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**PEEKSKILL FDC & PEEKSKILL IDA
PEEKSKILL FIREHOUSE KITCHEN INCUBATOR
FE PROJECT NO. 23-369**

2.0 Contractor Work Phasing

260100 SCOPE & GENERAL DESCRIPTION (E)

1.0 GENERAL DESCRIPTION

These specifications cover furnishing all labor and materials to provide a complete and operative electrical system for the renovation of the Peekskill Firehouse into a commercial kitchen incubator.

2.0 SCOPE

The systems described in these plans and specifications include but are not limited to the following:

Primary conduit from utility company terminal pole to PMT. Conduit and cable by utility company and installed by electrical contractor.

Arrangements with utility company, including payment for all charges and fees.

Secondary service to metering and main service entrance.

Metering facilities for utility company metering.

Main service entrance equipment.

Branch feeder circuits.

7. Branch panels.
8. Connections of feeder from new service to existing service.
9. Emergency power system.
10. Lighting fixtures.
11. Kitchen equipment wiring.
12. Telecom system and outlets. Service conduit and facilities.
13. General purpose circuits.
14. Individual equipment circuits.
15. Cutovers and removals of existing unused systems.

260500 GENERAL CONDITIONS (E)

1.0 GOVERNING CONDITIONS

General conditions of the electrical contract shall be in accordance with the "General Conditions of the Contract for the Construction of Buildings" NSPE/ACEC-CS 156465 (latest edition) with the latest addenda and revisions.

2.0 SUPPLEMENTARY GENERAL CONDITIONS

Supplementary general conditions may be provided for all mechanical and electrical work and are contained in the General Construction documents. This contractor should read and understand same.

3.0 DRAWINGS

Work on this project as described in these specifications is shown on drawings of sheets appropriately titled and plot plan.

4.0 SUBMISSION OF BID

Contractor shall submit bid as directed to the owner's agent at the time specified. The bid shall contain a statement of the work to be performed and the total construction. The contractor shall state that this work is to be performed in accordance with all applicable plans and specifications.

5.0 INVESTIGATION OF CONDITIONS

The electrical contractor shall visit the site of the work and familiarize themselves with all available information concerning the nature of local conditions bearing on transportation, handling and storage of materials. The electrical contractor shall make his own estimate of the facilities needed and difficulties attending the execution of the contract, including local conditions, availability of labor, uncertainties of weather, transportation and other conditions bearing on transportation, handling and storage of materials.

6.0 CONTRACTUAL RELATIONSHIP WITH OWNER

Upon award of this contract, the contractor shall save harmless the owner and his agents from any and all causes of action arising out of this contract.

7.0 NATIONAL ELECTRICAL CODE

Entire installation shall be made in accordance with the latest edition of National Electrical Code. Contractor shall cooperate with NEC inspector on the installation.

8.0 SAFETY

This electrical contractor shall perform all work in accordance with Rule #23 of the New York State Standards of the Labor Board and shall take special precaution during the construction to avoid any exposed live parts. When working on live equipment, the contractor shall give other trades adequate warning and provide adequate protection and warning for others. All open trenches shall be barricaded at all times and safety lighted at night.

9.0 FIELD MEASUREMENTS

The electrical contractor shall verify in the field, all measurements necessary for his work and shall assume responsibility for their accuracy.

10.0 EXCAVATION AND BACKFILL

All excavation and backfill for electrical work shall be performed by this contractor.

11.0 TEMPORARY POWER AND LIGHTING SERVICE

This contractor shall install, maintain and remove temporary electrical service for lighting and power for construction purposes. If during the course of this project it is necessary to interrupt electric lighting or power service, this contractor shall provide temporary power and lighting as required and directed. Existing lighting and power may be interrupted only upon written consent of the owner, after 48 hours notice.

12.0 EXISTING SYSTEMS AND EQUIPMENT

Portions of existing services, cables, conduits, panels or equipment may be reused and/or altered. See drawings for details.

13.0 TESTS AND ENERGIZING

After the electrical installation is complete, this contractor shall test all circuits, busses and equipment and verify to ensure that they are free from grounds and short circuits before energizing. All 600-volt cable shall be tested using megohmmeter. Cables of higher voltage rating shall be tested using a D.C. high potential tester. Equipment shall be energized only after said tests have been conducted and test results evaluated.

14.0 PREVAILING WAGE RATES

Provisions of the New York State Labor Law require payment of "Prevailing Wage Rates" in certain public projects. Where applicable, these will be made a part of this contract.

15.0 OTHER GENERAL CONDITIONS

15.1 Intent - It is the intent of these plans and specifications to provide alterations and/or new construction as indicated on the drawings and in the specifications to provide complete systems in every respect, capable of operating as designed. It is not intended that every

