

SECTION 263213 – PACKAGED ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged diesel engine generator set with the following features and accessories:
 - 1. Engine generator set (optional standby).
 - 2. Base mounted diesel fuel tank with spill containment.
 - 3. Battery charger/starting battery.
 - 4. Jacket water heater.
 - 5. Output circuit breaker (permanent load).
 - 6. Output circuit breaker (temporary load bank).
 - 7. Outdoor generator set enclosure.
 - 8. Factory installed door contacts on enclosure for integration in owner's SCADA system.
 - 9. Factory installed provision for owner's SCADA system voltage and current transducers.
 - 10. Factory installed digital contacts for owner's SCADA system monitoring.
 - 11. Generator platform, stairs and guard rail system.
 - 12. Remote annunciator.
 - 13. Remote EPO station.
- B. Related Requirements
 - 1. Section 269999 "Supervisory Control and Data Acquisition Systems" for monitoring and controlling remote systems and components, including packaged engine generator.

1.3 DEFINITIONS

- A. Standby Rating: Power output rating equal to the power the generator set delivers continuously under normally varying load factors for the duration of a power outage.
- B. 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 SUBMITTALS

- A. Product Data: Include data on features, components, ratings, and performance. Include the following:

1. Dimensioned outline plan and elevation drawings of engine generator set and other components specified.
 2. Thermal damage curve for generator.
 3. Time-current characteristic curves for generator protective device.
 4. Standard manufacturer's enclosure product data demonstrating compliance with specified sound pressure levels.
 5. Prototype exhaust emissions test report.
- B. Shop Drawings: Indicate fabrication details, dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Wiring Diagrams: Detail wiring for power and control connections and differentiate between factory-installed and field-installed wiring.
- C. Sound measurement test report.
- D. Maintenance Data: For each packaged engine generator and accessories to include in maintenance manuals specified in Division 1. Include the following:
1. List of tools and replacement items recommended to be stored at the Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 2. Detail operating instructions for both normal and abnormal conditions.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of emergency maintenance and repairs at the Project within 200 miles of site and within eight hours' maximum response time.
- B. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
- C. Source Limitations: Obtain packaged engine generator and auxiliary components specified in this Section through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- E. Comply with NFPA 70.
- F. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- G. Comply with UL 2200.
- H. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver engine generator set and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is safe from such hazards.

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: Minus 15 to plus 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet (300 m).

1.8 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases.

1.9 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Extended Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period. Warranty shall include all parts, labor (including travel), expenses and equipment necessary to perform replacement and/or repairs.
 - 1. Warranty Period: 5 years from date of Substantial Completion. Where manufacturer's standard warranty only covers equipment from date of manufacturer, the Contractor shall provide difference in warranty period.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work shall only include the following:
 - 1. Caterpillar, Inc.; Engine Division.

2. Cummins Power Generation; Industrial Business Group.
3. Kohler Co; Generator Division.
4. Generac.

2.2 ENGINE GENERATOR SET

- A. Factory-assembled and –tested, engine-generator set.
- B. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
- C. Output Connections: Three phase, four wire, wye; factory set for 480Y/277-volt, three phase, four wire, 12 lead reconnectable.
- D. Safety Standard: Comply with ASME B15.1.
- E. Nameplates: Each major system component is equipped with a conspicuous nameplate of component manufacturer. Nameplate identifies manufacturer of origin and address, and model and serial number of items.
- F. Mounting Frame: Adequate strength and rigidity to maintain alignment of mounted components without depending on concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components.
 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- G. Generator-Set Performance:
 1. Steady-State Voltage Operational Bandwidth: Maximum 3 percent of rated output voltage from no load to full load.
 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
 3. Steady-State Frequency Operational Bandwidth: Maximum 0.5 percent of rated frequency from no load to full load.
 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
 7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.

