

THE SCHOOL DISTRICT OF PHILADELPHIA
Office of Capital Programs
440 North Broad Street, 3rd Floor – Suite 371
Philadelphia, PA 19130

TELEPHONE: (215) 400-4730

ADDENDUM NO 2

Subject: Northeast HS Fire Alarm & Generator Replacement
SDP Contract No. 2022-039-E

Location: Northeast High School
1601 Cottman Avenue
Philadelphia PA 19111

This Addendum dated September 02, 2022, shall modify, and become part of the Contract Documents for the work of this project. Any items not mentioned herein, or affected by, shall be performed strictly in accordance with the original documents.

Question #1:

Drawing EP201 & EP701:

- **Response:** Drawing EP701 shall be “EX” Boiler Feed Tank within New Panel Schedule SP1 for Poles 8, 10, 12. This is a new feeder to existing to remain equipment.

Question #2:

Drawing EP202 & EP701:

- **Response:** Drawing EP203 shall consist of a 225A MLO for Panel SP2. This is consistent with EP701.

Question #3: The bid package does not contain specifications for: Panelboards & trim requirements (door in door, Corbin locks), Automatic Transfer Switches, Manual Transfer Switches & Docking station, Annunciator & emergency stop button.

Drawing EP202 & EP701:

- **Response:** See attached

Question # 4

Are Generac and MTU Acceptable Manufacturers for this bid?

- **Response:** The Acceptable manufacturers of generators for this project are Kohler, Onan Cummins or MTU.

ATTACHMENTS:

26 24 16 - PANELBOARDS

26 32 13 - DIESEL GENERATOR SETS

26 36 00 - ENCLOSED TRANSFER SWITCHES

28B 31 00 - FIRE DETECTION AND ALARM

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: The work specified in this Section consists of all materials for furnishing, installing connecting, energizing, testing, cleaning and protecting wall-mounted panelboards.
- B. Related Section:
 - 1. Section 26 05 00 – Common Work Results
 - 2. Section 26 05 28 – Hangers and Supports for Electrical Systems
 - 3. Section 26 05 53 – Identification for Electrical Systems
 - 4. Section 26 05 19 - Low Voltage Electrical Power Conductors and Cables

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM B164 Nickel-Copper Alloy, Bar and Wire.
 - 2. ASTM B187 Standard Specifications for Copper Bus, Bus Bar, Rod and Shapes
- B. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA 250 Electrical Enclosures.
 - 2. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches.
 - 3. NEMA AB 2 Molded Case Circuit Breakers and their Application.
 - 4. NEMA PB 1 Panelboards.
 - 5. NEMA PB 1.1 General Instructions for Proper installation, Operation, and Maintenance of Panelboards.
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code (NEC).
- D. Underwriters Laboratories (UL):
 - 1. UL 489 Molded Case Circuit Breakers and Circuit Breaker Enclosures
 - 2. UL 50 Cabinets and Boxes
 - 3. UL 67 Panelboards SYSTEM DESCRIPTION
- E. Panelboards are connected to system voltages as follows:
 - 1. 240/120 Volt, 1-phase, 3-wire.
 - 2. 240/120 Volt, 2-phase, 5-wire (no new panelboards of this configuration)

1.03 SUBMITTALS

- A. Product Data and Catalog Cuts: Provide product data for all products provided. Indicate clearly the usage and designation of each product.
- B. Shop Drawings: Submit shop drawings for all panelboards.
- C. Provide manufacturer's instructions for all panelboards.

1.04 QUALITY ASSURANCE

- A. Provide panelboards, which have been design tested in accordance with NEMA PB 1.

- B. Provide panelboards which have been production tested in accordance with NEMA PB 1.
- C. Conform all work to NFPA 70, National Electrical Code.
- D. Install work under supervision of licensed electricians

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Basic Electrical Materials: Those products such as conduit, wireways, wire and connectors, cable, support devices, fasteners, and similar devices as required for work of this Section are as specified in other Sections of these Specifications.

2.02 PANELBOARDS

- A. Provide dead-front panelboards as follows:
 - 1. Accommodate bolt-on molded case circuit breakers as specified below.
 - 2. Conform to NEMA PB 1 and NFPA 70, Article 384.
 - 3. Consist of interiors, matching enclosures and covers of a single manufacturer as specified below.
 - 4. Have circuit breakers of frame sizes, trip ratings, number of poles, and types as scheduled, indicated and noted.
 - 5. Provide branch circuits phased in sequence vertically and numbered uniformly left to right, top to bottom.
- B. Provide panelboards that are fully rated for a short circuit capacity as scheduled, indicated and noted on the Drawings.
- C. Interiors: Provide interiors, as follows:
 - 1. Provide tin plated main, ground and neutral copper buses conforming to ASTM B187 having not less than 98 percent conductivity.
 - 2. Mount interiors on galvanized steel backplate.
 - 3. Make provisions for future breakers and for circuit breakers in all future spaces as indicated, scheduled or noted and so that additional breakers can be mounted without additional connectors or extension of busses.
- D. Provide solderless type main, sub-feed, and through feed lugs rated for copper and aluminum conductors of size, number and type, as indicated, scheduled and noted on the Drawings.
- E. Enclosures:
 - 1. Provide NEMA 1 enclosures unless otherwise indicated on the Drawings.
 - 2. Fabricate from galvanized steel without knockouts.
 - 3. Provide side, bottom, and top gutters of minimum 4-inch width, of minimum 6 inch depth, and sized as indicated, scheduled, and noted and as required by NFPA 70 Article 312 for the actual entry point.
 - 4. Provide circuit directory of sufficient size to allow 40-characters per circuit; indicate the source of service (i.e. upstream panelboard, switchboard, motor control center, etc.) to the panelboard.
- F. Finishes:
 - 1. Factory finish enclosure cover completely using an electro-deposition process that deposits a complete finish coat of paint on all interior and exterior surfaces as well as bolted joints.
 - 2. Include in the paint process cleaning, rinsing, phosphatizing, pre-paint and post paint rinses, bake-cure and cool down steps.

