

~~~~~ **PROJECT NOTE** ~~~~~

ARCHITECT OF RECORD/ENGINEER OF RECORD IS RESPONSIBLE FOR REVIEWING THIS SPECIFICATION SECTION IN DETAIL FOR COORDINATION WITH THE PROJECT SCOPE OF WORK.

ALL "PROJECT NOTE" TEXT IS TO BE REMOVED FOLLOWING REVIEW OF THE CONTENT OF EACH NOTE BY THE ARCHITECT OF RECORD/ENGINEER OF RECORD.

EDIT THE DOCUMENT FOOTER TO INCLUDE THE PROJECT NAME AND NUMBER.

EDIT THE DOCUMENT HEADER TO INDICATE THE ARCHITECT OF RECORD PROJECT ISSUE" DATE. THE "CPS CONTROL" DATE SHOULD NOT BE EDITED.

ANY MODIFICATIONS TO THE TECHNICAL STANDARDS IN THIS SECTION - INCLUDING THE REMOVAL OR ADDITION OF MANUFACTURERS - MUST BE APPROVED BY CPS. REQUESTS FOR MODIFICATION ARE TO BE SUBMITTED TO THE DESIGN MANAGER DURING THE DESIGN PHASE FOR REVIEW AND APPROVAL.

~~~ **END OF PROJECT NOTE** ~~~

**SECTION 26 32 13
ENGINE GENERATORS**

~~~~~ **PROJECT NOTE** ~~~~~

SELECT GAS-DRIVEN OR DIESEL-DRIVEN GENERATOR SET(S) PER PROJECT SCOPE OF WORK. DESIGN TEAM SHALL EVALUATE THE USE OF NATURAL GAS VS DIESEL GENERATORS ON A PROJECT BY PROJECT BASIS AND MAKE A RECOMMENDATION TO CPS.

NOTE: CPS PREFERENCE IS TO PROVIDE NATURAL GAS GENERATORS WHEN FEASIBLE. WHERE DIESEL IS RECOMMENDED, CPS APPROVAL IN WRITING IS REQUIRED.

~~~ **END OF PROJECT NOTE** ~~~

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Packaged engine generator system and associated components and accessories:
 - 1. Engine and engine accessory equipment.
 - 2. Alternator (generator).
 - 3. Control Panel.
 - 4. Radiator.
 - 5. Batteries and charger.
 - 6. Fuel fittings and day tank.

~~~~~ **PROJECT NOTE** ~~~~~

UTILIZE FOR DIESEL-ENGINE-DRIVEN GENERATORS.

~~~ **END OF PROJECT NOTE** ~~~

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7. Exhaust silencer and fittings.

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UTILIZE FOR GAS-ENGINE-DRIVEN GENERATOR SETS

~~~ **END OF PROJECT NOTE** ~~~~

8. Exhaust silencer muffler, exhaust piping external to set, and fittings.
9. Generator set control system.
10. Generator set enclosure.

1.02 REFERENCE STANDARDS

- A. City of Chicago Building Code - Chicago Construction Codes, Title 14B; Current Edition.
- B. IEEE 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications; 1995.
- C. Chicago Electrical Code - Municipal Code of the City of Chicago, Building/Electrical Code Requirements; 2018.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- E. NECA/EGSA 404 - Standard for Installing Generator Sets; 2014.
- F. NEMA MG 00001 - Motors and Generators; 2024.
- G. NFPA 30 - Flammable and Combustible Liquids Code; 2024, with Errata (2025).
- H. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; 2024, with Amendment.
- I. NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.
- J. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.
- K. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries; Current Edition, Including All Revisions.
- L. UL 2200 - Stationary Engine Generator Assemblies; Current Edition, Including All Revisions.
- M. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- N. UL 508 - Industrial Control Equipment; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
 - a. Transfer Switches: See Section 26 36 00 - Transfer Switches.
 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.
 3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.
 5. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
 6. Notify Architect/Engineer of Record of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meeting: Convene at least one week before starting work of this section; require attendance of all affected installers.

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1. Ensure required submittals have been provided with sufficient time for review prior to scheduling the preinstallation meeting.
 2. Review the detailed requirements for the work of this section and to review the drawings and specifications for this work. Require attendance by all affected installers including but not limited to:
 - a. Contractor's Superintendent.
 - b. Installer.
 - c. Manufacturer/Fabricator Representative.
 - d. Other affected Subcontractors.
 - e. Architect/Engineer of Record.
 - f. Board's Representative.
 3. Record minutes and distribute copies within five (5) days after meeting to participants as well as Architect/Engineer of Record, Board and those affected by decisions made.
- C. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Board or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
1. Notify Architect and Board's Representative no fewer than seven (7) days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Architect's and Board's Representative written permission.
- 1.04 SUBMITTALS
- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

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INCLUDE WITHIN PRODUCT DATA SECTION, ENGINE'S POWER OUTPUT CURVE AS WELL AS MINIMUM/MAXIMUM GAS PRESSURE REQUIREMENTS.

~~~~ **END OF PROJECT NOTE** ~~~~

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
1. Include generator set sound level test data.
 2. Include characteristic trip curves for overcurrent protective devices.
 3. Include alternator thermal damage curve.
 4. Maximum fuel consumption per hour.

~~~~~ **PROJECT NOTE** ~~~~~

UTILIZE FOR GAS-DRIVEN GENERATOR SETS

~~~~ **END OF PROJECT NOTE** ~~~~

5. Engine's power output curve with changing gas pressure starting at 3.0 inches water pressure.
6. Minimum and maximum gas pressure requirements.

