DELIVERY, HANDLING AND STORAGE

- A. Equipment shall be packaged to avoid breakage and shall be clearly labeled for shipment. Equipment prone to breakage during shipment will be packaged in a separate container that is also clearly labeled.
- B. All connections shall be either capped or covered with a watertight material to avoid dirt, debris and moisture from reaching internal surfaces of the equipment before installation.

1.08 MAINTENANCE/SPARE PARTS

- A. Furnish extra materials described below that match products installed. All materials need to be packaged with protective covering for storage, and identified with labels describing contents. Deliver extra materials to Owner.
 1. Fuses: 1 for every 10 of each type and rating, but not less than 1 of each.
 2. Indicator Lamps: 2 for every 6 of each type used, but not less than 2 of each.
 3. Filters: One set each of lubricating oil, fuel, and combustion air filters for each engine.

1.09 WARRANTY/EXTENDED WARRANTY

- A. The manufacturer's standard warranty for standby duty applications shall in no event be for a period of less than five (5) years from date of field acceptance testing 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. The warranty shall include mandatory service calls every twelve (12) months and shall cover additional service calls as necessary for maintenance.

PART 2 PRODUCTS**2.01 MATERIALS****A. Engine**

1. Type: Liquid-cooled, four stroke turbo-charged internal combustion engine with pressure lubrication system.
2. Fuel System: Appropriate for use of No. 2 diesel fuel.
3. Engine Speed: Not more than 1800 RPM.
4. Emissions: Engine emissions shall comply with EPA Tier 3 requirements for stationary generator sets. Generator shall also comply with all Federal, State and local emission requirements.
5. The engine governor shall be an electronic Engine Control Module (ECM) with 12-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 drop 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.
6. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer. Individual indicating lights for each function.
7. Engine Jacket Heaters: Provide jacket water heater with circulation pump and integral thermostatic control, sized to maintain engine jacket water at 90° F and suitable for operation on 208VAC single phase, manually adjustable. Heater shall be equipped with isolation valves at the engine block to enable repairs without draining the engine coolant.
8. Engine Water Pumps: Engine-driven water pump(s) sized to maintain safe engine temperature using a 50 percent ethylene glycol and water mixture thru the engine mounted radiator.
9. Engine Mounted Radiator: Air-cooled radiator with blower type fan sized to maintain safe engine temperature in 122° F or 50° C ambient air with 50 percent ethylene glycol solution.
10. Engine Accessories:
 - a. Fuel filters, lube oil filters, intake air filters, fuel transfer pump, fuel priming pump, flex fuel lines.
 - b. Fuel primary filter, Racor triplex type, 30 micron, with isolation valves, water detection and filter restriction sensors. Wire alarms to the engine control system.

- c. Engine driven charging alternator, 24 VDC, 45 amps.
11. Mounting: Mount engine, generator and cooling system on a common structural base.
 12. Electric Starters: One (1) electric starting motor shall be furnished on the engine. One starter motor shall be capable of starting the engine. The starting motors shall be 12 VDC with positive engagement drive.
 13. Batteries: Two (2) set of heavy-duty, diesel starting type lead-acid storage batteries, one battery string per starting motor. Provide (2) 4D battery per starter, minimum 380 amp-hour capacity. Match battery voltage to starting system. Include necessary cables and clamps and racks. Size battery system to provide minimum of five consecutive 10-second cranking cycles at minimum ambient temperature of 40 degrees F.
 14. Battery heater pads: Provide battery heater pads, Kim Hotstart or equal, with thermostat and interconnecting cables. Battery pads shall be connected to the auxiliary AC panel in the enclosure.
 15. Battery Charger: Two (2) set of battery chargers, 2-rate automatic type, Sens Model NRG or equal, 10 amp output. Provide dry contacts for low dc, high dc, and charger failure. The chargers shall be internally protected against overload while the engine alternator is operating. Chargers shall be UL listed.
- B. Generator
1. Each generator shall be rated as specified on 1.06.
 2. The synchronous three phase generator shall be a self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling.
 3. The insulation material shall meet NEMA MG-1 standards for Class H insulation and be vacuum impregnated with epoxy varnish to be fungus resistant. Temperature rise of the rotor and stator shall not exceed 105° C in a 40° C ambient. Stator windings shall be form wound construction.
 4. Each generator shall utilize a permanent magnet excitation system capable of sustaining at least 300% rated current for 10 seconds under a 3 phase symmetrical fault. The excitation system shall be of brushless construction.
 5. Voltage Regulator:
 - a. The digital voltage regulator shall be microprocessor based with fully programmable operating and protection characteristics. The regulator shall maintain generator output voltage within +/- 0.5% 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. 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.
 - b. The voltage regulator shall communicate with the Generator Control Panel via a 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.