3. Finish switchboards with rust inhibiting primers and electro-disposition acrylic baked enamel top coating of No. 49 medium light grey conforming to ANSI Z55.1.
 4. Provide overall finish capable of passing a 300-hour salt spray per ASTM B117 with less than 1/8 loss of paint from a scribed line.
- G. Molded case circuit breakers:
1. Provide inverse time and instantaneous tripping characteristics.
 2. Provide trip ratings, frame sizes, and number of poles as indicated, scheduled, and noted on the Drawings.
 3. Provide full rated circuit breakers with short circuit ratings equal to the panelboard installed as scheduled on the Drawings.
 4. Provide molded case circuit breakers conforming to NEMA AB 1, and UL 489.
 5. Provide circuit breakers of the same manufacture and type as the panelboard installed.
- H. Design Criteria
1. Provide dead-front safety type normal-emergency lighting panelboards with arrangement shown, with anti-turn solderless pressure type main lug connectors approved for copper conductors.
 2. Provide a bare uninsulated copper grounding bar suitable for bolting to enclosure.
 3. Provide normal-emergency lighting panelboards with molded-case bolt-on-type circuit breakers for each circuit, with toggle handles that indicate when tripped. Provide circuit breakers with a minimum of 10,000 amperes RMS symmetrical rating interrupting rating.
 4. Panelboard enclosure: Provide galvanized sheet metal steel cabinet type enclosure, minimum 16-gage thick, 24" wide and 6" deep. Construct with multiple knockouts and wiring gutters.
 5. Provide fronts with full hinges and doors (door-in-door construction). Provide fronts with hinges on right unless specified and fasten to the cabinet with machine screws. Provide doors with flush locks and keys with concealed piano door hinges as indicated. Equip door with circuit directory frame and typewritten with card with clear plastic covering.
 6. Provide baked gray enamel finish over a rust inhibitor inside and outside the cabinets and fronts.
 7. Design the enclosure for surface mounting.
 8. Provide enclosures fabricated by the same manufacturer as panel boards, and which mate properly with panel boards to be enclosed.
 9. Locks and keys: All locks and keys for panel boards shall be keyed alike and keyed to the master of the School District of Philadelphia. Locks pull for doors of cabinets shall be Corbin #15767. The master key shall be #CAT60.
 10. Refer to the Philadelphia School District's typical details for the normal-emergency panel wiring diagram and enclosure design.
- I. Panelboard Types:
1. Branch Power and Lighting (240/120V)
- J. Acceptable Manufacturers:
1. Siemens
 2. Cutler Hammer
 3. General Electric
 4. Square D

PART 3 EXECUTION

3.01 PREPARATION

- A. Painted surfaces, which will be covered by items of this Section have a prime and finish coat of paint.
- B. Ensure that all indoor areas are enclosed from the weather.

3.02 INSTALLATION

- A. Space enclosures out from surfaces mounted on 1/4-inch (6mm) spacers or U-channel supports. Provide supports as specified in Section 26 05 28.
- B. Install all panelboards and circuit-breakers in accordance with the manufacturer's instructions and NEMA PB 1.1.
- C. Set enclosure top 6-feet 6-inches above finished floor or grade unless otherwise indicated or specified.
- D. Punch holes for conduit entries in the enclosures.
- E. In all areas except dry areas, install conduit drain fitting in punched hole in bottom of enclosure, conduit breather fitting in top of enclosure.
- F. Interface with other work:
 - 1. Connect conduits to enclosure with watertight hubs, except in damp locations on the bottom of enclosures a sealing locknut may be used in place of watertight hubs, and in dry locations two locknuts and bushings may be used.
 - 2. Connect wiring to line and load terminals with lugs provided or approved by manufacturer in conformance with Section 26 05 19. Remove interior or protect interior components during wire pulling.
 - 3. Identify in accordance with Section 26 05 53.
- G. At the end of the project update the circuit directories to reflect as-built conditions. Circuit directions shall be typed.

3.03 CLEANING

- A. After wiring, vacuum out interior and wipe clean of all foreign material.
- B. After painting in areas, remove all over paint, drips and splashes.

3.04 FIELD QUALITY CONTROL

- A. Site Testing:
 - 1. Prior to Energizing:
 - a. Have insulation testing and setting of overcurrent protective device adjustments made in conformance of Section 26 05 63.
 - b. Ensure that all load side wiring is clear of shorts and has received and passed the insulation tests of Section 26 05 63.
 - c. Open all downstream disconnects and open circuit breaker.
 - 2. Final testing after energizing:
 - a. Perform thermographic test and record circuit parameters in conformity with Section 26 05 63.

3.05 PROTECTION

- A. Protect all items during work of other trades including welding and cutting.
- B. Protect panelboards against overloads, short circuits, and improper operation, padlock off when work is being done on downstream circuits.

END OF SECTION

SECTION 26 32 13

DIESEL ENGINE DRIVEN GENERATOR SETS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: The work specified in this Section consists of services and work to install a standby power generator system.
- B. Related Sections:
 - 1. Section 03 33 00 – Cast-in-Place Concrete
 - 2. Section 26 05 00 – Common Work Results for Electrical
 - 3. Section 26 05 26 – Grounding and Bonding for Electrical Systems
 - 4. Section 26 05 26 – Hangers and Supports for Electrical Systems
 - 5. Section 26 05 53 – Identification for Electrical Systems

1.02 MANUFACTURERS QUALIFICATIONS

- A. Provide generating sets built, tested and shipped by one manufacturer to insure single source of supply and responsibility. Consideration shall be given only to manufacturers meeting the following qualifications:
 - 1. The standby generating units shall receive the manufacturer's standard testing to ascertain that they are functioning correctly prior to shipment.
 - 2. Twenty-four hours, seven days a week operating service facility with complete spare parts stock within 50 miles of Project Site. Delegation of this service responsibility for any or all of the equipment listed herein shall not be considered fulfillment of these Specifications.
 - 3. Service capability to provide, after acceptance of equipment, four service calls per year in two years by a qualified maintenance or service representative, with provision that each call shall not exceed one day of service. Service calls shall not include materials, parts or equipment.

1.03 DESIGN CRITERIA

- A. Standby generator sets rated continuous standby (defined as continuous for the duration of any power outage) at the following capacities:
 - 1. Generator Rating capacities as herein specified at 0.8 power factor for standby applications (without fan), and rated in accordance with NEMA Class H temperature rise.
 - 2. Generator Characteristics: (Minimum Nameplate Rating Values at Specified Design Conditions Including Step Loading and Ambient Temperature.)
 - a. 100 KW
 - b. All units shall conform to:
 - 1) Voltage 208/120V
 - 2) Phase 3
 - 3) No. Of Service Wires 4
- B. The basis of design is a Kohler (100REOZJF) 100 kW with permanent magnet excitation and 105 degree C rise alternator.
 - 1. Load and sizing calculations must be submitted to the Engineer for approval as specified below for any substitution to the above generator.
- C. Air Flow Requirements
 - 1. The following air flow rates and maximum static restriction are the basis of design for cooling the generator while running.
 - a. Combustion Air: 60 scfm

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- b. Radiator Cooling: 1,300 scfm
- c. Static Restriction: 0.5 in. of water column, maximum
- d. Contractor shall be held responsible for required changes to the louvers, dampers or other equipment in the air flow path as a result of a substitution to the above generator.