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INCLUDE THE FOLLOWING:

1. ELECTRICAL CHARACTERISTICS AND CONNECTION REQUIREMENTS (DIESEL AND GAS-ENGINE-DRIVEN).
2. MAXIMUM GAS CONSUMPTION PER HOUR, SOUND POWER LEVEL FOR EIGHT OCTAVE BANDS, VENTILATION AND COMBUSTION AIR REQUIREMENTS (DIESEL AND GAS-ENGINE-DRIVEN).
3. FUEL CONSUMPTION RATE CURVES (DIESEL-ENGINE-DRIVEN).
4. CENTER OF GRAVITY, MOUNTING AND ANCHORAGE PROVISIONS (DIESEL AND GAS-ENGINE-DRIVEN).

~~~ **END OF PROJECT NOTE** ~~~~

- C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
- D. Power, signal, and control wiring diagrams.
- E. Vibration isolation base details. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
- F. Derating Calculations: Indicate ratings adjusted for applicable service conditions.
- G. Fuel Storage Tank Calculations: Indicate maximum running time for generator set configuration provided.
- H. Specimen Warranty: Submit sample of manufacturer's warranty.
- I. Evidence of qualifications for installer.
- J. Evidence of qualifications for maintenance contractor (if different entity from installer).
- K. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
- L. Manufacturer's factory emissions certification.
- M. Manufacturer's certification that products meet or exceed specified requirements.
- N. Source quality control test reports.
- O. Provide NFPA 110 required documentation from manufacturer, including but not limited to:
 1. Certified prototype tests.
 2. Torsional vibration compatibility certification.
 3. NFPA 110 and the Chicago Building Code compliance certifications.
 4. Certified rated load test at rated power factor.
- P. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit. Indicate results of the performance testing and field procedures and findings. A certified test shall be performed by the manufacturer of the Emergency Power Supply System prior to shipment from the manufacturers facility demonstrating the following: Results at full load to be reported are: Engine RPM, frequency, average voltage, line-to-line voltages for all three phases, average current, and observed power at 0.8 power factor. The results to be reported at no load are: Engine RPM, average voltage and line-to-line voltages for all three phases.

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- Q. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 - R. Manufacturer's detailed field testing procedures.
 - S. Field quality control test reports.
 - T. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 - 1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
 - U. Executed Warranty: Submit documentation of final executed warranty completed in Board's name and registered with manufacturer.
 - V. Maintenance contracts.
 - W. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.
 - X. Maintenance Materials: Furnish the following for Board's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Fuses: One (1) for every ten (10) of each type and rating, but no fewer than one (1) set of three of each.
 - 3. Indicator Lamps: Two (2) for every six (6) of each type used, but no fewer than three (3) of each.
 - 4. Filters: One (1) set each of lubricating oil, fuel, and combustion-air filters.
 - 5. Belts: Two (2) for every six (6) of each type used, but no fewer than one set of three (3) of each.
 - 6. Tools: One (1) set of special tools that are required for the normal operation and maintenance of unit.
 - 7. Spark Plugs: One (1) complete set.
- 1.05 QUALITY ASSURANCE
- A. Comply with the following:
 - 1. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for Level 1 system.
 - 2. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
 - 3. NFPA 30 (Flammable and Combustible Liquids Code).
 - 4. IEEE 446 (Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications).
 - 5. Conform to the requirements of the following standards for the generator set and supplied accessories:
 - a. NEMA MG 00001 (Motors and Generators).
 - b. UL 1236 (Battery Chargers).
 - 6. Conform to the requirements of the following standards for the generator control panel:
 - a. EN 50082-2, Electromagnetic Compatibility - Generic Immunity Requirements, Part 2: Industrial.
 - b. EN 55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
 - c. FCC Part 15, Subpart B.
 - d. UL 508 (Industrial Control Equipment).
 - 7. Comply with ASME B15.1.
 - 8. Comply with the City of Chicago Building Code.

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9. Comply with NFPA 110 requirements for Level 1 emergency power supply system, Type 10, Class X.
 10. Comply with UL 2200. Where provisions of the City of Chicago Building Code for the emergency generators do not agree with UL 2200, the City of Chicago Building Code shall be followed.
 11. UL 250 - Enclosures for Electrical Equipment (1000 volts maximum).
 12. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
 13. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
1. Authorized service facilities located within 50 miles of project site.
 2. Authorized factory trained full time staffed service department with minimum ten years documented experience specializing in 24/7 servicing the Products specified capable of providing training, parts, and emergency maintenance repairs.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience with engine generator systems of similar size, type, and complexity; manufacturer's authorized installer.
- E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
1. Contract maintenance office located within 4 hours normal travel time from business to project site.
 2. Engineers Responsibility: Preparation of data for vibration isolators of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the Chicago Building Code, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Store generator set, components and accessories indoors in clean and dry space with uniform temperature to prevent condensation. Protect generator set, components and accessories from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover generator set, components and accessories to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials. Install electric heating of sufficient wattage to prevent condensation.
- C. Deliver and accept generator set, components and accessories in original manufacturer's packaging.
- D. Handling: Handle engine generator equipment carefully to prevent physical damage to equipment and components. Do not install damaged equipment. Replace damaged equipment with new.

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1.07 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 COORDINATION

- A. Coordinate under provisions of Division 01.
- B. Field meetings: Coordinate with other trades and field conditions within pre-installation meetings.
- C. Final measurements: Verify that field measurements are as shown on Drawings.
- D. Field locations: Verify locations of engine generator set assembly prior to rough-in.
- E. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.09 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Preliminary Acceptance, provide twelve (12) months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.10 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

~~~~~ **PROJECT NOTE** ~~~~~

DELETE ARTICLE IF GAS GENERATOR IS SPECIFIED.

~~~~ **END OF PROJECT NOTE** ~~~~

- A. Packaged Engine Generator Set - Diesel:
 - 1. Caterpillar Inc: www.cat.com
 - 2. Cummins Power Generation Inc: www.cumminspower.com
 - 3. Generac Power Systems: www.generac.com/industrial

~~~~~ **PROJECT NOTE** ~~~~~

DELETE ARTICLE IF DIESEL GENERATOR IS SPECIFIED.

~~~~ **END OF PROJECT NOTE** ~~~~

- B. Packaged Engine Generator Set - Gas:
 - 1. Caterpillar Inc: www.cat.com
 - 2. Cummins Power Generation Inc: www.cumminspower.com
 - 3. Generac Power Systems: www.generac.com/industrial
 - 4. Inland Power Group (MTU): www.powersystems.istate.com/products-services/generators/
 - 5. Kohler Co: www.kohlerpower.com

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- C. Source Limitations: Furnish engine generator sets and associated components and accessories produced by single manufacturer and obtained from single supplier.