6. Provide two embedded resistance temperature detectors per phase in the stator and one per each generator bearing connected to a transducer at each generator. Monitoring of stator and bearing temperatures with alarm or shutdown shall be capable through the engine control panel.
 7. Provide generator winding space heater with thermostat suitable for operation on 208 VAC, single phase.
 8. The generator shall be provided with a 100% rated Main output breaker supplied and installed by the generator manufacturer.
- C. Weatherproof Sounds Attenuated Enclosure
1. Provide a sound attenuated non walk-in type weatherproof enclosure with a resulting sound level not to exceed 50 dbA @ 62 feet min. or per local ordinance at the property line. Enclosure shall be constructed of formed galvanized sheet metal panels. The enclosure shall be sized to adequately house the generator set and all accessories. Enclosure shall be designed for a minimum wind load rating of 100 mph.
 2. Walls and roof shall be constructed of minimum 14 gauge galvanized sheet metal. The roof shall be adequately braced to support the exhaust silencers and other roof mounted components. Provide acoustic insulation and a perforated galvanized liner in the walls and roof as needed to achieve the sound level specified. Enclosure shall be equipped with 4 point lifting means to remove the enclosure from the base.
 3. Provide a structural base with full steel floor engineered to support the generator, enclosure and all related accessories. All conduits shall enter through an electrical stub-up located directly under the generator terminal box. Provide four point lifting lugs suitable for lifting the entire package.
 4. Provide two entrance doors on each side. Doors shall be strategically located to provide easy access and serviceability. One door shall be located directly in front of the generator terminal box. Door latches shall be refrigerator type. Door hinges and hardware shall be stainless steel. Each door shall be equipped with an aluminum access stair, access platform, and handrails per OSHA guidelines. Contractor shall coordinate with the generator manufacture for location and orientation of the required access stairs and shall provide the concrete pad required for mounting and access to the stairs.
 5. Intake air shall enter the enclosure through an acoustic baffle section located in the rear wall of the enclosure and shall include birdscreen. Air intake shall be 1250 feet per minute of less or minimize water intrusion. The radiator discharge air shall pass through an acoustic baffle section or vertical discharge plenum section, which incorporates a gravity damper and birdscreen. Intake louvers shall be fixed open galvanized construction. The air handling system shall be engineered and constructed so as not to exceed a total of 0.50 inches of water gauge static pressure drop with minimal water intrusion.
 6. Provide a complete pre-fabricated two-stage exhaust system to achieve the specified sound level to include internal mounting of the first stage silencer, external mounting of the second stage silencer, including stainless steel flex connector, silencer, elbow, rain cap, rain shield and silencer mounting brackets. The first stage silencer shall be internally insulated and associated internal piping wrapped with blankets. The exhaust system shall be completely assembled by the generator set supplier prior to shipment and the external second stage silencer removed for shipment.

7. Provide four (4) 12 VDC lights powered from the engine cranking batteries with spring wound 1 hour timer.
 8. If the generator has fill or inspection ports within 12" of the underside of the generator enclosure, the enclosure manufacturer shall provide an access hatch through the roof of the enclosure for maintenance. All generator enclosures with roof access hatches shall also be provide with stainless steel external access ladders per OSHA Guidelines.
- D. Fuel Tank Base
1. The complete generator package and sound attenuated enclosure shall be mounted on a structural steel base that incorporates an integral double wall fuel storage tank. The base shall be designed with adequate provisions to lift and transport the complete package to the jobsite.
 2. The generator sub-base tank shall be listed and labeled as UL142. The fuel tank shall be sized for 24 hours operation of the standby generator at 100% load.
 3. The primary tank shall be fabricated from minimum 3/16" steel. The tank shall be designed, tested and labeled per UL requirements. Lift lugs shall be approved by UL with a 4 to 1 safety factor. The primary fuel tank and secondary tank shall be tested at 3-5 PSI air pressure as outlined in UL 142.
 4. The tank shall incorporate internal stiffeners to create a smooth tank top surface and limit the accumulation of water on top of the tank. No external support beams shall be permitted on top of the tank to maintain a clear walkway around the generator. Provide a non-skid walk surface on the tank top.
 5. The tank shall be clearly labeled with the label indicating the type of product, the volume capacity and the manufacturer.
 6. Updraft and emergency venting systems shall be provided by tank manufacturer per UL 142 requirements. The normal vent shall extend thru the enclosure roof with a watertight penetration.
 7. The tank is intended for stationary installation and in accordance with NFPA 37, NFPA 110 and Uniform Fire Code.
 8. The following accessories shall be installed in the tank:
 - a. Leak sensor switch installed in interstitial space and wired to generator I/O module.
 - b. Low level switch set to alarm at 30% of tank capacity and wired to generator I/O module.
 - c. High level switch set to alarm at 95% of tank capacity and wired to generator I/O module.
 - d. Internal spill containment fill, 5 gallon capacity, affixed to the top of the tank. Provide a handle pull drain to allow spilled fuel to return to the tank.
 - e. Mechanical fill limiter with tight fill adapter and high level alarm.
 - f. Mechanical level gauge and electronic level gauge with 4-20mA output.
 - g. Engine supply pick-up tube and return connections with suction drop tube.
 - h. Electrical stub-up, rectangular type, located directly beneath the generator power terminations.