- fitting, minor detail or feature be shown on drawings. The contractor shall be responsible for any detail necessary for completion of these systems in accordance with good practice. Installation shall be executed so as to contribute to efficiency of operation, minimum maintenance, accessibility and sightliness. The installation shall conform and accommodate itself to the building structure, its equipment and its usage. No piping or equipment shall be installed in such a manner as to interfere with the operation of any doors or windows. Requirements specified herein shall govern applicable portion of mechanical and electrical sections whether so stated herein or not.
- 15.2 Regulations and Certificates - All work shall be done in strict accordance with rules and regulations of local and state authorities having jurisdiction over such work, utility companies operating where apparatus is being installed, National Fire Protection Association, IEEE and insurance companies. Where discrepancies occur between above regulations and these plans and specifications, requirements of the regulations shall take precedence, except that these specifications shall be minimum requirements and that no changes shall be made without approval of the engineer. Complete approval of all above mentioned authorities shall be secured and their certificates of approval shall be delivered to the owner before final acceptance. Any and all drawings or documents required (in addition to contract drawings) shall be furnished in order to secure above-mentioned approvals.
- 15.3 Drawings and Measurements - Contract drawings for mechanical and electrical work are in part diagrammatic, intended to cover the general design and extent of the systems and indicate general arrangement of equipment, ducts, conduits, piping and approximate sizes and locations of equipment and outlets. Drawings are not intended to be scaled for roughing-in measurements nor to serve as shop drawings. Where drawings are required for these purposes or have to be made from field measurements, they shall be prepared by the various trades and coordinated by the contractor. Where job conditions require reasonable changes from indicated locations and arrangements, such changes shall be made without cost to the owner. Exact locations of all grilles, registers, plumbing fixtures, electrical fixtures, panelboards, etc., shall be governed by plans, elevations and details.
- 15.4 Record Drawings - During the course of construction the respective contractor shall keep a careful record (in drawing form) of all deviations from the work as shown on the contract drawings on the installation of pipes, ducts, electric outlets, equipment, invert elevations, etc. These drawings shall be delivered to the engineer before the final certificate of payment is issued.
- 15.5 Accessibility - Locate all equipment which must be serviced, operated or maintained, in fully accessible position. Equipment shall include but not be limited to valves, traps, cleanouts, motors, controllers, drain points, etc. Furnish access doors where required. Minor deviations from the drawings may be made to allow for better accessibility, but changes of magnitude or which involve extra cost shall not be made without approval.
- 15.6 Access Doors and Panels - Furnish flush type door or panel with metal frame for all junction boxes or apparatus located in chases, walls or floors. Finish shall be prime coat.

- 15.7 Quiet Operation - All work shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the engineer. In case of moving machinery, sound or vibration noticeable outside of room in which it is installed or annoyingly noticeable inside its own room will be considered objectionable by the engineer shall be corrected in approved manner by the contractor at the latter's expense.
- 15.8 Covering of Work - No pipe fittings or other work of any kind shall be covered up or hidden from view before it has been examined or approved by the engineer or other authority having jurisdiction. Any unfaithful or imperfect work or material which may be discovered shall be removed and corrected immediately before being condemned, and other work and materials shall be furnished which shall be satisfactory to the engineer.
- 15.9 Guarantee - The electrical contractor shall guarantee all workmanship, materials, performance for a period of one year from the date of the certificate of completion and acceptance of his work. The contractors shall promptly correct any defects upon notice from the owner to do so, without cost to the owner.
- 15.10 Waterproofing - Where any work pierces waterproofing, the installation shall be as approved by the engineer. The electrical contractor shall furnish all necessary sleeves, caulking and flashing as required to make the openings absolutely watertight.
- 15.11 Excavation and Backfill - All excavation and backfill shall be by the contractor who is furnishing and installing the respective equipment. Cleanup, resurface and resod all disturbed areas.
- 15.12 Fire Stopping - All penetrations through fire and smoke rated walls, floors and ceilings shall be thoroughly sealed with 3M brand Fire Barrier CP25WB latex based caulk, or approved equal. Install in accordance with manufacturer's instructions.
- 15.13 Equipment Returns - As part of this contract, contractors shall ensure that suppliers of any and all equipment supplied for this project agree to accept the return of any equipment on this project that is in undamaged condition and has not been put into service with a maximum restocking fee of 25%, up until the date of certified substantial completion of the project.
- 15.14 Coordination of Trades - It is understood that coordination between all of the trades on this project is the responsibility of the construction manager (if any), the general contractor (if any) and the trades themselves. This coordination will include meetings and discussions as needed among the parties noted above, and preparation of coordination drawings as needed. The cost of this coordination work shall be included in the contractors' bids. It is not the responsibility of the engineer to perform this coordination. No extra charges will be paid to any contractor that is due to additional work being performed due to lack of coordination between the trades.

- 15.15 Building Services Shutdowns - All building services shutdowns, including electric, gas, water, and telephone utilities, and HVAC, sprinkler, and plumbing systems in existing buildings, for the purpose of performing cutovers and tie-ins of new systems, shall be strictly coordinated with the appropriate utility companies and the building owner. For work in existing buildings, it will be required to perform this work outside of normal building operation hours and the cost for this is to be included in the bids.

260800 CODES, PERMITS AND INSPECTIONS (E)

1.0 APPLICABLE CODES

The entire installation shall conform to the rules and regulations of the following parties having jurisdiction:

- A. National Electrical Code of the National Fire Protection Association, latest edition.
- B. State Codes, Local Electrical Codes and other regulations of municipality.
- C. "Specifications for Electrical Installations" issued by supplying electric utility company.
- D. Telephone company standards.

2.0 PERMITS

Contractor shall obtain all permits required by local utility company ordinances. Contractor shall cooperate with utility companies on electric and telephone installations. Contractor shall obtain approval of all utilities on service entrances.

3.0 CERTIFICATE OF INSPECTION

Upon completion, the electrical contractor shall furnish a certificate of final inspection to the owner from the New York Board of Fire Underwriters covering all electrical installations in these plans and specifications in his contract. The cost of said inspection shall be borne by the contractor and shall be included in the contract amount.

4.0 ELECTRIC UTILITY COMPANY STANDARDS

Entire installation shall conform to all rules and regulations for service as issued by the utility company. Pad mount transformer installation shall conform to the supplying utility company standards and specifications provided by utility company.

5.0 LAWS, ORDINANCES AND FEES

This contractor shall give all necessary notices, obtain all permits, and pay all taxes, fees and other documents and obtain all necessary approvals of all local, County, New York and/or State of New York Departments, having jurisdiction; obtain all required Certificates of Inspection for his work and deliver same to the engineer before request for acceptance and final payment for the work. This contractor shall include in the work, without extra cost to the owner, any labor, materials, services, apparatus, drawings (in addition to contract drawings and documents) which are necessary in order to comply with all applicable laws, ordinances, rules and regulations whether or not shown on drawings and/or specified. With submission of bid, the electrical contractors shall give written notice to the engineer of any materials or equipment believed inadequate or unsuitable in violation of laws, ordinances, rules or regulations of authorities having jurisdiction and any

necessary items of work omitted. In the absence of such written notice, it is mutually agreed that this contractor has included the cost of all required items in his proposal, and that they will be responsible for the approved satisfactory functioning of the entire system without extra compensation.