~~~~~ **PROJECT NOTE** ~~~~~

MAKE ADJUSTMENTS TO PACKAGED ENGINE GENERATOR FOR PROJECT SCOPE TO BE NEW OR EXISTING TO BE MODIFIED. ADJUST ACCESSORIES AND REQUIREMENTS.

~~~ **END OF PROJECT NOTE** ~~~

2.02 PACKAGED ENGINE GENERATOR SYSTEM

- A. Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. System Description:
1. Application: Emergency/standby.
 2. Configuration: Single packaged engine generator set operated independently (not in parallel).
 3. Where design is based on single generator set, use of multiple, smaller unit(s) operated in parallel to obtain equivalent total system power rating is not permitted.
- D. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation. Skid is free from sharp edges and corners. Lifting attachments are arranged to facilitate lifting with slings without damaging any components.
- E. Provide 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.
- F. Capacities and Characteristics:
1. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.

~~~~~ **PROJECT NOTE** ~~~~~

PROVIDE OUTPUT CONNECTION REQUIREMENTS FOR PROJECT.

~~~ **END OF PROJECT NOTE** ~~~

2. Output Connections: _____ kW, _____ voltage, _____-phase, three wire.
 3. Nameplates: For each major system component to identify manufacturer's name and address, model and serial number of component.
- G. Mounting: The engine and generator shall be assembled to a common base by the engine-generator manufacturer. The generator set base shall be designed and built by the engine-generator manufacturer to resist deflection, maintain alignment, and minimize resonant linear vibration. Provide unit with suitable pad-type vibration isolators.
- H. Insulation: The exhaust manifold and turbo-charger shall be insulated with high temperature insulation installed by the manufacturer. Insulation shall maintain a surface temperature not to exceed 150 degrees F.
- I. Enclosure: NEMA MG 00001, the regulator shall be shock-mounted and epoxy-encapsulated for protection against vibration and atmospheric deterioration.

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- J. Generator Termination Box: Provide oversized termination/conduit box for all load connections to the generator. Provide box with adequate size so no box extensions or enlargements need to be done in the field when terminating wiring with type THHN insulation. Provide bus bars with two hole compression lugs for all cable terminations.

~~~~~ **PROJECT NOTE** ~~~~~

PROVIDE COOLANT JACKET HEATER VOLTAGE.

~~~ **END OF PROJECT NOTE** ~~~

- K. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity. Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F and suitable for operation on _____ Volts ac. Vee type engines of 8 cylinders or more shall have one heater per each bank of cylinders. Provide installed isolation valves.
- L. Governor: Adjustable isochronous, with speed sensing to maintain isochronous engine speed. Frequency regulation as follows.
1. Within 0.5 percent, steady state.
 2. Within 1 percent, no load to full load.
 3. Recovery to steady within 2 seconds following sudden load changes.
- M. Engine Accessories: Gas pressure regulator, gas solenoid valve, lube oil filter, intake air filter, lube oil cooler, gear-driven water pump. Provide unit mounted instruments including service meter, water temperature gauge, and lube oil pressure gauge on engine/generator control panel.

~~~~~ **PROJECT NOTE** ~~~~~

SELECT ONE OF TWO PARAGRAPHS BELOW FOR FACTORY MOUNTED OR REMOTE RADIATOR.

~~~ **END OF PROJECT NOTE** ~~~

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

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1. Configuration: Vertical air discharge.
 2. Radiator Core Tubes: Aluminum.
 3. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 4. Fan: Blower type, sized to maintain safe engine temperature in ambient temperature of 110 degrees F. Driven by totally enclosed electric motor with sealed bearings.
 5. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anti-corrosion additives as recommended by engine manufacturer to protect the system at 0 degrees F.
 6. Maximum radiator inlet and outlet air flow restriction of 0.5 inches of water. Radiator shall be pretreated by the supplier for the inhibition of internal corrosion. Provide suitable duct flange.
 7. Flexible pipes for engine and radiator shall be provided by genset vendor.
 8. The radiator fans shall derive power from separate circuits connected to emergency power source.
 9. The genset supplier shall provide the motor starter, fused disconnect (installed on the radiator), remote fan control, temperature and pressure switch (installed).
 10. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
- P. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed manufacturer's engine backpressure requirements.
1. Exhaust Silencer: Critical type silencer, with muffler companion flanges, flexible stainless steel exhaust fitting, and stainless steel expansion fitting sized sufficiently in accordance with engine manufacturer's instructions to ensure that exhaust back pressure does not exceed the maximum limitations specified. Provide a suitable rain cap.
 2. Exhaust Insulation: The silencer and all indoor exhaust piping shall be insulated by the contractor to maintain a surface temperature not to exceed 150 degree F. The insulation shall be installed so that it does not cover or interfere with the functioning of the flexible exhaust fitting.
- Q. Air Intake Filter: Heavy duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- R. Packaged Engine Generator Set:

~~~~ **PROJECT NOTE** ~~~~~

MAKE SELECTIONS FOR PACKAGED ENGINE GENERATOR SET TYPE (DIESEL OR GAS). ALL MODIFICATIONS TO MANUFACTURER AND FRONT OF SPEC TO MATCH SELECTION.

~~~ **END OF PROJECT NOTE** ~~~

1. Type: Diesel (compression ignition).

~~~~ **PROJECT NOTE** ~~~~~

POWER RATING TO BE STANDBY, PRIME, OR CONTINUOUS POWER. DERATING ADJUSTMENTS TO BE INCLUDED IN CONTINUOUS LOAD.

~~~ **END OF PROJECT NOTE** ~~~

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2. Power Rating: As indicated on drawings, standby, including applicable derating adjustments.
 3. Voltage: As indicated on drawings.
 4. Main Line Circuit Breaker:
 - a. Type: Thermal magnetic.
 - b. Trip Rating: As indicated on drawings.
 - c. Operating handle or indicators must have visible indication if switch is in " ON" or " OFF" position.
 - d. Features:
 - 1) Shunt trip.
 - 2) Auxiliary contacts.
 5. Nameplates: For each major system component to identify manufacturer's name and address, model and serial number of component.
- S. Generator-Set Performance:
1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 00001, 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 and the City of Chicago Building Code for emergency generators.
- T. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.
- U. Starting and Load Acceptance Requirements:
1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.
 2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate over-crank alarm condition and lock-out generator set from further cranking until manually reset.
 3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10) and the City of Chicago Building Code for emergency generators.
 - a. Provide permanent magnet excitation for power source to voltage regulator.

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4. Maximum Load Step: Supports 100 percent of rated load in one step.
- V. Exhaust Emissions Requirements:
 1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
 2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.

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PROVIDE MAXIMUM dBA MEASUREMENTS IN SPECIALIZED CONDITIONS WHEN ADJACENT TO AREAS OF HIGH SOUND SENSITIVITY.

CCBC DOES NOT REQUIRE LIFE SAFETY GENERATORS TO MEET SOUND REQUIREMENTS