- a. The control shall include a minimum 64 x 240 pixel, 28mm x 100mm, white backlight graphical display with text based alarm/event descriptions.
 - b. The control shall include a minimum of 2-line data display.
 - c. Audible horn for alarm and shutdown with horn silence switch.
 - d. Multiple language capability.
 - e. Remote start/stop control.
 - f. Local run/off/auto control integral to system microprocessor.
 - g. Cooldown timer.
 - h. Speed adjust.
 - i. Lamp test.
 - j. Push button emergency stop button.
 - k. Voltage adjust.
 - l. Voltage regulator V/Hz slope - adjustable.
 - m. Password protected system programming.
4. The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units.
- a. Engine
 1. Engine oil pressure.
 2. Engine oil temperature.
 3. Engine coolant temperature.
 4. Engine RPM.
 5. Battery volts.
 6. Engine hours.
 - b. Generator
 1. Generator AC volts (Line to Line, and Line to Neutral).
 2. Generator AC current (and Per Phase).
 3. Generator AC Frequency.
 4. Generator kW (Per Phase).
 5. Generator kVA (Per Phase).
 6. Generator kVAR (Per Phase).
 7. Power Factor (Per Phase).
 - c. The following information shall be available as service data only:
 1. Fuel temperature.
 2. Fuel pressure.
 3. Fuel filter differential pressure.
 4. Fuel consumption rate.
 5. Total fuel consumed.

5. 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:
 - a. Engine Alarm/Shutdown
 1. Low oil pressure alarm/shutdown.
 2. High coolant temperature alarm/shutdown.
 3. Overspeed shutdown.
 4. Overcrank shutdown.
 5. High air inlet temperature alarm/shutdown.
 6. Emergency stop depressed shutdown.
 7. Low coolant temperature alarm.
 8. Low battery voltage alarm.
 9. High battery voltage alarm.
 10. Battery charger failure alarm.
 - b. Generator Alarm/Shutdown
 1. Generator over voltage.
 2. Generator under voltage.
 3. Generator over frequency.
 4. Generator under frequency.
 5. Generator reverse power.
 6. Generator overcurrent.
 - c. Voltage Regulator Alarm/Shutdown
6. The Controller shall include the ability to accept ten (10) programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.
7. The control shall include the ability to operate ten (10) 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 ten (10) Form C (Normally Open & Normally Closed) contacts.
8. The control shall include the ability to operate two (2) discrete outputs, integral to the controller, which are capable of sinking up to 300mA.
9. 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.
 - a. Engine running hours display.
 - b. Service maintenance interval (running hours or calendar days).
 - c. Engine crank attempt counter.
 - d. Engine successful starts counter.
 - e. 20 events are stored in control panel memory.

- f. 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:
 - i. Day of week.
 - ii. Time of day to start.
 - iii. Duration of cycle.
- 10. The control shall include Modbus TCP or MODBUS RTU Communication.
- 11. Provide a local, control panel mounted, annunciator to meet the requirements of NFPA 110, Level 1.
 - a. Annunciators shall be networked directly to the generator set control.
 - b. Local Annunciator shall include a lamp test pushbutton, alarm horn and alarm acknowledge pushbutton.
 - c. Provide the following individual light indications for protection and diagnostics.
 - i. Overcrank.
 - ii. Low coolant temperature.
 - iii. High coolant temperature warning.
 - iv. High coolant temperature shutdown.
 - v. Low oil pressure warning.
 - vi. Low oil pressure shutdown.
 - vii. Overspeed.
 - viii. Low coolant level.
 - ix. High battery voltage.
 - x. Low battery voltage.
 - xi. Battery charger AC failure.
 - xii. Emergency stop.
 - xiii. Spare.
 - xiv. Spare.
- 12. All push buttons, selector switches and indicating lights shall be industrial rated, heavy duty oil resistance type, 30 mm. Lights shall be push to test, transformer type, and LED type.