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

2.3 ENGINE

- A. Fuel: Fuel oil, Grade DF-2.
- B. Rated Engine Speed: 1800 rpm.
- C. Lubrication System: Pressurized by a positive-displacement pump driven from engine crankshaft. The following items are mounted on engine or skid:
 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 2. Thermostatic Control Valve: Controls flow in system to maintain optimum oil temperature. Unit is capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps or siphons or special tools or appliances.
- D. Engine Fuel System: Comply with NFPA 37. System includes the following:
 1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 2. Relief/Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- E. Coolant Jacket Heater: Electric-immersion type, 208V, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment.

2.4 GOVERNOR

- A. Type: Adjustable isochronous, with speed sensing.

2.5 ENGINE COOLING SYSTEM

- A. Description: Closed loop, liquid cooled, with radiator factory mounted on engine generator-set skid and integral engine-driven coolant pump.
- B. Radiator: Rated for specified coolant. Sized adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
- C. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
- D. Expansion Tank: Constructed of welded steel plate and equipped with gage glass and petcock.
- E. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

- F. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - 1. Rating: 50-psig maximum working pressure with 180 deg F coolant, and noncollapsible under vacuum.
 - 2. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

2.6 FUEL SUPPLY SYSTEM

- A. Comply with NFPA 30 and NFPA 37.
- B. Double-Walled Base-Mounted Fuel Oil Tank: Heavy gauge steel, double walled tank, factory-installed and -piped, listed and labeled fuel oil tank. Features include the following:
 - 1. Type: Closed-top diked base-mounted fuel tank. Minimum 8 gauge steel.
 - 2. UL Listed double wall fuel tank with leak detection sensor and alarm.
 - 3. Capacity: Fuel for 24 hours continuous operation at 100 percent rated power output.
 - 4. Tank level indicator that is viewable from outside the generator enclosure.
 - 5. Remote low-level alarm contact.
 - 6. Vandal-resistant fill cap.
 - 7. Containment Provisions: Comply with requirements of authorities having jurisdiction.
 - 8. Provide vent pipe riser such that vent pipe outlet is terminated a minimum of 12' above grade in accordance with the North Carolina Fire Code Article 3404.7.3.3. Vent pipe riser shall be routed outside of generator enclosure and supported per manufacturer's recommendations.

2.7 ENGINE EXHAUST SYSTEM

- A. Muffler: Integral to enclosure. See sound enclosure paragraph for further requirements.
- B. Coordinate remaining paragraphs with Drawings.
- C. Exhaust piping shall terminate vertically with bird screen and flapper-style rain cap. Exhaust piping external to enclosure shall be A STM A 53/A 53M, Schedule 40, welded, black steel, with welded joints and fittings
- D. Connection from Engine to Exhaust System: Flexible section of corrugated stainless-steel pipe.
- E. Connection from Exhaust Pipe to Muffler: Stainless-steel expansion joint with liner.

2.8 COMBUSTION-AIR-INTAKE SYSTEM

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

2.9 STARTING SYSTEM

- A. Description: 24-V electric, with negative ground and including the following items:

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Environmental Conditions" Paragraph in "Service Conditions" Article above.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Adequate capacity within ambient temperature range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article above to provide specified cranking cycle at least three times without recharging.
5. Battery Cable: Size as recommended by generator set manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater is arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article above. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit complies with UL 1236 and includes the following features:
 1. Operation: Equalizing-charging rate of 10 A is initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit then automatically switches to a lower float-charging mode and continues operating in that mode until battery is discharged again.
 2. Automatic Temperature Compensation: Adjusts float and equalizes voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 3. Automatic Voltage Regulation: Maintains output voltage constant regardless of input voltage variations up to plus or minus 10 percent.
 4. Ammeter and Voltmeter: Flush mounted in door. Meters indicate charging rates.
 5. Safety Functions: Include sensing of abnormally low battery voltage arranged to close contacts providing low battery voltage indication on control and monitoring panel. Also include sensing of high battery voltage and loss of ac input or dc output of battery charger. Either condition closes contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 6. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.10 CONTROL AND MONITORING

- A. Functional Description: When the 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 the generator set. When the mode-selector switch is switched to the on position, the generator set manually starts. The off position of the same switch initiates generator-set shutdown. When the generator set is running, specified system or equipment failures or derangements automatically shut down