D. Site Conditions:

- 1. The operating environment of the power generating system shall be:
 - a. Altitude Less than 2,000 feet
 - b. Outside temperature, max. 104 deg. F
 - c. Outside temperature, min. -20 deg. F
 - d. Engine jacket water, glycol 50 percent
 - e. Fuel type Diesel Fuel Oil No. 2
 - f. Cooling system type Radiator, blower fan

1.04 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 126; Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - 2. ASTM D 396; Specification for Fuel Oils.
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE Standard 446; Recommended Practice for Emergency and Standby Power Systems.
- C. National Electric Manufacturer's Association (NEMA):
 - 1. NEMA MG 1 - Motors and Generators
 - 2. NEMA ICS 2 - Industrial Control and Systems - Controllers, Contactors and Overload Relays.
 - 3. NEMA ICS 6 - Industrial Control and Systems - Enclosures.
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 37: Stationary Combustion Engines and Gas Turbines.
 - 2. NFPA 70: National Electrical Code. (NEC)
 - 3. NFPA 110: Emergency and Standby Power Systems.
- E. Underwriter's Laboratories, Inc. (UL):
 - 1. UL 142 - Above Ground Tanks for Flammable and Combustible Liquids.

1.05 QUALITY ASSURANCE

- A. Product Quality Control:
 - 1. Manufacturers must fabricate their products in such a manner that ensures all criteria for appearance, fit and tolerances are met.
 - 2. Each manufacturer must carefully control his operations to ensure that the engineering, quality, safety and reliability of product are achieved.

1.06 SUBMITTALS

- A. As specified in Section 26 05 00; submit product data for the products contained within this Section, including:
 - 1. List of materials to be used.
 - 2. Catalog cuts of all materials and equipment.
- B. Shop Drawings: Shop drawings are required for the following:
 - 1. Diesel Engine.

2. Generator.
 3. Engine and Generator Foundation Details.
 4. Engine and Generator Vibration Isolators.
 5. Generator Engine Systems Interface; Detail Drawings.
 6. Engine/Generator Control Schematics, One-Lines, and Generator Accessories Wiring Diagrams.
 7. Main Line Circuit Breaker.
 8. Exhaust Silencer.
 9. Battery Charger.
 10. Batteries.
 11. All Heaters and Controls.
 12. Control Panel with Safety Controls.
 13. Manufacturer shall submit curves/calculations to indicate each generator meets the load starting and transient voltage dip requirements.
- C. Factory Tests:
1. Upon approval of all shop drawings and the engine generator calculations, the manufacturer shall fabricate and factory test each unit. A certified factory test report certifying each units full power rating, stability along with voltage and frequency regulation shall be forwarded to the Engineer for review, comments and approval.
 2. Upon receipt of the above referenced factory test approval, the manufacturer shall release the units for shipment; and forward the Operational and Maintenance Manuals to the Engineer for review and comments.
- D. Field Tests: Field test of the engine generator set shall take place after the installation of the unit is completed; and shall conform to stipulations outlined in Section 26 05 63. A factory authorized representative shall be present during the tests; and a manufacturer's certification indicating acceptance and approval of each engine generator installation and the associated field tests shall be forwarded to the Engineer for review and comments and subsequent insertion into the O & M Manuals.
- E. Operation and Maintenance Manual Contents: shall include spare parts lists, fuel types, lubricating oils, special tools, maintenance requirements and schedule, equipment/systems operation for the following:
1. Engine.
 2. Generator.
 3. Cooling system - complete.
 4. Air intake and discharge system.
 5. Fuel system.
 6. Fuel tank.
 7. Control panel/control system.
 8. Main circuit breaker, solid-state type.
 9. Battery charger.
 10. Batteries.
 11. Exhaust system.
 12. Other auxiliaries as called out in this section.

1.07 WARRANTY TERMS

- A. The manufacturer's and dealer's extended warranty shall in no event be for a period of less than two (2) years from date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Applicable deductible costs shall be specified in the manufacturer's warranty. Running hours shall not be a limiting factor for the system warranty

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by either the manufacturer or servicing dealer. Submittals received without written warranties as specified will be rejected in their entirety.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Basic Electrical Materials: Those Products such as conduit, wireways, wire and connectors, cable, support devices, fasteners, and similar devices, as required for Work of this Section are as specified in other Sections of these Specifications.
- B. Diesel Engine Generator Sets:
1. Diesel Engine: Heavy duty industrial type, water-cooled, of four stroke cycle compression ignition operation, having solid-injection, and of either vertical in-line or V-type design. Minimum displacement shall be 158 cubic inches, with 4 cylinders.
 - a. Engine designed to operate at 1800 RPM at normal full load operation.
 - b. Provide engine with removable wet or dry type cylinder liners of close-grained alloy cast iron.
 - c. Provide engine capable of satisfactory performance when operating on commercial grade No. 2 Fuel Oil (ASTM D 396). Engines requiring premium or special fuels will not be considered.
 - d. Provide engine capable of operating without loss in power up to 2,000 feet elevation in an ambient temperature of 125 degrees F.
 2. Electronic Governor: Engine provided with an electronic solid state governing system for precise speed control of the prime mover. Provide a governor capable of operation in a droop or constant speed system with control at any set speed to be isochronous within plus or minus .25 percent.
 - a. Governing system shall comprise an electronic control module, a speed setting potentiometer, a magnetic pick-up and a hydraulic actuator with fail-safe provisions for loss of power or speed. A sensor signal is incorporated in control module to shutdown the prime mover.
 - b. The governor system shall operate from starting batteries and allow automatic paralleling with one or more generator sets.
 - c. Fail-safe features shall include a separate overspeed device to prevent prime mover run-away in the event of any failure, which might render the governor inoperative.
 3. Diesel Fuel System Components:
 - a. Fuel system equipped with a fuel filter having replaceable elements, which may be easily removed from their housing for replacement without breaking any fuel line connections, or disturbing the fuel pumps or any other part of the engine. Locate fuel filters in one easily accessible housing, ahead of fuel injection pumps so fuel is thoroughly filtered before it reaches the pumps. No screens or filters requiring cleaning or replacement permitted in the injection pump or injection valve assemblies.
 - b. Injection pump of positive action, constant-stroke design and actuated by a cam driven by gears from the engine camshaft. Engine shall have an individual mechanical injection pump and injection valve for each cylinder, of a type not requiring adjustment in service and capable of replacement within a few minutes.
 - c. Provide a manual shut-off valve on the fuel line and any check valves, flexible fuel connections and such other items that may be required for proper operation of the engine.
 4. Lubrication:
 - a. Engine provided with a gear-type lubricating oil pump for supplying oil under pressure to main bearings, crank pin bearings, pistons, piston pins, timing gears, cam-shaft bearings and valve rocker arm mechanism.
 - b. Provide a suitable water-cooled oil cooler.