6.0 O.S.H.A.

All work on this project shall be accomplished in accordance with Federal statutes such as the Occupational Safety and Health Act (1970).

261000 MATERIALS, WORKMANSHIP AND GUARANTEE (E)

1.0 MATERIALS STANDARDS

All materials shall be new and comply with the best accepted industry standards and shall bear the Underwriters' Laboratories (UL) seal of approval. All material shall be of such quality and dimensions specified and shall be manufactured in accordance with American Standards Association, National Electrical Manufacturers Association, I.E.E.E., and Underwriter's Laboratories. In any conflict, the engineer shall be sole judge of whether or not these conditions are met or whether the "or equal" clause is met. All conductors on entire project shall be copper. Abbreviations in the plans and specifications may be used as follows:

EMT - "Electro Metallic Tubing" - Thin wall conduit.

GIC - "Galvanized Iron Conduit" - Heavy wall conduit.

PVC - "Polyvinyl Chloride" - Schedule 40 or 80 conduit as specified.

Samples - Contractor may be required to submit sample of all materials used to the engineer. Materials may be rejected any time during project if installed without presenting samples, if found to be not equal to the quality specified in its category. The engineer shall be the sole judge of this matter.

2.0 APPEARANCE OF WORK

All work shall be executed to present a neat mechanical appearance and leave the installation in proper operating order.

3.0 GUARANTEE

The contractor shall replace any work or material which develops defects from ordinary wear and tear within one year of the date of the final certificate of approval. Replacement shall be made without cost to the owner.

4.0 LAYOUT, CUTTING AND PATCHING

The electrical contractor shall layout all conduits, box locations, etc., in advance of pouring concrete or installation of walls. Any cutting or patching required because of the contractor's neglect to properly lay out the work shall be performed at the expense of the contractor and shall be approved by the engineer to assure a workmanlike job. Contractor shall verify all dimensions shown on plans and shall be responsible for dimensions and conduit sizes to assure adequate sizing where larger conduits are installed to provide for more than one circuit per conduit. Contractor shall cooperate with other contractors on locations of facilities where conflicts of location arise.

5.0 SHOP DRAWINGS AND SAMPLES

Before ordering material shipped to the job, submit to engineer six copies of shop drawings for review giving all details, dimensions, etc., of the following equipment:

Natural gas generator

Electrical contractor shall also furnish samples of wire, cable, plug receptacles, light switches, disconnect switches and other small parts as requested by the engineer.

6.0 RIGID STEEL CONDUIT AND EMT

All rigid steel conduit shall be full weight standard i.p.s. galvanized or Sheradized threaded conduit equal to National Electric Products Company "Sheraduct" or approved equal, and no conduit smaller than 3/4" in size shall be used on any part of the installation. Rigid steel conduit shall be used in floor slab and on all main feeders to light panels, power panels, etc. All conduits, where located in outside walls, underground or underfloors, shall have joints redlead. Conduits buried underground, chased in roof planking or in slab on grade shall be painted with two coats of asphaltum paint. Conduits shall be continuous from outlet to outlet, and from outlets to cabinets, junction or pull boxes and shall enter and be secured to all boxes in such a manner that each system shall be electrically continuous from service to all outlets. Terminals of all conduits shall be furnished with double locknuts and bushings. Changes in direction of conduit where concealed shall be made by means of standard radius bend, and where exposed by means of Crouse-Hinds or equal galvanized or sheradized threaded condulets. Armored cable shall be used only for short connections to fractional horsepower utility motors. Electrical metallic tubing may be permitted on exposed ceiling work and for concealed branch circuit wiring where not installed in slab construction.

7.0 JUNCTION AND PULL BOXES

Junction or pull boxes shall be furnished and installed under this section of the specifications where indicated on the drawings, wherever else such a box may be deemed necessary to facilitate the pulling or splicing of wires or cables. All such boxes must be accessible and shall be built only from approved detail working drawings. Conduits shall enter these boxes through tight fitting clearance holes. Covers for the boxes shall be designed for quick removal. Where junction boxes are required for splicing box for special recessed fixtures, consult the engineer before installing and determine exact location of each box. Each feeder passing through a pull box shall be tagged with tag of fireproof material, or designated in another approved manner. Generally, junction boxes and pull box shall not be exposed in finished spaces. Where necessary, reroute conduits or make other arrangements to meet approval of engineer.

263213 ENGINE GENERATORS (E)

1.0 RELATED DOCUMENTS

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

2.0 SUMMARY

- A. This Section includes packaged engine-generator sets for emergency power supply with the following features:
 - A. Natural gas engine.
 - B. Unit-mounted cooling system.
 - C. Unit-mounted control and monitoring.
 - D. Performance requirements for sensitive loads.
 - E. Load banks.
 - F. Outdoor enclosure.
- B. Related Sections include the following:
 - 1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

3.0 DEFINITIONS

- A. 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.

4.0 SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 - 4. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that engine-generator set, batteries, battery racks, accessories, and components will withstand seismic

forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For installer, manufacturer, and testing agency.
- E. Source quality-control test reports.
1. Certified summary of prototype-unit test report.
 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 5. Report of sound generation.
 6. Report of exhaust emissions showing compliance with applicable regulations.
 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- H. Warranty: Special warranty specified in this Section.

5.0 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints 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.

- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles (321 km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with ASME B15.1.
- G. Comply with NFPA 37.
- H. Comply with NFPA 70.
- I. Comply with NFPA 99.
- J. Comply with NFPA 110 requirements for Level 2 emergency power supply system.
- K. Comply with UL 2200.
- L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- M. 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.

6.0 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
- B. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
- C. Do not proceed with interruption of electrical service without Owner's written permission.
- D. 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).

7.0 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified on the drawings.

8.0 WARRANTY

- A. Special 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.
 - 1. Warranty Period: 5 years from date of Substantial Completion.

9.0 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 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.

10.0 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. Fuses/breakers: One for every 10 of each type and rating, but no fewer than one of each.
 - 2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
 - 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

11.0 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Caterpillar; Engine Div.
 - 2. Generac Power Systems, Inc.
 - 3. Kohler Co.; Generator Division.
 - 4. Magnetek, Inc.
 - 5. Onan/Cummins Power Generation; Industrial Business Group.
 - 6. Spectrum Detroit Diesel.

12.0 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
 - 1. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 2. 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.
- B. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated.
 2. Output Connections: Three-phase, four wire.
 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- C. 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 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.
- D. Generator-Set Performance for Sensitive Loads:
1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
 - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
 2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
 3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
 4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
 5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.

7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
 - a. Provide permanent magnet excitation for power source to voltage regulator.
10. Start Time: Comply with NFPA 110, Type 10, system requirements.

13.0 ENGINE

- A. Fuel: Natural gas.
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).
- D. Lubrication System: 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: Control flow in system to maintain optimum oil temperature. Unit shall be 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, siphons, special tools, or appliances.
- E. Engine Fuel System:
 1. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
 2. Natural Gas System:
 - a. Carburetor.
 - b. Gas Regulator.
 - c. Fuel-Shutoff Solenoid Valve.
 - d. Flexible Fuel Connector.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. Cooling System: Closed loop, liquid cooled, with remote radiator and integral engine-driven coolant pump.
 1. Configuration: Vertical or horizontal 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. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 5. Fan: Driven by multiple belts from engine shaft or totally enclosed electric motor with sealed bearings.

6. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
7. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
- I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 1. Minimum sound attenuation of 25 dB at 500 Hz.
 2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.
- J. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- K. Starting System: 12- or 24-V electric, with negative ground.
 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking 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 Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice to three times without recharging.
 5. Battery Cable: Size as recommended by engine 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 shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. 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 shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

- d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
- e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

14.0 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- C. 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.
- D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 2 system, and 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. Fuel tank derangement alarm.
 - 11. Fuel tank high-level shutdown of fuel supply alarm.
 - 12. Generator overload.
- E. Indicating and Protective Devices and Controls:
 - 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. Fuel tank derangement alarm.
 16. Fuel tank high-level shutdown of fuel supply alarm.
 17. Generator overload.
- F. 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.
- G. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.
1. Engine high-temperature shutdown.
 2. Lube-oil, low-pressure shutdown.
 3. Overspeed shutdown.
 4. Remote emergency-stop shutdown.
 5. Engine high-temperature prealarm.
 6. Lube-oil, low-pressure prealarm.
 7. Fuel tank, low-fuel level.
 8. Low coolant level.
- H. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- I. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

15.0 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
 2. Trip Rating: Matched to generator rating.
 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 4. Mounting: Adjacent to or integrated with control and monitoring panel.
- B. Generator Disconnect Switch: Molded-case type, 100 percent rated.
1. Rating: Matched to generator output rating.

2. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.
- C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
 1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
- D. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

16.0 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. 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.
- F. Enclosure: Dripproof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12 percent, maximum.

17.0 LOAD BANK

- A. Description: Permanent, outdoor, weatherproof, remote-controlled, forced-air-cooled, resistive and reactive unit capable of providing a balanced 3-phase, delta-connected load

- to generator set at 100 percent rated-system capacity, at 80 percent power factor, lagging. Unit may be composed of separate resistive and reactive load banks controlled by a common control panel. Unit shall be capable of selective control of load in 25 percent steps and with minimum step changes of approximately 5 and 10 percent available.
- B. Resistive Load Elements: Corrosion-resistant chromium alloy with ceramic and steel supports. Elements shall be double insulated and designed for repetitive on-off cycling. Elements shall be mounted in removable aluminized-steel heater cases.
 - C. Reactive Load Elements: Epoxy-encapsulated reactor coils.
 - D. Load-Bank Heat Dissipation: Integral fan with totally enclosed motor shall provide uniform cooling airflow through load elements. Airflow and coil operating current shall be such that, at maximum load, with ambient temperature at the upper end of specified range, load-bank elements operate at not more than 50 percent of maximum continuous temperature rating of resistance elements.
 - E. Load Element Switching: Remote-controlled contactors switch groups of load elements. Contactor coils are rated 120 V. Contactors shall be located in a separate NEMA 250, Type 3R enclosure within load-bank enclosure, accessible from exterior through hinged doors with tumbler locks.
 - F. Contactor Enclosures: Heated by thermostatically controlled strip heaters to prevent condensation.
 - G. Load-Bank Enclosures: NEMA 250, Type 3R, complying with NEMA ICS 6. Louvers at cooling-air intake and discharge openings shall prevent entry of rain and snow. Openings for airflow shall be screened with 1/2-inch- (13-mm-) square, galvanized-steel mesh. Reactive load bank shall include automatic shutters at air intake and discharge.
 - H. Protective Devices: Power input circuits to load banks shall be fused, and fuses shall be selected to coordinate with generator circuit breaker. Fuse blocks shall be located in contactor enclosure. Cooling airflow and overtemperature sensors shall automatically shut down and lock out load bank until manually reset. Safety interlocks on access panels and doors shall disconnect load power, control, and heater circuits. Fan motor shall be separately protected by overload and short-circuit devices. Short-circuit devices shall be noninterchangeable fuses with 200,000-A interrupting capacity.
 - I. Remote-Control Panel: Separate from load bank in NEMA 250, Type 1 enclosure with a control power switch and pilot light, and switches controlling groups of load elements.
 - J. Control Sequence: Control panel may be preset for adjustable single-step loading of generator during automatic exercising.