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

- B. SCADA System Remote ATS/Generator Operation:
 - 1. School (Normal/Test) Mode: SCADA system sends ATS transfer inhibit signal to prevent ATS transfer and automatic (ATS) generator start/stop but allows separate SCADA signal to manually start/stop (test) generator without ATS load.
 - 2. Shelter Mode: SCADA ATS transfer inhibit signal is removed, allowing ATS to automatically transfer upon loss and return of utility power and automatic generator start/stop.
- C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages are grouped on a common control and monitoring panel mounted on the generator set. Mounting method isolates the control panel from generator-set vibration.
- D. Remote emergency power off control station, red mushroom head operator with NEMA 3R enclosure, lockable off, manual reset, protective cover.
- E. Indicating and Protective Devices and Controls: NFPA 110 Level 1 compliant and include the following:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. AC frequency meter.
 - 4. DC voltmeter (alternator battery charging).
 - 5. Engine-coolant temperature gage.
 - 6. Engine lubricating-oil pressure gage.
 - 7. Running-time meter.
 - 8. Ammeter-voltmeter, phase-selector switch (es).
 - 9. Generator-voltage adjusting rheostat.
 - 10. Start-stop switch.
 - 11. Overspeed shutdown device.
 - 12. Coolant high-temperature shutdown device.
 - 13. Coolant low-level shutdown device.
 - 14. Oil low-pressure shutdown device.
 - 15. Generator overload.

2.11 SCADA SYSTEM INTERFACE

- A. As specified in Section 269999, provide digital inputs/outputs from the generator control panel for connection into owner's SCADA system, and provide additional generator control space inside the generator enclosure for **new** SCADA analog output transducers. Generator vendor to provide factory-installed auxiliary devices, as needed, to accomplish the digital outputs requested. Transducers shall be field installed as per manufacturer's recommendations but shall not void the generator listing or warranty and include the following:
 - 1. Individual generator & ATS dry, 120V, N.O. digital outputs (to SCADA):
 - a. Generator Running
 - b. Generator low fuel (belly tank)

- c. Generator Intrusion (generator enclosure doors open)
 - d. Generator Battery Status (high or low DC voltage)
 - e. Transfer Switch Status (normal or emergency positions)
 - f. Generator Auto (HOA switch status)
 - g. Generator Common Alarm (high temp, overspeed, overcrank, low oil, and other common alarms)
 - h. Generator Pre-high Temp/Pre-Low Oil (temp approaching high alarm limit or oil pressure approaching low alarm limit)
 - i. Generator Frequency Error (Hz high or low)
2. Individual generator & ATS dry, 120V, N.O. digital inputs (from SCADA):
 - a. Generator remote manual start/stop
 - b. Transfer Switch Inhibit (Inhibit transfer)
 3. Individual generator analog 4-20mA outputs (to SCADA) **from new** transducers reconnected around generator output cabling:
 - a. Generator RMS voltage (Lines A,B,C)
 4. Individual generator analog 4-20mA outputs (to SCADA) from new current transducers connected around generator output cabling:
 - a. Generator RMS current (Lines A,B,C)

2.12 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type, electronic trip with fully adjustable long-time pickup and delay, short-time pickup and delay, and instantaneous, and ground fault alarm settings; 100 percent rated; complying with NEMA AB 1 and UL 489.
 1. Electronic Trip Circuit Breakers: Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field-replicable electronic trip and individually field-adjustable long time, short time, and instantaneous trip pickup level settings. Trip unit shall also have adjustable long time and short time delay settings. Provide trip unit power supply for 0-100% current indication. Provide for all generator circuit-breaker frame sizes.
 1. Energy Reducing Maintenance Switching with local status indication: All circuit breakers rated 1200A and larger shall have reduced energy let-through switch protection in addition to overcurrent trip settings indicated above
 2. Tripping Characteristic: Designed specifically for generator protection.
 3. Trip Rating: See drawings for rating.
 4. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 5. Mounting: Adjacent to or integrated with control and monitoring panel.