~~~ **END OF PROJECT NOTE** ~~~

- W. Sound Level Requirements:
 1. Do not exceed _____ dBA when measured at 23 feet from generator set in free field (no sound barriers) while operating at full load; include manufacturer's sound data with submittals.
 2. Comply with applicable noise level regulations.

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PROVIDE MAXIMUM SOUND LEVEL REQUIREMENT AT PROPERTY LINE FOR SCOPE OF PROJECT.

~~~ **END OF PROJECT NOTE** ~~~

- a. Do not exceed _____ dBA when measured at property line.

~~~~~ **PROJECT NOTE** ~~~~~

PROVIDE BUILDING AUTOMATION SYSTEM TYPE AND COORDINATED INTEGRATION FOR PROJECT SCOPE WHEN APPLICABLE.

~~~ **END OF PROJECT NOTE** ~~~

- X. Interface with building automation system.

~~~~~ **PROJECT NOTE** ~~~~~

INTERFACE WITH EXISTING WORK AND SYSTEMS WITH EXISTING CONDITIONS (REMODEL, RENOVATION, OR EXPANSION) TYPES ARE TO BE INCLUDED IN PROJECT SCOPE OF WORK FOR REMODELS PROJECTS.

~~~ **END OF PROJECT NOTE** ~~~

- Y. Interface with Existing Work: _____.
- 2.03 ENGINE AND ENGINE ACCESSORY EQUIPMENT

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PROJECT NUMBER | 26 32 13 - 12 | ENGINE GENERATORS |
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- A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.

~~~~~ **PROJECT NOTE** ~~~~~

PROVIDE PARAGRAPH "ENGINE FUEL SYSTEM-DIESEL" FOR DIESEL-ENGINE-DRIVEN GENERATOR SETS.

~~~~ **END OF PROJECT NOTE** ~~~~

- B. Engine Fuel System - Diesel (Compression Ignition):
1. Fuel Source: Diesel, Fuel oil, Grade DF-2.
 2. Fuel Storage: Sub-base fuel tank.
 3. Engine Fuel Supply: Provide engine-driven, positive displacement fuel pump with replaceable fuel filter(s), water separator, check valve to secure prime, manual fuel priming pump, and relief-bypass valve. Provide fuel cooler where recommended by manufacturer.
 4. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
 5. Rated Engine Speed: 1800 rpm.
 6. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.
 7. Main Fuel Tank (Bulk Tank): Comply with Section 26 32 13 - Facility Fuel-Oil Piping, NFPA 30 and the City of Chicago Building Code.
 8. Day Tank:
 - a. Provide separately mounted double-wall day tank with secondary containment, constructed of corrosion resistant steel, with fuel transfer pump(s), valves, and automatic controls suitable for operation in the configuration to be installed; listed and labeled as complying with UL 142 and the City of Chicago Building Code.
 - b. Tank Capacity: Size for minimum of 24hrs of continuous engine generator operation at 100 percent rated load, but not larger than permissible by applicable codes; account for fuel returned to main fuel tank (bulk tank), if applicable; account for heating where engine fuel is returned to day tank without fuel cooler.
 - c. Alarm Indications/Shutdowns:
 - 1) Low fuel level alarm; provides local indication and activates remote output contact.
 - 2) High fuel level; provides local indication and activates remote output contact.
 - 3) Critical high fuel level alarm; provides local indication and activates remote output contact; shuts down fuel transfer supply pump but shall not shut down engine-generator set.
 - d. Features:
 - 1) Direct reading fuel level gauge.
 - 2) Normal atmospheric vent.
 - 3) Emergency pressure relief vent.
 - 4) Leak detection switch; located within secondary containment interstitial space for detection of primary tank fuel leak.
 - (a) Provide audible and visual alarm in the event of day-tank leak.
 - (b) Secondary containment vessel shall have capacity complying with requirements of the City of Chicago Building Code.

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| NAME OF SCHOOL
PROJECT NUMBER | 26 32 13 - 13 | ENGINE GENERATORS |
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- 5) Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine.
- e. Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent line, overflow line; and tank drain line with shutoff valve. No bottom fittings allowed.
9. Sub-Base Fuel Tank:
 - a. Provide sub-base mounted, double-wall fuel tank with secondary containment; listed and labeled as complying with UL 142 and the City of Chicago Building Code.
 - b. Tank Capacity: Size for minimum of 24 hours of continuous engine generator operation at 100 percent rated load, but not larger than permissible by applicable codes.
 - c. No bottom fittings are allowed.
 - d. Features:
 - 1) Direct reading fuel level gauge.
 - 2) Normal atmospheric vent.
 - 3) Emergency pressure relief vent.
 - 4) Fuel fill opening with lockable cap (vandal-resistant).
 - 5) Dedicated electrical conduit stub-up area.
 - 6) Low fuel level switch.
 - 7) Leak detection switch; located within secondary containment interstitial space for detection of primary tank fuel leak.
 - (a) Provide audible and visual alarm in the event of day-tank leak.
 - (b) Secondary containment vessel shall have capacity complying with requirements of the City of Chicago Building Code.
10. Filter/Separator: In addition to the standard fuel filters provided by the engine manufacturer, provide a primary fuel filter/water separator in the fuel inlet line to the engine. Dual Racor filters will be supplied providing by-pass capability.
11. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