18.0 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). 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.
- B. Description: Prefabricated or preengineered walk-in enclosure with the following features:
 - 1. Construction: Galvanized-steel, metal-clad, integral structural-steel-framed building erected on concrete foundation.
 - 2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.
 - 3. Space Heater: Thermostatically controlled and sized to prevent condensation.

4. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
5. Hinged Doors: With padlocking provisions.
6. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
7. 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.
8. Muffler Location: Within enclosure.
- 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 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. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
- D. Interior Lights with Switch: Factory-wired, vaporproof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
 1. AC lighting system and connection point for operation when remote source is available.
 2. DC lighting system for operation when remote source and generator are both unavailable.
- E. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

19.0 VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or 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: 30.
 3. Number of Layers: One.
- 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.

20.0 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

21.0 EXAMINATION

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

22.0 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases.
- D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

23.0 CONNECTIONS

- A. Piping installation requirements are specified in Division 22 and 23 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel adjacent to packaged engine generator to allow service and maintenance.
- C. Connect fuel piping to engines with a gate valve and union and flexible connector.
 - 1. Natural-gas piping, valves, and specialties for gas distribution are specified in Division 22.
- D. Ground equipment and connect wiring according to Division 26.

24.0 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. 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.
- D. 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. 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.
 3. 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.
 - d. Verify that measurements are within manufacturer's specifications.
 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 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. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). 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.
 7. Exhaust Emissions Test: Comply with applicable government test criteria.
 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 on the property line, and compare measured levels with required values.
- E. Coordinate tests with tests for transfer switches and run them concurrently.
- F. 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.
- G. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- J. Remove and replace malfunctioning units and retest as specified above.

- K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- L. 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.
- M. 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. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

25.0 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

264000 SERVICE ENTRANCE (E)

1.0 LOCATION AND DESCRIPTION

This contractor shall furnish and install complete and operative service entrance as shown on plans.

2.0 FEEDERS

Furnish and install 120/208V three phase service. Entire installation shall be furnished and installed in accordance with rules of electric service of local utility company. This contractor shall obtain approval of the utility company on the installation.

3.0 MAIN SWITCHGEAR AND FUSES

Furnish and install service entrance switchboards as herein specified and shown on associated electrical drawings. The switchboards shall meet Underwriters' Laboratories (UL) enclosure requirements. The entire switchboard is to be Square 'D' Bus-Stack construction. System shall operate at Enclosure Construction - The switchboard framework shall be fabricated on die-formed steel base or base assembly consisting of formed steel and commercial channel welded or bolted together to rigidly support the entire shipping unit for moving on rollers and floor mounting. The framework is to be formed code gauge steel, rigidly welded and together to support all cover plates, bussing and component devices during shipment and installation. Each switchboard section shall have an open bottom and individual removal top plate for installation and termination of conduit. Top and bottom conduit area is to be clearly shown and dimensioned on the shop drawings. The wireway front covers are to be hinged to permit access to the branch switch load side terminals without removing the covers. All front plates used for mounting meters, selector switches or other front mounted devices shall be hinged with all wiring installed and laced with flexibility at the hinged side. All closure plates shall be screw removable and small enough for easy handling by one man. The paint finish shall be gray enamel over a rust inhibiting phosphate primer.

Bolted Pressure Switches - The main switches shall be fusible of the bolted contact type with ratings as shown on the associated drawings. The switches shall be dead-front type with fuse-door interlock and provisions for padlocking in the open position with at least three padlocks. The bolted contacts are to firmly bolt the movable blades to both the top and bottom stationary contacts. The switch shall be capable of opening and closing into a fault of six times current rating in accordance with UL requirements to insure safety on emergency operation.

Fusible Switches - The fusible switches shall be quick-make, quick-break and suitable for use on the service as described for the sizes as shown on the associated drawings. The units shall be listed and approved applicable, shall be dual horsepower rated for both standard one-time or dual element fuses. The fusible switches shall be group mounted in panel type construction. Each switch is to be enclosed in a separate steel enclosure. The enclosure will employ a hinged cover for access to the fuses which will be interlocked with the operating handle to prevent opening the cover when the switch is in the ON position. This interlock shall be constructed so that it can be released with a standard electrician's tool for testing fuses without interrupting service. The units shall have

padlocking provisions in the OFF position and the operating handle position shall give positive switch position indication (i.e. Horizontal OFF, diagonal ON). Switches shall pass industry standard 12+ withstandability tests and fuse race tests as described elsewhere in these specifications. All switchboards shall be UL approved and shall be labeled and approved for service entrance use. All fuses shall be current limiting, 200,000 amp interrupting rating and shall be approved type as manufactured by Bussman Co., St. Louis, Missouri.

4.0 GROUNDING

Furnish and install neutral and frame grounds as shown on plans and herein described and as per National Electrical Code. Provide 5/8" x 8'-0" copperweld ground rod for service entrance ground. All ground clamps shall be UL approved. Electrical contractor shall measure all ground resistances and shall provide additional groundings of system as required to provide a maximum resistance of one half-ohm system ground.

5.0 PROVISION FOR FUTURE CIRCUITS

Main switchgear shall be provided with space for installation of a minimum of equivalent of the number of overcurrent protection units shown on plans.

6.0 TEMPORARY SERVICE DURING CONSTRUCTION

Electrical contractor shall install, maintain and remove temporary electrical service for lighting and power during construction consisting of but no limited to the following:

Extension lines of sufficient capacity to provide power for saws, drills, hammers and other construction tools as requested by trades.