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- c. Threaded spin-on type oil filters provided and so located and connected that lubricating oil is continuously filtered and cleaned. Filters shall be conveniently located for servicing. Equip filters with a spring loaded bypass valve as an assurance against stoppage of lubricating oil circulation in the event filters become clogged.
5. Air Cleaners: Engine provided with one or more dry type replaceable element air cleaners of sufficient capacity to effectively protect working parts of the engine from dust and grit. Crankcase connected together with engine air intake with a tube to eliminate crankcase emissions.
6. Automatic Starting System:
 - a. Provide engine equipped with an electric starting system with positive engagement drive and of sufficient capacity to crank the engine at a speed, which will allow full diesel starting of the engine. System shall be 12 volts or as recommended by engine manufacturer.
 - b. Automatic Controls: Fully automatic start-stop controls provided in generator set control panel. Controls shall provide shutdown for low oil pressure, high coolant temperature, engine overspeed, engine overcrank, and three single pole double throw auxiliary contacts for activating accessory items, contacts actuate upon an engine start signal. Include a minimum 30 second single cranking cycle limit with lockout. Also provide two timed output contacts meeting intake louver control requirements.
 - c. Batteries: Lead-acid storage battery set of heavy-duty diesel starting type. Battery voltage compatible with starting system. Batteries of sufficient capacity to provide for four consecutive full starts consisting of four complete cranking cycles of ten seconds each and ten seconds rest, and in no case less than 225 AH (minimum of 650A. CC). Provide battery rack, necessary cables, and clamps.
7. Heaters:
 - a. Generator winding anti-condensation strip heater, 120 volts A.C. thermostatically controlled. Factory wired to the generator control panel. Wattage as per manufacturer's recommendations.
 - b. Generator control panel heater, 120 volts A.C. thermostatically controlled. Factory wired to the generator control panel. Wattage as per manufacturer's recommendations.
 - c. Battery heater, 120 volts A.C. thermostatically controlled. Factory wired to the generator control panel. Wattage as per manufacturer's recommendations.
8. Engine Cooling: The cooling system for each emergency standby unit shall have sufficient capacity for cooling the respective engine when the generator set is delivering full-rated load at the design ambient temperature.
 - a. Engine Circulating System:
 - 1) Each engine shall be equipped with an engine driven, centrifugal-type water circulating pump for circulating water through engine jacket, cylinder heads and radiator;
 - 2) Thermostatic valve to maintain the engine at recommended temperature level under all load conditions.
 - 3) Each cooling system shall be equipped with one or more spin-on type engine water filters, which will treat the coolant and prevent corrosion and scale deposits from forming inside the cooling system.
 - 4) Provide a gate valve between engine and jacket water heater to facilitate maintenance on jacket water heater.
 - b. Provide a skid-mounted radiator and cooling system rated for full load operation in 122 degrees F ambient as measured at the generator air inlet. The cooling system shall be filled with 50/50 ethylene glycol/water mixture by the equipment supplier. Rotating parts shall be guarded against accidental contact per OSHA requirements.
9. Jacket Water Heaters:

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- a. An engine mounted, thermostatically controlled immersion type engine water jacket heater to be provided to insure maintaining engine block coolant temperature in the range of 120 to 140 degrees F.
 - 1) Heater to be suitable for operation on 240 volts, 1-phase AC power, wattages per manufacturer's recommendations.
 - 2) Heater shall include a lube oil pressure switch for automatic cut-out on engine start.
 - 3) Each engine shall be equipped with an engine driven, centrifugal-type water circulating pump for circulating water through engine jacket, cylinder heads and radiator;
 - 4) Thermostatic valve to maintain the engine at recommended temperature level under all load conditions.
 - 5) Each cooling system shall be equipped with one or more spin-on type engine water filters, which will treat the coolant and prevent corrosion and scale deposits from forming inside the cooling system.
 - 6) Provide a gate valve between engine and jacket water heater to facilitate maintenance on jacket water heater.
 - b. Provide a skid-mounted radiator and cooling system rated for fuel load operation in 122 degrees F (50 degrees C) ambient as measured at the generator air inlet. The cooling system shall be filled with 50/50 ethylene glycol/water mixture by the equipment supplier. Rotating parts shall be guarded against accidental contact per OSHA requirements.
10. Generator: Generator shall be a 4 pole revolving field synchronous type, brushless, with a permanent magnet exciter, coupled directly to the engine flywheel through a flexible coupling arrangement designed for positive alignment. The generator shall be of a single sealed bearing design, bearing being maintenance free and lifetime lubricated. The generator housing shall bolt directly to the engine flywheel housing. The rotor shall be dynamically balanced for operating speeds up to 125 percent of rated speed. The rotor shall be constructed using techniques such that shaft currents are negligible and an insulated bearing is not needed. The rotor shall be provided with full amortisseur windings.
- a. Generator construction shall comply with all applicable sections of NEMA Standard MG-1. Generator insulation shall be Class H protected with 100 percent epoxy impregnation and an overcoat of resilient insulating material on the stator and rotor to reduce possible fungus and/or abrasion deterioration. Incorporate reactive droop compensation.
 - b. Generator field excitation performed through a solid state, brushless, full wave rectification, rotating diode system.
 - c. The generator shall be capable of maintaining 300 percent of the standby current during short circuit conditions for a minimum of 10 seconds without the addition of external hardware such as a current boost system.
 - d. Generator provided with a solid state voltage regulator. Voltage regulator mounted in the control panel on the generator. A built-in voltage adjusting rheostat shall provide five percent voltage adjustment. The voltage regulator shall have an adjustable maximum voltage dip. The voltage regulator shall also include overexcitation protection that will turn the voltage regulator off to protect the generator in the event of extended operation in an overload condition. The generator shall be equipped with an overvoltage protection device as standard equipment to prevent damage to the generator and connected loads in the event that the generator goes into an overvoltage situation. The overvoltage device shall be factory set for 125 percent of rated voltage. The voltage regulator shall have been designed for use with a diesel engine prime mover. The voltage regulator shall have been designed around the engine generator match for optimum load pick up.
 - e. Voltage Regulation: From no load to rated load maintained within a band of plus or minus 0.5 percent of rated voltage. The steady state voltage stability shall remain

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within a 0.5 percent band of rated voltage. Steady state voltage modulation shall not exceed one cycle per second.