~~~~~ **PROJECT NOTE** ~~~~~

PROVIDE PARAGRAPH "ENGINE FUEL SYSTEM - GASEOUS(SPARE IGNITION)" FOR GAS-ENGINE-DRIVEN GENERATOR SETS.

~~~ **END OF PROJECT NOTE** ~~~

C. Engine Fuel System - Gaseous (Spark Ignition):

~~~~~ **PROJECT NOTE** ~~~~~

SELECTION OF GAS TYPE [I.E. NATURAL, PROPANE (LP)]

~~~ **END OF PROJECT NOTE** ~~~

1. Fuel Source: Natural gas.
2. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
3. Rated Engine Speed: 1800 rpm.
4. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.

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| NAME OF SCHOOL
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5. Provide components/features indicated and as necessary for operation and/or required by applicable codes, including but not limited to:
 - a. Carburetor.
 - b. Gas pressure regulators and gas solenoid valve shall be engine-mounted and shall be connected to the engine with flexible gas connection which shall be a minimum 18 inches long and shall be as recommended by the engine generator equipment manufacturer. The solenoid valve coil shall be rated for the generator starting battery voltage.
 - c. Fuel shutoff control valves.
 - d. Low gas pressure switches.
- D. Engine Starting System:
 1. System Type: 24V Electric, with negative ground.
 2. Battery(s):
 - a. Battery Type: Lead-acid.
 - b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
 - c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
 3. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
 4. Battery Charger:
 - a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
 - b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
 - c. Listed as complying with UL 1236.
 - d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection. Heavy Duty, 100 percent rated, non-fused maintenance disconnect. Match to generator output rating. Operating handle or indicators must have visible indication if switch is in " ON" or " OFF" position.
 - e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
 - f. Provide alarm output contacts as necessary for alarm indications.
 - g. Adjust float and equalize 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.
 - h. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 5 percent.
 - i. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - j. No on-off switch is allowed on battery charger.
 - k. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall

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- close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- I. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.
- E. Engine Speed Control System (Governor):
1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.
 2. Generator Sets Used with Closed Transition Transfer Switches: Provide electronic isochronous governor with frequency regulation suitable for transfer.
 3. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.
- F. Engine Lubrication System:
1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.
 2. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 3. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and designed to be fail-safe.
 4. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- G. Engine Cooling System:
1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
 2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.
- H. Engine Air Intake and Exhaust System:
1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
 2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.

~~~~~ **PROJECT NOTE** ~~~~~

VERIFY ALTERNATOR CHARACTERISTICS WITH MANUFACTURER

~~~ **END OF PROJECT NOTE** ~~~

2.04 ALTERNATOR (GENERATOR)

- A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 00001; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.
- B. Exciter:
1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.
 2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
 3. Voltage Regulation (with PMG excitation): Solid-state type, separate from exciter, plus/minus 0.5 percent for any constant load from no load to full load.
- C. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

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- D. Temperature Rise: Comply with UL 2200.
- E. Insulation System: NEMA MG 00001, Class H; suitable for alternator temperature rise.
- F. Subtransient Reactance: 12 percent, maximum.
- G. Enclosure: NEMA MG 00001, drip-proof.
- H. Total Harmonic Distortion: Not greater than five percent.
- I. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- J. Stator-Winding leads brought out to terminal box to permit future reconnection for other voltages.
- K. Instrument Transformers mounted within generator enclosure.
- L. Voltage Regulator: Include generator mounted volts per hertz exciter regulator to match engine and generator characteristics, with voltage regulation plus or minus 1 percent from no load to full load. Include 3 phase sensing. Include readily accessible manual controls to adjust voltage droop, voltage level (plus or minus 5 percent) and voltage gain.

2.05 GENERATOR SET CONTROL SYSTEM

- A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.
- B. The generator shall provide continuous service and no alarms or pre-alarms can automatically cause the generator to shut down.
- C. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts.
- D. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. Switch to be key operated. Key must be captive in all positions except " Automatic" . Provide flashing pilot light to indicate when key is in any position other than " Automatic" .
- E. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- F. Control Panel:
 - 1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
 - 2. Generator Set Control Functions:
 - a. Automatic Mode: Initiates generator set start upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
 - b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
 - c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
 - d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
 - e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
 - f. Time Delay: Programmable for start (engine warmup).
 - g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.
 - 3. Generator Set Status Indications:
 - a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
 - b. Current (Amps): For each phase.
 - c. Frequency (Hz).
 - d. Real power (W/kW).

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- e. Reactive power (VAR/kVAR).
 - f. Apparent power (VA/kVA).
 - g. Power factor.
 - h. Duty Level: Actual load as percentage of rated power.
 - i. Engine speed (RPM).
 - j. Battery voltage (Volts DC).
 - k. Engine oil pressure (psi).
 - l. Engine coolant temperature.
 - m. Engine run time.
 - n. Engine oil temperature.
 - o. Number of start attempts.
 - p. Generator powering load (position signal from transfer switch).
4. Generator Set Protection and Warning Indications: As required by the Chicago Building Code.
- a. Conditions required to be annunciated with an audible and visual alarm shall include:
 - 1) Overcrank (warning).
 - 2) Low coolant temperature (warning).
 - 3) High coolant temperature (warning).
 - 4) High coolant temperature (warning).
 - 5) Low oil pressure (warning).
 - 6) Low oil pressure (warning).
 - 7) Overspeed (warning).

~~~~~ **PROJECT NOTE** ~~~~~

UTILIZE ON DIESEL-ENGINE-DRIVEN GENERATOR SETS ONLY.

~~~ **END OF PROJECT NOTE** ~~~

- 8) Low fuel level (warning).
 - (a) Less than 3 hours fuel supply.
- 9) Low coolant level (warning).
- 10) Generator control not in automatic mode (warning).
- 11) High battery voltage (warning).
- 12) Low cranking voltage (warning).
- 13) Low battery voltage (warning).
- 14) Battery charger failure (warning).
- 15) Excessive engine temperature (pre-alarm).
- 16) Engine temperature sender failure (warning).
- 17) Low DC voltage (warning).
- 18) High DC voltage (warning).
- 19) Weak battery (warning).
- 20) Overcurrent (warning).
- 21) Ground Fault (warning).
- 22) 80% load indicator (warning).