Power for using fuel fired temporary heating equipment.

Power shall be provided to each space in building as requested by various contractors.

Temporary lighting system consisting of "festoon" incandescent lighting with guards to provide approximately 5 foot-candles average illumination on the work surfaces.

Furnish all labor needed to keep this temporary system energized during the entire standard period of daily working for all trades plus 15 minutes before and 15 minutes after the working period.

Temporary lighting at all construction shanties and trailers shall be operative at all times. Provide each with a connection at 120 volts - 20A capacity.

Provide for safety lighting of corridors and stairs.

Each section of temporary light or power facilities shall remain as long as needed or until replaced by permanent facilities. Permanent facilities may be utilized as they are installed. Contractor shall accept full responsibility for their use.

Remove temporary facilities upon cutover to permanent facilities.

264400 INDIVIDUAL EQUIPMENT CIRCUITS (E)

1.0 DESCRIPTION AND LOCATION

Install all individual equipment circuits as shown on drawings.

2.0 WIRING METHOD

Install all individual equipment circuits with Type THHN copper conductors in conduit. Type MC (BX) insulated copper conductors may be utilized for drop whips from junction box to device, unless otherwise noted. Connect and test. Furnish and install all wiring and furnish and install disconnect switches on equipment furnished and installed by others.

3.0 MECHANICAL EQUIPMENT

Electrical contractor shall furnish and install all power wiring, disconnect switches and connections as required to all mechanical equipment spaces to fans, air handlers, etc., as shown on drawings. Electrical control systems of all HVAC and plumbing equipment shall be furnished by respective contractors. Respective contractors shall hire, as necessary, licensed electricians to perform control work requiring same. Motor starting shall be furnished by respective contractors for installation by Electrical Contractor.

264600 GENERAL PURPOSE BRANCH CIRCUITS (E)

1.0 DESCRIPTION

Install general-purpose branch circuits as shown on one-line diagrams on plan.

2.0 WIRING METHOD

All general purpose branch circuits shall be installed as shown on drawings. Conductor and conduit sizes are shown on drawings. No wire size smaller than #12 AWG copper shall be used. No conduit smaller than 3/4" shall be used. All boxes shall be 4" square or larger and minimum depth of 1-1/2". All conduits and boxes shall be concealed in all areas except mechanical rooms, pipe tunnel and storage areas. Metallic armored cable may be used at locations shown on drawings and for whips to branch devices. All circuits installed in floor slab shall be rigid galvanized iron conduit. All conduits installed in or below any concrete shall be rigid galvanized iron conduit and coated with "Bitumastic". All junction boxes shall be sized as shown on drawings or as per N.E.C. requirements. Provide swing cover or screw as shown or dictated by usage. All junction boxes shall be code grade steel galvanized. All junction boxes shall be accessible. Electrical contractor is required to provide and install access doors or panels for same unless otherwise noted. It is noted that the hereinbefore-described wiring method is applicable to various other signal systems as well as general purpose circuits as herein described.

Location of Outlets - Locate outlets as shown on drawing. Contractor shall cooperate with other trades in conflict of locations. Except as otherwise specified on drawings, centerline height of outlets above floorline shall be as follows:

Bracket Outlets	6'-6"
Wall Switches	4'-0"
Clock Outlets	7'-0"
Convenience Outlets	3'-8"
(Counters)	
Convenience Outlets	1'-6"

See plans for locations of other lighting and power outlets.

3.0 CONTROL OF CIRCUITS

Circuit control shall be provided as shown on drawings. Where no switches are shown on the drawings, the breaker switch in panel shall be used as the switching means, and shall be of the switching duty type.

4.0 WIRING DEVICES

Shall be as listed in legend and schedule described on drawings.

5.0 CONNECTIONS

All connections shall be made using Buchanan Compression Type connectors or equal, using nylon or P.V.C. insulators.

6.0 PLATES

All switches, receptacles and wiring device plates shall be chrome/brushed stainless steel as desired by Owner. Furnish and install same as directed. Chrome in baths and toilets, stainless steel in all other areas. All plates shall be 0.40 thick.

265000 LIGHTING AND EQUIPMENT (E)

1.0 DESCRIPTION AND GUARANTEE

Contractor shall furnish and install all lighting equipment as shown on the drawings and as contained in these specifications. All material shall be NEMA standard manufactured and shall be Underwriters Laboratories approved and shall bear that seal of approval. Contractor shall furnish and install all lamps of types and sizes as described on plans in the schedule of electrical equipment to the maximum size permitted by the fixture design. Equipment shall be tested and rendered operative by the contractor.

2.0 LIGHTING FIXTURE SCHEDULE

The contractor shall furnish and install the lighting fixtures complete for each and every light outlet in the type, quality and size of fixture indicated on plans and as described in the schedule. It shall be the responsibility of the contractor to check the plans with the schedule for completeness, as this schedule is made up for the purpose of indicating the general type, quality and size of fixtures that will be required. The use of catalog numbers describing a fixture does not necessarily include all the required accessories that may be required for a complete installation. The use of a vendor's name and catalog is for convenience in specifying the quality, style, size, finish and general type of fixture required and does not intentionally exclude similar equipment available from other manufacturers. This contractor shall include all fixtures, wiring, hanging, uncrating, connecting up, and making ready to operate. All fixture wire for fixtures shall be not less than #16 gauge, but larger if capacity of fixture requires it. All splices shall be pressure type connectors as hereinbefore described. Contractor shall include the cost of furnishing and installing all lamps for all fixtures under this contract throughout. All lamps for all fixtures shall be furnished in type specified. All tubes for all fluorescent fixtures shall be furnished by General Electric, Westinghouse, Sylvania or approved equal of color as later selected and type called for under each fixture type. The engineer reserves the privilege of having samples specified lighting fixtures mounted in place in operating condition for evaluation prior to final approval. In the event any fixture type is rejected for aesthetic or other reasons, the contractor shall procure and install other suitable fixtures as directed until a satisfactory approval is granted. Any difference in cost of fixtures thus approved shall be mutually agreed upon before installation, but all work involved in sample installations and final approval by the engineer shall be at no additional expense to the owner.