- f. One step load acceptance shall be 100 percent of nameplate KW rating to meet NFPA 110, Paragraph 5-13.2.6.
 - g. For any addition of load up to and including 100 percent of rated load, the transient voltage dip shall not exceed 20 percent of rated voltage. The voltage shall recover to, and remain within, the steady band in not more than 1.5 seconds. The unit to be able to nameplate power output in ambient temperature of 125 degrees F (52 degrees C).
11. Frequency Regulation: Under varying loads from no load to full load shall be isochronous. Random frequency variation shall not exceed plus or minus 0.25 percent.

12. Circuit Breaker:

- a. A generator mounted main line molded case circuit breaker shall be provided for each unit. Each circuit breaker shall serve as a load circuit interrupting and protective device which shall operate both manually for normal switching functions and automatically during overloads and short circuit conditions.
- b. Circuit breakers shall be sized as follows:

Unit Size	Circuit Breaker	
	Frame Size	Trip
	KW	Amps
100	400	350

Circuit breakers shall be a solid state trip breaker

- c. Circuit breaker shall be 80% rated; and be provided with a shunt trip attachment for emergency power shut-off.
 - d. Circuit breakers shall conform to types indicated above as manufactured by the Square D Company, General Electric, Siemens Industry for LV Power Distribution, Eaton Electric.
13. Engine-Generator Set Control. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.
- a. The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.
 - 1) The generator set mounted control shall include the following features and functions:
 - 2) Three position control switch labeled RUN/OFF/AUTO. In the RUN position the generator set shall automatically start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - 3) RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 - 4) PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power.
 - 5) Generator Set AC Output Metering: The generator set shall be provided with a metering set with the following features and functions:
 - a) Analog AC Voltmeter, dual range, 90 degree scale, 2% accuracy;
 - b) Analog AC Ammeter, dual range, 90 degree scale, 2% accuracy;
 - c) Analog Frequency/RPM meter, 45-65 Hz, 1350-1950 RPM, 90 degree scale, +/- 0.6 Hz accuracy.
 - d) Seven position phase selector switch with OFF position to allow meter display of current and voltage in each generator phase. When supplied

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- with reconnectable generators, the meter panel shall be reconnectable for the voltage specified.
- b. Generator Set Alarm and Status Display: The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing warning and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on an alphanumeric digital display panel:
- 1) Low oil pressure (alarm)
 - 2) Low oil pressure (shutdown)
 - 3) Oil pressure sender failure (alarm)
 - 4) Low coolant temperature (alarm)
 - 5) High coolant temperature (alarm)
 - 6) High coolant temperature (shutdown)
 - 7) Engine temperature sender failure (alarm)
 - 8) Low coolant level (alarm or shutdown--selectable)
 - 9) Fail to crank (shutdown)
 - 10) Fail to start/overcrank (shutdown)
 - 11) Overspeed (shutdown)
 - 12) Low DC voltage (alarm)
 - 13) High DC voltage (alarm)
 - 14) Weak battery (alarm)
 - 15) High AC voltage (shutdown)
 - 16) Low AC voltage (shutdown)
 - 17) Under frequency (shutdown)
 - 18) Over current (warning)
 - 19) Over current (shutdown)
 - 20) Short circuit (shutdown)
 - 21) Over load (alarm)
 - 22) Emergency stop (shutdown)
- c. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.
- d. Engine Status Monitoring: The following information shall be available from a digital status panel on the generator set control:
- 1) Engine oil pressure (psi)
 - 2) Engine coolant temperature (degrees F)
 - 3) Engine oil temperature (degrees F)
 - 4) Engine speed (rpm)
 - 5) Number of hours of operation (hours)
 - 6) Number of start attempts
 - 7) Battery voltage (DC volts)
- e. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.
- f. Alternator Control Functions:
- 1) The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested with the governing system provided. It shall be immune from mis-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and

- limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
- 2) Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator. The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.
 - 3) Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.
 - 4) Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
 - 5) An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
 - 6) A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine starting, the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a "weak battery" alarm shall be initiated.
- g. Control Interfaces for Remote Monitoring. Provide the following features in the control system:
- 1) Form "C" dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.
 - 2) One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.
 - 3) A fused 10 amp switched 12VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
 - 4) A fused 20 amp 12VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.
- h. Furnish and install a 20-light LED type remote alarm annunciator with horn, located as per direction in the field. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems; and in addition shall provide indications for fuel leak, high battery voltage, low battery voltage, loss of normal power to the charger. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps

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shall be replaceable, and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2.

14. Battery Charger:
 - a. Fully automatic, transistorized controlled, constant voltage, current-limiting charger having and equalize charge timer with SCR controls. Equalizing charge must be up to 12 hours. Instruments must include a DC voltmeter, DC ammeter, ON/OFF switch, loss of AC power light, low battery voltage light, high battery voltage light and power ON light.
 - b. Charging range must be adjustable from 10 volts to 15 volts and taper to 0 at full charge. Amperage must be 10 amps, tapering to 0 amps at full charge. Operating temperature must be -40 degrees F to 140 degrees F. Battery charging system must be negative ground.
 - c. Operational monitors shall provide visual output along with individual form C contacts rated at 2 amps, for remote indication of:
 - 1) Loss of AC power - red light
 - 2) Low battery voltage - red light
 - 3) High battery voltage - red light
 - 4) Power ON - green light (no relay contact)
 - d. Acceptable Manufacturers:
 - 1) Lamarche Manufacturing Company.
 - 2) Master Control Systems, Inc.
15. Base: The engine-generator set shall be mounted on a heavy, duty steel base to maintain alignment between components. The base shall include a battery tray with hold-down clamps within the rails.
 - a. Provide a sub-base fuel tank for the generator set, sized to allow for full load operation of the generator set for 24 hours. The sub-base fuel tank shall be UL142 listed and labeled. Installation shall be in compliance to NFPA37. The fuel tank shall be a double-walled, steel construction and include the following features:
 - 1) Emergency tank and basin vents.
 - 2) Mechanical level gauge.
 - 3) Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by the engine manufacturer and in compliance to UL2200 and NFPA 37 requirements.
 - 4) Leak detection provisions, wired to the generator set control for local and remote alarm indication.
 - 5) High and low level float switches to indicate fuel level. Wire switches to generator control for local and remote indication of fuel level
 - 6) Basin drain.
 - 7) Integral lifting provisions.
16. Acceptable manufacturers for the diesel engine generator sets:
 - a. Kohler Power Systems (Basis of Design)
 - b. Cummins Power Generation
 - c. Onan
 - d. MTU