~~~~~ **PROJECT NOTE** ~~~~~

UTILIZE ON DIESEL-ENGINE-DRIVEN GENERATOR SETS ONLY.

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| NAME OF SCHOOL<br>PROJECT NUMBER | 26 32 13 - 18 | ENGINE GENERATORS |
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~~~ **END OF PROJECT NOTE** ~~~~

- 23) Fuel tank high level (warning).

~~~~~ **PROJECT NOTE** ~~~~~

UTILIZE ON DIESEL-ENGINE-DRIVEN GENERATOR SETS ONLY.

~~~ **END OF PROJECT NOTE** ~~~~

- 24) Fuel in leak safety container (warning).
25) Voltage variation more than 5% (warning).
26) (4) configurable conditions (spare).

~~~~~ **PROJECT NOTE** ~~~~~

UTILIZE ON GAS-ENGINE-DRIVEN GENERATOR SETS ONLY.

~~~ **END OF PROJECT NOTE** ~~~~

- 27) Low natural gas pressure (leakage).
28) Cool down timer.
29) Control Switch Not In Automatic Position (warning).
b. Provide contacts for local and remote common alarm.
c. Provide lamp test function that illuminates all indicator lamps.
d. Provide devices and controls to monitor the following functions:
1) Voltage
2) Current
3) Frequency
4) Running time
5) Oil pressure
6) Water temperature
7) Generator voltage adjusting rheostat
8) Ammeter-voltmeter, phase-selector switch(es).

~~~~~ **PROJECT NOTE** ~~~~~

UTILIZE ON DIESEL-ENGINE-DRIVEN GENERATOR SETS ONLY.

~~~ **END OF PROJECT NOTE** ~~~~

- 9) Fuel supply or pressure.

~~~~~ **PROJECT NOTE** ~~~~~

UTILIZE ON DIESEL-ENGINE-DRIVEN GENERATOR SETS ONLY.

~~~ **END OF PROJECT NOTE** ~~~~

- 10) Fuel tank high-level fuel gauge.

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- e. All gauges and meters to be permanently and clearly identified.
- 5. Other Control Panel Features:
 - a. Event log.
 - b. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
 - c. Remote monitoring capability via PC.
 - d. The control system shall also incorporate a data logging and display provision to allow logging of the last ten (10) warnings or indications on the generator set, as well as total time of operation at various loads.
 - e. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
 - f. The control system shall also incorporate a data logging and display provision to allow logging of the last ten (10) warnings or indications on the generator set, as well as total time of operation at various loads.

~~~~~ **PROJECT NOTE** ~~~~~

INCLUDE IN SPECIFICATIONS IF REMOTE ANNUNCIATOR PANEL IS REQUIRED BY THE PROJECT SCOPE OF WORK.

~~~ **END OF PROJECT NOTE** ~~~

- G. Remote Annunciator Panel: Annunciation panel located in 24hr location if generator is not within a reasonable distance from manned station during normal operating facility times.
 - 1. Flush (or surface) mounted, single-membrane front face enclosure with integral test light and alarm acknowledge silence switches. Environmentally sealed, remotely mounted up to 1000 feet away from generator control panel. Designed for operation on 24VDC.
 - 2. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator.
 - 3. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided.
 - 4. The interconnecting wiring between the annunciator and other system components shall be monitored and failure of the interconnection between components shall be displayed on the annunciator panel.
 - 5. The annunciator shall include the following audible and visible LED indicators and alarms as required by the Chicago Building Code:

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| a. Condition | Audible Alarm | |
| b. Normal Power (to Loads) | | No |
| c. Genset Supplying Load | | No |
| d. Genset Running | | No |
| e. Not in Auto | Yes | |
| f. High Battery Voltage | | Yes |
| g. Low Battery Voltage | | Yes |
| h. Charger AC Failure | | Yes |
| i. Fail to Start | Yes | |
| j. Low Engine Temperature | | Yes |
| k. Pre-High Engine Temperature | | Yes |
| l. High Engine Temperature | | Yes |

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- m. Pre-Low Oil Pressure Yes
- n. Low Oil Pressure Yes
- o. Overspeed Yes
- p. Low Coolant Level Yes
- q. Network OK Yes
- r. (4) Spares Configurable

~~~~~ **PROJECT NOTE** ~~~~~

UTILIZE ON GAS-ENGINE-DRIVEN GENERATOR SETS ONLY.

~~~~ **END OF PROJECT NOTE** ~~~~

- s. Low Natural Gas Pressure Yes

~~~~~ **PROJECT NOTE** ~~~~~

UTILIZE ON DIESEL-ENGINE-DRIVEN GENERATOR SETS ONLY.

~~~~ **END OF PROJECT NOTE** ~~~~

- t. Low Fuel Level (less than 3hrs operating supply) Yes
- u. Voltage Variation of more than 5 percent Yes
- 6. Low battery voltage lamp shall also be lighted for low cranking voltage or weak battery alarm.

~~~~~ **PROJECT NOTE** ~~~~~

GEN SET ENCLOSURE FOR OUTDOOR REQUIREMENTS. INTERIOR GENERATORS DO NOT REQUIRE ENCLOSURE.

~~~~ **END OF PROJECT NOTE** ~~~~

2.06 GENERATOR SET ENCLOSURE

- A. Enclosure Type: Sound attenuating, weather protective. 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. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts is not acceptable. Fasteners to be corrosion resistant and designed to minimize marring of the painted surface when removed for normal installation or service work.
- B. Comply with Chicago Electrical Code.
- C. Enclosure Material: Minimum 12-gauge steel framework and 14-gauge steel for panels.
- D. Hardware Material: Stainless steel.
 - 1. Hardware material includes hinges.
- E. Finish: Manufacturer's standard color and finish over corrosion-resistant pretreatment and compatible primer.
- F. Access Doors: Provide with padlocking provisions.
- G. Openings: Designed to prevent bird/rodent entry.
 - 1. Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.