3.0 INSTALLATION OF LIGHTING FIXTURES

Fixtures shall be completely wired in accordance with the latest requirements of the National Electrical Code. All pendant type fixtures in the same room shall be installed at a uniform height from the floor and hang plumb. Fixtures shall be rigidly mounted in fixture stud in outlet box. Malleable iron hickies or extension pieces shall be provided where required. Each lighting fixture unit shall be installed in a manner approved by the manufacturer using a fastening method approved to sustain three times the weight of each unit. Use only stems, fittings and appurtenances provided by same fixture manufacturer. All suspended units where used with suspended ceiling shall be suspended from a structural portion of building and shall not be dependent upon ceiling for support. Contractor shall furnish and install all miscellaneous materials required to install

lighting fixtures. Provide and install suitable cover plates or canopy for fixture outlet box where the fixture does not provide a suitable cover. Fixtures located on exterior of building shall be installed with cadmium-plated brass screws. Electrical contractor shall confer with the general contractor to locate and install pendant-ceiling fixtures and install supports for any ceiling fixtures which require special provision for their support. Installation of all lighting fixtures shall be done by experienced mechanics. Lighting fixtures shall not be installed until finished coat of paint has been applied to ceilings and walls and allowed to dry thoroughly. Lighting fixtures in the equipment rooms shall not be installed until all piping and ductwork is in place. Lighting fixtures layout shown on plans is typical layout for bid purposes but must be modified by the contractor to provide adequate lighting of the equipment space according to final construction conditions. Any relocation of fixtures due to duct or piping interference shall be as directed by Architect, at the expense of the contractor and not billed to the owner.

4.0 OUTDOOR LIGHTING

Furnish and install outdoor lighting equipment as shown in detail on drawing. Ground all light poles. Furnish and install underground cable and conduit to concrete lighting fixture foundations as shown. Conduit to parking lot fixture may be schedule 80 pvc. Contractor shall install separate ground wire for all parking lot lighting. All poles shall be aluminum, style as indicated by representative catalog numbers. Furnish and install time switches on outdoor lighting circuits, as shown. Locate time switches as shown. Provide only time switch or time and photocell type operated at 120/208 volts using regulating type ballasts. Provide outdoor lighting on building perimeter as shown.

265200 EMERGENCY LIGHTING SYSTEM (E)

1.0 DESCRIPTION

The contractor shall furnish and install emergency lighting system as shown on plans and as follows; 12-volt emergency lighting units featuring lead calcium or nickel cadmium type batteries allowing up to 9 years without maintenance.

2.0 BATTERY/CHARGER

Batteries shall carry a minimum 9-year pro-rata guarantee. The charger shall constantly maintain battery at full charge during normal operation. Upon interruption of normal AC power, the transfer circuit shall automatically switch the DC load to battery providing emergency lighting. When normal power is restored, the load shall switch off and charger recharge battery to its initial state for next emergency. Charger and controls in units shall be fully automatic solid state of modified constant potential type designed to recharge in 12 hours of maximum load AC-0.7 amps in high rate. Charge rate pilot light shall indicate both AC input and state of charge. Test switch shall check transfer function and DC lamps. Cabinet construction shall be of 18 gauge CRS with baked-on bronze hammertone finish. Shall mount directly to wall by means of two keyhole slots.

3.0 FIXTURES, WIRING AND INSTALLATION

Equipment shall be as shown on plans. Construction shall be high-impact, heat resistant Lexan with fully adjustable swivel for remote mounting or unit equipment mounting. Units shall be supplied for conduit connection as standard knockouts for concealed entry. DC load fusing in compliance with UL 294 shall be supplied as standard, where required. Charger shall also be supplied with brownout sensitive circuit to connect load to battery when AC input falls to 35% of supply voltage.

266000 ELECTRICAL CONNECTIONS TO HVAC AND PLUMBING EQUIPMENT (E)

1.0 GENERAL

This contractor shall do all power wiring required for plumbing, ventilating and heating motors and pumps including mounting of switches and starters, as well as wiring of same. Electrical contractor shall furnish one manual thermal starter with all motors less than ½ HP; magnetic across-the-line starters will be furnished by respective contractors on unitary equipment.

Respective contractors refers to the contractor providing the equipment which requires control and power connections.

2.0 OVERCURRENT PROTECTION AND DISCONNECT SWITCHES

The contractor shall furnish and install overcurrent protection and disconnecting means as required by NEC for all motors. Motor driven equipment specified under plumbing and HVAC sections may be factory wired complete with controller motor disconnects; therefore, this contractor should check equipment purchased under these sections to avoid duplication of protective and disconnecting means. This contractor shall connect, ready for operation, motors and control apparatus specified under other sections unless specifically mentioned as being connected under such section. Each motor shall be provided with an enclosed safety switch having quick-make and quick-break contacts. The disconnecting switch shall open all ungrounded conductors simultaneously and shall have a rating equal to, or in excess of the motor control. Where manual control is called for in addition to automatic control, provide HAND-OFF-AUTO control. Each motor protective device shall be calibrated or selected for its rated capacity. NOTE: Heating and other contractors shall furnish, FOB, premises, the electrical magnetic switches for installation and connection by electrical contractor as indicated on the plans. Where more than one motor is wired to a single circuit, each motor shall be provided with a thermal protective switch.