2.13 TEMPORARY LOAD BANK BREAKER

- A. Load Bank Circuit Breaker: Molded-case, thermal-magnetic type, electronic trip with fully adjustable long-time pickup and delay, short-time pickup and delay, and instantaneous, and ground fault alarm settings; 100 percent rated; complying with NEMA AB 1 and UL 489.
 1. Electronic Trip Circuit Breakers: Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field-replicable electronic trip and individually field-

adjustable long time, short time, and instantaneous trip pickup level settings. Trip unit shall also have adjustable long time and short time delay settings.

1. Energy Reducing Maintenance Switching with local status indication: All circuit breakers rated 1200A and larger shall have reduced energy let-through switch protection in addition to overcurrent trip settings indicated above
2. Tripping Characteristic: Designed specifically for generator protection.
3. Trip Rating: See drawings for rating.
4. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
5. Mounting: Adjacent to or integrated with control and monitoring panel. Breaker/whip/camlock ratings see drawings. Provide 10' of DLO whips with cam-lock connectors, and nameplate direction for breaker operation transferring from permanent generator load to portable load bank.

2.14 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Permanent magnet excitation.
- B. Comply with NEMA MG 1 and specified performance requirements.
- C. Drive: Generator shaft is directly connected to engine shaft. Exciter is rotated integrally with generator rotor.
- D. Electrical Insulation: Class H or Class F. Maximum 105-degree Celsius rise above 40-degree Celsius ambient.
- E. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- F. Construction prevents mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- G. Excitation uses no slip or collector rings, or brushes, and is arranged to sustain generator output under short-circuit conditions as specified.
- H. Enclosure: Dripproof.
- I. Instrument Transformers: Mounted within generator enclosure.
- J. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 1. Adjusting rheostat on control and monitoring panel provides plus or minus 5 percent adjustment of output- voltage operating band.
- K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- L. Subtransient Reactance: 12 percent, maximum.

2.15 GENERATOR-SET ENCLOSURE

A. Level II Sound Steel Enclosure

- B. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Enclosure shall be constructed of 14 gauge cold rolled steel. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure. Enclosure shall be provided with Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.
- C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 8 hours with ambient temperature at top of range specified in system service conditions.
1. Vertical Discharge: Discharge of radiator exhaust/discharge shall exit enclosure vertically up away from enclosure.
 2. Louvers: Fixed-engine cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
- D. Exhaust Silencing System: Exhaust silencing system shall be totally self-contained within enclosure. Exhaust system shall terminate in vertical discharge. All sound levels produced by exhaust system shall be included in measurements listed below.
- 1.
- E. Finish: Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.
- F. Enclosure doors shall have installed tamper switches capable of being wired back to SCADA system for monitoring door position.
- G. The enclosure shall be large enough to house the Owner's existing SCADA analog PT's, CT's, and transducers which will be relocated from the existing generator and connected within the new generator housing.

2.16 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.
- B. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

2.17 GENERATOR PLATFORM

- A. Provide Generator Work platform for General access and Maintenance as detailed in drawings.
1. Platform shall be aluminum or approved corrosive metal construction with non-slip walkway surfaces.
 2. Platform shall be at length shown with steps increments as shown on drawings.

3. Provide kick plates on platform top level and 42" minimum handrails for one side of stairs and platform.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment foundations, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.
- B. Examine roughing-in of electrical connections. Verify actual locations of connections before packaged engine generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for packaged engine generators. Refer to Division 3 Section "Cast-in-Place Concrete" and Division 26 Section "Basic Electrical Materials and Methods".

3.3 INSTALLATION

- A. Comply with packaged engine generator manufacturers' written installation and alignment instructions, and with NFPA 110.
- B. Set packaged engine generator set on concrete bases.
 1. Support generator-set mounting feet on rectangular metal blocks and shims or on metal wedges having small taper, at points near foundation bolts to provide 3/4- to 1-1/2-inch gap between pump base and foundation for grouting.
 2. Adjust metal supports or wedges until generator is level.
- C. Install packaged engine generator to allow access for periodic maintenance, including removal of drivers and accessories.
- D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
 1. Verify that electrical wiring is installed according to manufacturers' submittal and installation requirements in Division 26 Sections. Proceed with equipment startup only after wiring installation is satisfactory.