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- H. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.
- I. Sound Attenuating Enclosures: Line enclosure with non-hygroscopic, self-extinguishing sound-attenuating material.
- J. Utilize an upward discharging radiator hood.
- K. Connections to the generator set shall be through seamless flexible connections.
- L. Comply with ASCE 7 for wind loads.
- M. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
 - 2. Automatic Dampers: At engine cooling-air inlet and discharge.
 - a. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
 - b. Dampers shall be spring open-motor close type.
 - c. Motorized operators for supply and exhaust dampers shall develop adequate torque to operate the dampers during normal and abnormal conditions such as sleet on dampers.
 - d. Voltage of motorized operators shall correspond to the voltage output of the engine generator control panel.

~~~~~ **PROJECT NOTE** ~~~~~

PROVIDE DISTRIBUTION PANEL FOR GENERATORS 50KW OR LARGER

~~~ **END OF PROJECT NOTE** ~~~

- N. Provide a factory mounted and wired electrical distribution panel to serve the generator set and enclosure. The provisions required include:
 - 1. 100-amp distribution panel board connected to a VAC utility service by the installer.
 - 2. Factory-wired normal AC service from the panel board to the engine coolant and alternator heaters, and battery charger.
 - 3. Factory-wired normal AC service from the panel board to two duplex GFI receptacles, one inside the enclosure, and a weatherproof receptacle on the outside of the enclosure.
 - 4. Factory-wired normal AC service from the panel board to interior Lights with Switch: Factory-wired, vapor proof-type fixtures within housing; arranged to illuminate controls and accessible interior.

~~~~~ **PROJECT NOTE** ~~~~~

PARAGRAPH FOR ARRANGEMENT FOR EXTERNAL CONNECTIONS, ITEMS 1 THROUGH 4, TO BE UTILIZED IF THERE IS NOT A REQUIREMENT IN THE PROJECT FOR A DISTRIBUTION PANEL (LESS THAN 50KW).

~~~ **END OF PROJECT NOTE** ~~~

- O. Arrange for external connections:
 - 1. To the engine coolant and alternator heaters, and battery charger.

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2. Two duplex GFI receptacles, one inside the enclosure, and a weatherproof receptacle on the outside of the enclosure.
 3. Interior Lights with Switch: Factory-wired, vaporproof-type fixtures within housing; arranged to illuminate controls and accessible interior.
 4. Lighting system for operation independently from the remote source. Provide lighting emergency battery unit.
- P. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
- Q. Muffler shall be within enclosure. Muffler connections to the generator set shall be through seamless flexible connections.
- R. Space Heater: Thermostatically controlled and sized to prevent condensation.
- 2.07 VIBRATION ISOLATION DEVICES**
- A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer, arranged in multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
1. Material: Standard neoprene.
 2. Durometer Rating: 50.
 3. Number of Layers: Three.
- B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- 2.08 SOURCE QUALITY CONTROL**
- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
1. Tests: Comply with the Chicago Building Code , NFPA 110 Level 1 Energy Converters and IEEE 115.
- C. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.
1. Provide fourteen (14) days' advance notice of tests and opportunity for observation of tests by Board's representative.
 2. Report factory test results within ten (10) days of completion of test.
- D. Generator Set production testing to include, at a minimum:
1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 2. Operation at rated load and rated power factor.
 3. Single step load pick-up.
 4. Transient and steady state voltage and frequency performance.
 5. Operation of safety shutdowns.

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| NAME OF SCHOOL
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- 6. Voltage regulation..
- E. Diesel Fuel Storage Tanks: Perform pressurized leak test prior to shipment.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.
- C. Verify that rough-ins for field connections are in the proper locations.
- D. Verify that mounting surfaces are ready to receive equipment.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions, the City of Chicago Building Code, and with NFPA 110.
- C. Install generator sets and associated accessories in accordance with NECA/EGSA 404.
- D. Arrange equipment to provide minimum clearances and required maintenance access.
- E. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch on 4 inch high concrete base per manufacturer' s installation instructions. Secure sets to anchor bolts installed in concrete bases.
- F. Provide required support and attachment in accordance with Section 26 05 29 - Hangers and Supports for Electrical Systems.
- G. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.

~~~~~ PROJECT NOTE ~~~~~

UTILIZE DIESEL FUEL PIPING AND VENTING AND DAY TANK PARAGRAPHS FOR DIESEL-ENGINE-DRIVEN GENERATOR SETS

~~~~~ END OF PROJECT NOTE ~~~~~

- H. Provide diesel fuel piping and venting in accordance with Section 23 11 13 - Facility Fuel-Oil Piping, where not factory installed.
- I. Install day tank in accordance with Section 23 11 13 - Facility Fuel-Oil Piping.

~~~~~ PROJECT NOTE ~~~~~

UTILIZE GAS PIPING FOR NATURAL GAS AND PROPANE FOR GAS-ENGINE-DRIVEN GENERATOR SETS

~~~~~ END OF PROJECT NOTE ~~~~~

- J. Provide natural gas piping in accordance with Section 23 11 23.
- K. Provide propane gas piping in accordance with Section 23 11 26.
- L. Provide duct for cooling air intake/exhaust in accordance with Section 23 31 00 - HVAC Ducts and Casings.
- M. Provide engine exhaust piping in accordance with Section 23 51 00 – Breechings, Chimneys, and Stacks, where not factory installed.
 - 1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.

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2. Do not exceed manufacturer's maximum back pressure requirements.
- N. Do not insulate piping for engine components restricted by manufacturer.
- O. Install engine generator remote annunciator panels and wiring to generator control panel.
- P. Install battery starting cable within raceway sized in accordance with manufactures recommendations.
- Q. Provide grounding and bonding in accordance with Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- R. Identify system wiring and components in accordance with Section 22 05 53 - Identification for Plumbing Piping and Equipment and 26 05 53 - Identification for Electrical Systems.
- S. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Section 23 21 13 - Hydronic Piping.
 1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Section 23 21 13 - Hydronic Piping.
- T. Electrical Wiring:
 1. Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
 2. Provide all the wiring specified by the manufacturer in the installation instructions as "Field Wiring".
 3. Install emergency systems wiring within separate raceways.
- U. Install emergency branch circuits and control wiring for the engine generator accessories including the following:
 1. Battery charger.
 2. Engine jacket heater.
 3. Damper motors and controls.

~~~~ **PROJECT NOTE** ~~~~~

RETAIN PARAGRAPH BELOW FOR DIESEL DRIVEN GENERATOR SETS

~~~ **END OF PROJECT NOTE** ~~~

4. Day tank pump and controls.
 - V. Install engine generator remote annunciator panels and wiring to generator control panel.
 - W. Install battery-starting cable within raceway sized in accordance with manufactures recommendations.
- 3.03 CONNECTIONS
- A. Piping installation requirements are specified in Division 22 and Division 23 Sections. Drawings indicate general arrangement of piping and specialties.
 - B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
 - C. Connect cooling-system water piping to engine-generator set.
 - D. Connect engine exhaust pipe to engine with flexible connector.
 - E. Ground equipment according to Section 26 05 26 - Grounding and Bonding for Electrical Systems.