2.02 SPARE PARTS

- A. Filters:
 1. Provide three complete sets of filters for each unit as required for normal service and maintenance routines.
 - a. Corrosion Filter(s).
 - b. Primary Fuel Filter(s).

- c. Secondary Fuel Filter(s).
 - d. Lubrication Filter(s).
 - e. Air Intake Filter(s).
 - f. Related Gasket(s).
 - g. Coolant Filter(s).
2. Pack spare filters in manufacturer's standard cartons and turned over to Owner upon the completion of the final performance test and acceptance of equipment by Owner.

2.03 FOUNDATION FOR GENERATOR SET

- A. Concrete work shall be as specified in Section 03 30 00.
- B. Final connections shall be made with liquid tight flexible metallic conduit.
- C. The construction of the generator set concrete pad and the installation of same shall be in strict conformance with these specifications and the details indicated on the drawings.

2.04 GROUNDING MATERIALS

- A. Grounding materials shall be as specified in Section 26 05 26.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Install equipment with skilled mechanical erection labor in accordance with manufacturer's instructions. Provide such operations and work as may be necessary to provide a complete installation in accordance with these Specifications and/or Drawings, or as may be reasonably interpreted there from for a complete installation ready for service operation.
 - 1. Following the mechanical performance test, instruct Owner's operating personnel regarding each engine-generator operation and maintenance.
- B. Mounting:
 - 1. Provide pre-set anchor bolts as specified in Section 26 05 28, to anchor each engine-generator in place on concrete foundation.
- C. Identify generators in accordance with Section 26 05 53, Electrical Identification.
- D. Generator is shipped with fuel tank removed. Manufacturer representative to be on site during rigging and final assembly.

3.02 GROUNDING

- A. Generator set shall have all ground pads connected to a solid earth ground using cone pointed drive ground rods as specified in Section 26 05 26 of these specifications. Install as indicated to provide an earth ground having a test resistance of no more than 5 ohms.

3.03 TESTING/CERTIFICATION

- A. Testing/Certification: Consult Section 26 05 63 for requirements for field inspection and testing of the diesel-engine generator set.

END OF SECTION

SECTION 26 36 00

TRANSFER SWITCH

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for 240 Volt automatic transfer switch and related installation.
- B. Related Sections:
 - 1. Section 26 05 00 – Common Work Results for Electrical
 - 2. Section 26 05 63 - Acceptance Testing of Electrical Systems

1.02 REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 70: National Electrical Code (NEC).
- B. Underwriters Laboratories (UL):
 - 1. UL 1008: Automatic Transfer Switches.

1.03 SUBMITTALS

- A. General: Include shop drawings, manufacturer's descriptive literature and published details with performance/capacity rating schedules or charts as applicable, and where required by the cited referenced standards.
- B. Shop Drawings: All mechanical and electrical equipment and components specified herein must be included to be considered a complete shop drawing.
 - 1. Product Data: For each mechanical and electrical component, include manufacturers descriptive literature; product specifications; published details. technical bulletins; performance and capacity rating curves, charts, and schedules; catalogue data sheets; and other submittal materials as required to verify that the proposed products conform to the quality and function ability of the specified products.
 - a. Identification - Clearly indicate by an arrow on submissions covering more than one product type or style exactly which product is being submitted for approval.
 - b. Manufacturer - Include the catalogue name, company name, address, and telephone number for each product submitted.
 - 2. Equipment Drawings: Submit completely dimensioned plan, elevations, and cross-sections of system equipment and sub-assemblies. Shop drawings clearly indicate enclosure size, gutter space, and withstand current rating and continuous ampere rating of switch.
 - 3. Details: Provide detail drawings of the automatic transfer switch equipment as specified in this Section. Submit complete detail drawings of all sub-assemblies.
 - 4. Product List: Provide a list of equipment and components on all drawings with each product identified by legend reference. Include product name, manufacturer, and model number.
 - 5. Wiring Diagrams: Submit wiring diagrams for electrical apparatus showing numbered wiring terminals where applicable. In addition, submittal to contain detailed three- line diagrams and assembly wiring diagrams. Submit control diagrams indicating control devices mounted in automatic transfer switch, interconnecting wiring, and remote control devices, if any.
 - 6. Provide from manufacturer a notarized letter certifying compliance with the requirements of the specification. The certification will also identify by serial number(s) the equipment

involved. No exceptions to the specifications, other than those stipulated at time of submittal to be included in the certification.

- C. Submit a copy of the shop drawing to the local Utility Company for approval.
- D. Submit Operation and Maintenance (O & M) Manuals, which shall include detailed parts lists, list of recommended spare parts, circuit diagrams, maintenance procedures, and operating instructions.

1.04 QUALITY ASSURANCE

- A. Provide products that are listed and labeled by Underwriters Laboratory, approved by Factory Mutual, or certified as meeting the standards of UL by the Electrical Testing Laboratory (ETL) unless products meeting the requirements of these testing laboratories are not readily available or unless standards do not exist for the products. Provide products that are for the location installed and listed and labeled or approved as indicated and specified for the short circuit currents, voltages, and currents applied and listed and labeled or approved for the applications the items are intended.
- B. Conform all work to NFPA 70, National Electrical Code.
- C. Perform all electrical work under the supervision of a licensed electrician.

1.05 DESIGN CRITERIA

- A. 240/120 volts, single phase, three-wire, 60 Hertz, unless indicated otherwise. All components in the system shall have adequate capacity, capability and bracing for the fault current indicated on the Drawings. The transfer switch shall comply with local Utility Company requirements.
- B. The transfer switch is rated at 100-amperes.