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
 1. Connect fuel piping to engines with flexible fuel lines.
 2. Connect exhaust-system piping to engines.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

C. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 IDENTIFICATION

A. Identify system components according to Division 26 Section "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections, and to assist in testing. Report results in writing.

B. Testing Technician

1. The testing technicians shall be trained in all the methods of correctly and safely conducting the required test. The technician shall have regular experience conducting the required tests and they must have the knowledge to determine the serviceability of a specific piece of equipment.

C. Physical Inspection and Testing

1. Verify equipment rating correspond to drawings and specifications.
2. Inspect the physical and mechanical condition and verify that it complies with manufacturer's standards.
3. Verify equipment is properly secured and aligned and grounded as specified in the drawings and specifications.
4. Verify the equipment is clean.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at distances specified for enclosure and at nearest point along property line. Compare measured levels with required values and issue report.

D. Electrical Inspection and Testing

1. Test the insulation resistance with the guidelines established in the ANSI/IEEE Standard 43. If the engine is 200 HP or less the test shall last one minute otherwise the test shall last ten minutes. The polarization should not be less than 1 and the insulation resistance of most engines is 5 mega-ohms.
2. Test the generator control systems and verify that it shuts the generator down when an alarm is triggered.
3. Test the equipment vibration according to manufacturer's recommendations.
4. Performs tests consistent with the guidelines in ANSI/NFPA 110 and manufacturer's standards.
5. Verify functionality of the governor and regulator.
6. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.

7. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 1. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 2. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 3. Verify acceptance of charge for each element of the battery after discharge.
 4. Verify that measurements are within manufacturer's specifications.
 8. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
- E. Load Bank Testing: Prior to acceptance of the installation, the generator shall be subjected to a four hour load bank test. This test shall be performed at the job site in the presence of an Owner's representative. Test shall include continuous operation of generator set at 50% load for one hour, 75% for next hour, and 100% for final two hours. Upon completion of the four hour test, the generator shall be shut-down after the cool down period. Next the generator shall be started and immediately upon reaching rated speed, 100% percent load shall be applied to demonstrate one step full load capability. The capability of the system to pick up full standby service load with 10 second of power outage shall also be demonstrated. After testing is complete:
1. A full tank of fuel shall be provided, replacing any fuel used for testing. Diesel fuel shall be treated with an alcohol-free additive to disperse water and clean injectors.
 2. Copy of the generator's load test report shall be sent to the Designer and the Owner.
- F. Coordinate tests with tests for transfer switches and run them concurrently.
- G. Coordinate testing with Wake county personnel on installation, connection, and demonstration of County owned SCADA system. Obtain completion of installation from County representative prior to final acceptance.
- H. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- I. Fuel Tank Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- J. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Functional testing shall include entire system including:
1. New ATS.
 2. New Generator.
 3. **New** SCADA system.
- K. Remove and replace malfunctioning units and retest/reinspect as specified above.

- L. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
 - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation and thermal photograph of deficiencies detected, remedial action taken, and observations with thermal photograph after remedial action demonstrating resolution.
- M. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- N. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
 - 4. Insulation Resistance
 - 5. Time Delays.

3.7 CLEANING

- A. On completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.8 GENERATOR TURNED OVER TO OWNER

- A. Contractor is responsible for all fuel and maintenance costs for operation of generator prior to Substantial Completion, including all testing and inspections. After all testing is complete, Contractor shall re-fill fuel tank to full level.
- B. After Substantial Completion, but not more than 30 days after Final Acceptance, Contractor shall have generator serviced by a factory-authorized service technician. Service shall include replacement of air and oil filter. All components of generator system shall be inspected and replaced if defective.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators as specified below:
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
 - 2. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data".
 - 3. Coordinate this training with that for transfer switches.
 - 4. Schedule training with Owner, through Architect, with at least ten days' advance notice.

5. Minimum Instruction Period: Four hours.

END OF SECTION 263213