2.03 FACTORY TESTS

- A. Prior to shipment to the jobsite, each generator set package shall be tested as per the following guidelines:
 - 1. Verify safety shutdowns as follows:
 - i. Verify Emergency Stop works.
 - ii. Simulate low oil pressure pre-alarm.
 - iii. Simulate low oil pressure shutdown.
 - iv. Simulate high water temperature pre-alarm.
 - v. Simulate high water temperature shutdown.

- vi. Simulate low water level.
 - vii. Simulate over speed shutdown.
 - viii. Simulate over crank shutdown.
2. Block load the generator set at rated voltage and 0.80 power factor and record the resulting voltage dip, frequency dip and recovery time using a strip chart recorder for the following load steps:
 - a. 0-25%.
 - b. 0-50%.
 - c. 0-75%.
 - d. 0-100%.
 3. After a warm-up period, perform steady state load bank testing at full rated load and 0.80 power factor for four (4) hours. Record the following parameters at 15 minute intervals:
 - a. Generator voltage.
 - b. Generator current.
 - c. Generator frequency.
 - d. Engine oil pressure.
 - e. Engine coolant temperature.
 - f. Engine oil temperature.
 - g. Ambient air temp.
 - h. Exhaust outlet temperature.
 4. Correct any defects that become evident during the test and re-test as necessary until successful operation is achieved.
 5. Provide certified test results within 10 days of completion of test.

PART 3 EXECUTION

3.01 DEMOLITION/PREPARATION

- A. Examine elements and surfaces to receive generators for compliance with installation tolerances and other conditions affecting performance.
- B. Check that concrete pads are level and free of irregularities.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. The Contractor shall provide manpower and equipment to manufacturer's field representative and assist with supervision of unloading, installation, adjustment, and testing of the equipment. The Contractor shall observe equipment in operation after startup and report any irregularities in equipment operation to Owner and Engineer. The Contractor shall assist equipment manufacturer in making and testing adjustments to equipment to improve its performance and to reduce operating irregularities, rough operation, vibration, and noise such that equipment operates within acceptable limits set by manufacturer and typical for other similar installations.

- B. The Contractor shall install concrete equipment pad. Equipment bases shall be set level and in alignment, and shall be grouted in place in accordance with supplier's recommendations and drawings.
- C. Do not cut or weld any galvanized steel component in the field. Violation of this requirement will result in rejection of affected components.

3.03 INSPECTION

- A. Inspect completed installation for physical damage, proper alignment, anchorage and grounding.

3.04 FIELD TESTING

- A. Coordinate all start-up and testing activities with the Construction Manager, Engineer and Owner.
- B. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:
 - 1. Verify that the equipment is installed properly.
 - 2. Check all auxiliary devices for proper operation, including battery charger, jacket water heater(s), generator space heater, remote annunciator, etc.
 - 3. Test all alarms and safety shutdown devices for proper operation and annunciation.
 - 4. Check all fluid levels.
 - 5. Start engine and check for exhaust, oil, fuel leaks, vibrations, etc.
 - 6. Verify proper voltage and phase rotation at switchgear before connecting to the load.
 - 7. Connect the generator to building load and verify that the generator will start and run all designated loads in the plant.
 - 8. Perform a four (4) hour startup and test based on the load profile, sequence, and conditions as shown on the drawings and as outlined in Section 1.06 of this specification.
 - 9. Perform a four (4) hour load bank test at 1.0 power factor at full nameplate load using a resistive load bank and cables supplied by the local generator dealer. Observe and record the following data at 15 minute intervals:
 - a. Service meter hours.
 - b. Volts AC - All phases.
 - c. Amps AC - All phases.
 - d. Frequency.
 - e. Power factor or Vars.
 - f. Jacket water temperature.
 - g. Oil Pressure.
 - h. Fuel pressure.
 - i. Ambient temperature.
 - j. Top off all fluids after performance test.
 - k. Repeat performance test in case of failure and replace the system after 3 attempts.
 - 10. Fuel for start-up services shall be included in Contractor's price. Generators shall be turned over to Owner with a full fuel tank.

3.05 FIELD PAINTING

- A. Touch-up minor scratches and scrapes in galvanized finishes using at least three mils of zinc-rich compound conforming to Federal Specification MIL-P-26915A. Clean surface with wire brush and wipe clean with damp rag. Allow to dry before application.
- B. The Contractor shall provide touch-up painting, as required, for equipment which is delivered painted, in accordance with manufacturer's instructions for the paint system used for manufacturer's equipment.

3.06 CLEANING

- A. A.The Contractor shall provide cleanup and disposal of unneeded or surplus materials which were delivered with equipment after installation of equipment. If the Owner desires, the Contractor shall remove unneeded or surplus materials, deliver to location designated by the Owner, and unload and place in designated storage location for the Owner's future use.

END OF SECTION