1.06 FACTORY TESTS

- A. Upon completion of the factory tests, and prior to shipment, forward the following to the Engineer for review and comments.
 - 1. Certified test report, or in lieu thereof a certified letter, ascertaining that the equipment in question was tested in strict conformance with all applicable Standards, and that the equipment met or exceeded all tests requirements.
 - 2. A certified quality control report indicating the items checked, the date when checked and initialed by the individual performing the quality control.
 - 3. Provide as part of this submittal the Operational and Maintenance Manuals for the referenced equipment as specified herein in this Section of the Specifications.
- B. Equipment not accepted at the job site without prior receipt of the associated certified test report or the certified letter and the certified quality control report referenced to above.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Furnish all items of the materials, design, herein specified.
- B. Furnish materials and equipment bearing evidence of UL listing where UL standards exist and manufacturer identification and customary size or rating data.

- C. Provide products that are free from defects impairing performance, durability, or appearance, and of the commercial quality best suited for the purpose shown on the Drawings or specified herein.

2.02 MATERIALS AND EQUIPMENT

- A. Basic Electrical Materials: Provide Products such as conduit, wireways, wire and connectors, cable, support devices, fasteners, and similar devices, as required for Work of this Section as specified in the various Sections of the Division 26 Specifications.

2.03 AUTOMATIC TRANSFER SWITCHES

- A. Provide automatic transfer switches rated for continuous duty in an unventilated NEMA 1 sheet metal enclosure. Enclosure shall be UL listed. The cabinet door shall be key-locking. Controls on cabinet door shall be key-operated. The cabinet shall provide required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles or non-key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.
- B. All poles of transfer switch shall be mechanically held in both normal and emergency positions. All switches shall be double throw having electrically operated normal-emergency positions, inherently interlocked both mechanically and electrically so that all main contacts move simultaneously on the same shaft, without the utilization of multiple snap-action devices.
- C. The electrical operator shall be a single mechanism, comprised of a minimum number of operating parts, a service handle designed for one hand operation shall be provided for manual service operation. All main contacts shall be silver alloy wiping action type and be protected by separately removal arcing contacts. Transfer switches with main and/or arcing contacts that weld in the event of a fault current as indicated by UL or independent test lab reports will not be acceptable. Main contacts shall transfer in 1/6 of a second or less.
- D. All switch and relay contacts, coils, springs and control elements shall be conveniently removable from the front of the transfer switch without use of special tools, or removal of the switch panels from the enclosure and without major disassembly or disconnection of drive linkages or power conductors. Sensing and control relays shall be continuous duty industrial control type with minimum contact rating of 10 amperes. Sensing relays shall operate without contact chatter or false response when voltage is slowly varied to drop out and pick up levels.
- E. The continuous duty rating of the automatic transfer switch shall be capable of handling all classes of loads on a make, carry and break basis per UL 1008. Certified test data shall be available to verify that a withstand test has been conducted in accordance with UL-1008, Sections 25 and 26. The switch must be capable of surviving in operable condition the maximum short circuit fault current available at the load side of the overcurrent device indicated on the Drawings.
- F. The transfer switches shall be specifically designed for 4 pole application. Transfer switches utilizing adapted devices such as molded case circuit breakers, or circuit breaker parts, disconnect switches, etc., which have not been intended to repeatedly open and close load currents are not acceptable. UL approval on individual power switch devices alone is not sufficient. Transfer switches shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar.

- G. The transfer switch shall obtain its operating voltage from the source to which it will transfer.
- H. Failure of any coil or disarrangement of any part shall not permit the transfer switch to assume a neutral position.
- I. Operation: The automatic transfer switch control panel shall utilize solid-state sensing on normal and emergency for automatic, positive operation. The following shall be provided:
 - 1. All phases of the normal source voltage shall be monitored line-to-line. Close differential voltage sensing shall be provided on all phases. The pickup voltage shall be adjustable from 85% to 100% of nominal and the dropout voltage shall be adjustable from 75% to 98% of the pickup value. The transfer to emergency will be initiated upon reduction of normal source to 85% of nominal voltage and retransfer to normal shall occur when normal source returns to 90% of nominal.
 - 2. A time delay to override momentary normal source outages to delay all transfer switch and engine starting signals. The time delay shall be field adjustable from 0.5 to 6 seconds and factory set at 1 second.
 - 3. A time delay on retransfer to normal source. The time delay shall be automatically bypassed if the emergency source fails and normal source is available. The time delay shall be field adjustable from 0 to 30 minutes and factory set at 30 minutes.
 - 4. An unloaded running time delay for emergency generator cool down. The time delay shall be field adjustable from 0 to 5 minutes and factory set at 5 minutes.
 - 5. A time delay on transfer to emergency. Initially set at zero but field adjustable up to 1 minute for controlled timing of load transfer to emergency.
 - 6. Independent single phase voltage and frequency sensing of the emergency source. The pickup voltage shall be adjustable from 85% to 100% of nominal. Pickup frequency shall be adjustable from 90% to 100% of nominal. Transfer to emergency upon normal source failure when emergency source voltage is 90% or more of nominal and frequency is 95% or more of nominal.
- J. Auxiliary Contacts, Indicating Lights, Control Switches: The following shall be provided:
 - 1. A contact that closes when normal source fails for initiating engine starting, rated 10 amps, 32VDC. Contacts to be gold plated for low voltage service.
 - 2. A contact that opens when normal source fails for initiating engine starting, rated 10 amps, 32VDC. Contacts to be gold plated for low voltage service.
 - 3. Two auxiliary contacts that are closed when automatic transfer switch is connected to normal source and two auxiliary contacts that are closed when automatic transfer switch is connected to emergency source. Rated 10 amps, 480 VAC.
 - 4. One auxiliary contact that is closed when normal source is available and one auxiliary contact that is closed when emergency source is available. Rated 10 amps, 480 VAC.
 - 5. A green signal light to indicate when the automatic transfer switch is connected to the normal source. A red signal light to indicate when the automatic transfer switch is connected to the emergency source.
 - 6. A white signal light to indicate when the normal source is available. A white signal light to indicate when the emergency source is available.
 - 7. A test switch to momentarily simulate normal source failure.
 - 8. A key-operated switch with standby and normal positions to manually switch between the standby and normal source.
 - 9. A solid state exerciser clock to set the day, time, and duration of generator set exercise/test period. A with/without load selector switch for the exercise period.
- K. Transfer switches shall be equipped with a field adjustable controls to allow the operator to control the transfer switch operating time during switching in both directions. The controls shall control the time the load is isolated from both power sources, to allow load residual voltage to decay before closure to the opposite source. The transfer switch operating speed control feature shall have an adjustable range of 0 to 7.5 seconds.