3.0 THERMAL PROTECTION

Starters with thermal protection for motors will in general be furnished under the other sections of the specifications. Thermal elements are specified in these sections to protect all motors at 100% of the nameplate readings. Where the protection does not comply with the specifications the equipment supplier will be notified to have the thermal elements changed.

267200 FIRE ALARM SYSTEM (E)

1.0 DESCRIPTION OF SYSTEM

Furnish and install a completely supervised detection and fire alarm system, as manufactured by Simplex, Edwards, Fire Lite, or equal. The system shall contain battery back-up power to operate the system in case of power outage. The battery unit shall be provided with battery charger with a trickle charge feature. The system shall conform to the following National Fire Protection Association Bulletins:

1. NFPA-70 National Electrical Code, latest edition.
2. NFPA-101 Life Safety Code.
3. NFPA-72 latest edition.
4. All work to be performed by qualified personnel of the contractor experienced in such work.

2.0 WIRING

Electrical service for equipment shall be connected to the supply side of the service disconnect. Minimum wire size shall be as recommended by equipment manufacturer. (No wire smaller than 18-gauge will be approved). Use UL listed wire only. All wiring shall be concealed in walls or in conduit where exposed at the ceiling.

3.0 DRAWINGS

See drawings for equipment location. Drawings are schematic. Exact locations to be approved by architect in field before installation.

4.0 EQUIPMENT

The system components shall be as indicated on plans.

- 4.1 Strobes and horn strobes shall be ADA compliant and shall be installed to comply with same.
- 4.2 Pull stations shall be dual action type.
- 4.3 Smoke detectors shall be photoelectric.
- 4.4 Duct smoke detectors shall be ionization type with full-length sampling tube.
- 4.5 Fan shutdown shall be provided on all air handling systems greater than 2000 cfm.

- 4.6 The annunciator panel shall be located at the main entrance visible to the exterior, where possible.

5.0 MOUNTING, INSTRUCTIONS AND CHECKOUT

- 5.1 Securely mount all devices.
- 5.2 Provide instructions and maintenance manual for entire system.
- 5.3 Complete systems shall be tested and operation shall be demonstrated before final acceptance. Provide separate circuit from panel shown to battery charger unit. All wiring shall be permanently connected to unit.

Entire system shall be installed with separate wiring from other system of the building.

267400 TELECOMMUNICATION SYSTEMS (E)

1.0 DESCRIPTION OF SYSTEM

This Electrical Contractor shall furnish and install a system of raceways for use of supplying Telecommunication Company and private owner or tenant hired telecommunication systems installers in order to provide facilities for the installation of a complete and operative telecommunication system.

2.0 WIRING METHOD

Methods shall consist of but not be limited to:

1. Telecommunication terminator board (T.T.B.) in telecommunication entrance closed, painted 2 coats AIA grey.
2. 1-20A dedicated duplex receptacle mounted to lower left corner of TTB.
3. Ground conductor at telecommunication service entrance.
4. Pull line or telecommunication wires as directed in each telecommunication outlet location as shown on plan.
5. Removal of existing telecommunication lines as indicated on the plans.

3.0 RELATIONSHIP WITH TELEPHONE COMPANY

This electrical contractor shall perform to the following:

- 3.1 Communicate with franchised telecommunication company and conform to all requirements for telecommunication service installation.
- 3.2 Cooperate with owner's interconnect telecommunication company in use of specified conduit system selected by owner.
- 3.3 Cooperate with all telecommunication installers on location of conduits, boxes and fitting up of systems and final details such as plates, etc.

269000 CUTOVERS AND REMOVALS (E)

1.0 CUTOVER

Contractor shall arrange to cutover from existing to new equipment to minimize outage to equipment in service. Contractor shall advise the owner as to proposed time of cutover.

2.0 REMOVALS

The contractor shall remove existing electrical feeds upon completion of cutover.

269200 COMPLETION OF WORK (E)

1.0 TESTING

Completed installation shall be tested. Cable shall be tested with ohmmeter for grounds, opens, insulation resistance. Cable insulation resistance shall be in the megohm range in the category required by I.P.C.E.A. for the cable.

2.0 ACCEPTANCE

In the presence of engineer and owner, demonstrate operation of systems and that all specifications have been met to the satisfaction of the owner.

3.0 MISCELLANEOUS

Provide all miscellaneous spare parts, devices and appurtenances as required. Install and test.

4.0 CLOSE OUT

4.1 Contractor shall provide 2 copies of all O&M manuals, warranty and catalog cut data in a 3 ring binder, neatly arranged, to the owner prior to application of final payment. Binder shall be acceptable to owner and engineer prior to approval of final payment.

4.2 Demonstrate to building maintenance personnel correct preventive and schedule maintenance services.

4.3 Provide warranty to owner, including points of contact for warranty work for system installation and manufacturers equipment installed.

Final payment will not be released until contract closeout is complete.

269400 SEQUENCE OF CONTRACT WORK (E)

1.0 DESCRIPTION

This project work shall be subject to strict coordination of all trades to permit completely normal operations of this facility throughout the construction of the new addition and the reconstruction of the existing facility. Sequencing shall consist of the following or variations thereof:

1. Remove existing equipment and connections as indicated.
2. Install new systems as equipment as indicated.
3. Provide service cut-overs from existing to new.

2.0 CONTRACTOR WORK PHASING

This contractor shall phase all work to meet the foregoing conditions of the project work. Said phasing shall require, but not be limited to the following:

1. Temporary relocation of all mechanical and electrical components to permit construction (i.e. HVAC & Electrical).
2. Installation of new electric, telephone and communication services and rendering same operative to new and existing systems.
3. Installation of new heating system.
4. Installation of new plumbing facilities and interconnections.
5. Rendering operative of new work and keeping existing area in operation.
6. Alterations and all new work in existing building.
7. Removal of specified services and equipments in existing building.