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- F. Connect wiring according to Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables
- G. Provide equipment grounding connections for generator units as indicated on the drawings. Tighten connections to comply with tightening torques specified in UL 486A-486B-Wire Connectors to assure permanent and effective grounding.
- H. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B-Wire Connectors.
- I. Install generator set with adequate space allowed for removal, repair and code required clearances. Verify the exact dimensions of engine generator set and check for adequate room dimensions. Notify the architect/engineer of all discrepancies immediately.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.
- C. Notify Board and Architect/Engineer of Record at least two weeks prior to scheduled inspections and tests.
- D. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- E. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.
- F. Preliminary inspection and testing to include, at a minimum:
 - 1. Inspect each system component for damage and defects.
 - 2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
 - 3. Check for proper oil and coolant levels.
- G. Prepare and start system in accordance with manufacturer's instructions.
- H. Perform acceptance test in accordance with NFPA 110 and the Chicago Building Code, including:
 - 1. Battery Test: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - 2. Battery-Charger Test: Verify specified rates of charge for both equalizing and float-charging conditions.
 - 3. 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.
 - 4. Exhaust System Back Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 - 5. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
 - 6. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 - 7. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four (4) locations on the property line, and compare measured levels with required values.

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- I. Inspection and testing to include, at a minimum:
 - 1. Verify compliance with starting and load acceptance requirements.
 - 2. Verify voltage and frequency; make required adjustments as necessary.
 - 3. Verify phase sequence.
 - 4. Verify control system operation, including safety shutdowns.
 - 5. Verify operation of auxiliary equipment and accessories (e.g. battery charger, heaters, etc.).
 - 6. Perform load tests in accordance with NFPA 110 (1.5 hour building load test followed by 2 hour full load test).
 - J. Provide field emissions testing where necessary for certification.
 - K. Sound Level Tests: Measure sound levels for compliance with specified requirements. Identify and report ambient noise conditions.
 - L. Coordinate tests under load(s) with tests for transfer switches and run them concurrently.
 - M. Test instruments shall have been calibrated within the last twelve (12) months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
 - N. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - O. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least four (4) hours. Coordinate timing and obtain approval for start of test with site personnel. Test to be per Chicago code requirements. The test must be witnessed by an inspector from the Chicago Bureau of Electrical Inspection.
 - P. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
 - Q. Submit detailed reports indicating inspection and testing results and corrective actions taken.
- 3.05 IDENTIFICATION
- A. Identify system components according to Section 23 05 53 - Identification for HVAC Piping and Equipment and 26 05 53 - Identification for Electrical Systems.
- 3.06 CLEANING
- A. Clean work under provisions of Division 01.
 - B. Clean engine and generator surfaces. Replace after testing all oil, fuel filters and re-fill fuel tank.
 - C. Vacuum dirt and debris; do not use compressed air to assist in cleaning.
 - D. Clean engine generator set using methods and materials as recommended by the manufacturer.
 - E. Remove paint splatters and other spots, dirt and debris. Touch up scratches and mars on finish to match original finish.
- 3.07 CLOSEOUT ACTIVITIES
- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
 - B. See Section 01 79 00 - Demonstration, Training and Commissioning, for additional requirements.
 - C. Demonstration: Demonstrate proper operation of system to Board, and correct deficiencies or make adjustments as directed.
 - D. Training: Train Board's personnel on operation, adjustment, and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of four hours of training.

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3. Instructor: Manufacturer's authorized representative.
 4. Location: At project site.
 5. Schedule training with at least seven (7) days advance notice.
 - E. After successful acceptance test and just prior to Preliminary Acceptance, replace air, oil, and fuel filters and fill fuel storage tank.
- 3.08 CONTRACTOR START UP AND REPORTING
- A. Perform tests and inspections and prepare test reports.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - B. Tests and Inspections:
 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Acceptance Tests: Perform tests required by the ANSI/IEEE 802.7 that are additional to those specified here including, but not limited to, single-step full-load pickup test. Include a "cold start" test, a two (2) hour full load test, and a one (1) step rated load pickup test in accordance with NFPA 110 and the ANSI/IEEE 802.7. Provide a resistive load bank and make temporary connections for full load test, if necessary.
 3. Perform tests required by the ANSI/IEEE 802.7 and NFPA 110 that are additional to those specified here.
 4. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. 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.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 5. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 6. 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.
 7. Exhaust System Back Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
 9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four (4) locations on the property line, and compare measured levels with required values.
 - C. Coordinate tests with tests for transfer switches and run them concurrently.

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- D. Test instruments shall have been calibrated within the last twelve (12) months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 4 hours. Coordinate timing and obtain approval for start of test with site personnel. Test to be per the ANSI/IEEE 802.7 requirements. The test must be witnessed by an inspector from the Chicago Bureau of Electrical Inspection.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest and re-inspect as specified above.
- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.09 PROTECTION

- A. Protect installed engine generator system from subsequent construction operations.

3.10 MAINTENANCE

- A. See Section 01 70 00 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide to Contractor a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of engine generator system for two (2) years from date of Preliminary Acceptance; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.
- C. Conduct site visit at least once every three (3) months to perform inspection, testing, and preventive maintenance. Submit report to Board indicating maintenance performed along with evaluations and recommendations.
- D. Provide trouble call-back service upon notification by Board:
 - 1. Provide on-site response within four (4) hours of notification.
 - 2. Include allowance for call-back service during normal working hours at no extra cost to Board.
 - 3. Board will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- E. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

END OF SECTION

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