- L. Acceptable Manufacturers:
 - 1. Kohler Power Systems (basis of design)
 - 2. Cummins Power Systems
 - 3. ASCO.
 - 4. Caterpillar.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Products shall be installed, connected, and interconnected, where indicated, and in accordance with the manufacturer's printed instructions, as specified herein and as indicated on the Drawings. Connections shall be made in a manner, which will insure electrical continuity and operability of the products. Verify the Work of other trades is complete to the extent that substrates on which electrical apparatus is to be installed is ready to receive same.
- B. Protect the equipment against foreign matter and moisture during installation.

3.02 TESTING

- A. Test transfer in the field in the presence of the owner to demonstrate it operates properly.

END OF SECTION

SECTION 28 31 00

FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fire alarm system: complete, including all wiring, raceways, terminal cabinets, pull boxes, outlet and mounting boxes, initiating devices, alarm indicating devices, annunciator(s), control equipment, tests, and all other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described.
- B. Verify requirements with Jurisdictional authorities, i.e.: Insurance authority or Underwriter, Fire Department or Marshal, or Building Department. Provide system complete, functional and acceptable to Jurisdictions without penalty of any type to the insurance premium rate. This Contractor shall be completely responsible for all aspects of coordination with other sections of these specifications and drawings. No change will be issued for lack of coordination or lack of verification of requirements of Jurisdictional Authorities.
- C. Related Sections:
 - 1. Section 26 05 00 – Common Work Results for Electrical
 - 2. Section 26 05 28 – Hangers and Supports for Electrical Systems
 - 3. Section 26 05 33 – Conduits for Electrical Systems
 - 4. Section 26 05 34 – Surface Raceways for Electrical Systems
 - 5. Section 26 05 35 – Boxes for Electrical Systems.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI/ASME A117.1, A117.3 Standard for Accessible and Usable Building and Facilities.
- B. National Electrical Manufacturer's Association (NEMA).
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 – National Electrical Code
 - 2. NFPA 72 – National Fire Alarm Code
 - 3. NFPA 90A – Standard for the Installation of Air conditioning and Ventilating Systems
 - 4. NFPA 101 – Life Safety Code.
- D. Underwriters Laboratory, Inc. (UL):
 - 1. UL-864 – Control Units and Accessories for Fire Alarm Systems.
- E. International Fire Code (IFC).
- F. The Americans with Disabilities Act (ADA), Public Law 101 - 336.
- G. Underwriters Laboratories (UL) or Factory Mutual (FM) Approval.
- H. Philadelphia Electrical Code.
- I. Philadelphia Fire Alarm Code.

1.03 QUALITY ASSURANCE

- A. **Installer Qualifications:** An experienced installer who is an authorized representative of the FACP manufacturer for both installation and maintenance of units required for this Project. Installer shall be able to produce, upon request, references and proof of five (5) years minimum experience in the installation of systems of comparable size and performance to that specified.
- B. **Manufacturer's Representative:** The system shall be provided and commissioned by the authorized Manufacturer's Local Representative. This representative shall provide documentation that the organization is factory certified on the system. This organization must maintain a qualified technical and engineering staff to program and service the system. This distributor shall fully stock and show evidence that they maintain a complete inventory of spare parts to allow prompt and proper servicing of the system. Before commencing work, submit data showing the commissioned fire alarm systems of the same type and design as specified. He shall include the names and locations of at least five such installations within one hundred miles of the project. Specify type and design for each system and furnish documentation that the system has performed satisfactorily for the preceding 48 months.

1.04 SYSTEM DESIGN REQUIREMENTS

- A. Verify requirements with jurisdictional authorities (i.e. Insurance Carrier or Underwriter, Fire Department or Marshall, or local Building Code Department). This contractor shall be responsible for providing a complete and functional system, acceptable to the jurisdictions involved.
- B. **Qualification of System Technician:** Installation drawings, shop drawing and as-built drawings shall be prepared by or under the supervision of an individual who is experienced with the type of work specified herein and is currently certified by the National Institute of Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level III certification in the fire alarm and detection system program. Contractor shall submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings. All submittals shall be stamped by a Registered Fire Protection Engineer.
- C. Notification circuits shall be designed with twenty percent (20%) spare capacity for future visual notification devices.

1.05 SUBMITTALS

- A. Contractor shall submit shop drawings, product data and calculations to the Authority Having Jurisdiction, Fire Department/Marshall, Owner's Insurance Underwriter, and/or other regulatory agency, and obtain approvals prior to submission to Engineer for review. Include approval documentation with submission to Engineer.
- B. Provide complete submittals, which shall include schematic wiring drawings of the control panel showing internal and external control panel wiring and all devices. Floor plans/device layout drawings, sequence of operation, annunciator wiring schematics, battery calculations, and specification sheets for all equipment, all devices shall be provided. Drawings shall be done on full size sheets and to scale (1/8" = 1'-0" minimum). Partial submittals will not be accepted.
- C. **System Operation Description:** Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and

automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit to Engineer the following operation and maintenance information in accordance with the requirements of this section and General Conditions of Contract:
 - 1. Instruction books and/or leaflets
 - 2. Recommended renewal parts list
 - 3. Final as-built drawings
 - 4. Complete Wiring diagrams
 - 5. NFPA 72 Test Report/Certificate.

1.07 DEFINITIONS

- A. Alarm-Initiating Device: A system component that originates transmission of a change-of-state condition, such as a manual pull station, smoke detector, heat detector, supervisory switch, etc.
- B. Alarm Signal: Signifies a state of emergency requiring immediate action. Pertains to signals such as the operation of a manual station, the operation of a sprinkler system flow switch, etc.
- C. Class A Wiring: Circuits arranged and electrically supervised so a single break or single ground fault condition will be indicated by a trouble signal at the fire alarm control panel (FACP) and the circuit will continue to be capable of operation for its intended service in the faulted condition no matter where the break or ground fault condition occurs.
- D. Class B Wiring: Circuits electrically supervised such that a single break or a single ground fault condition will be indicated by a trouble signal at the FACP no matter where the break or ground fault condition occurs.
- E. Hard-Wired System: Alarm, supervisory, and initiating devices directly connected, through individual dedicated conductors, to a central control panel without the use of multiplexing circuits or devices.
- F. Multiplex System: One using a signaling method characterized by the simultaneous or sequential transmission, or both, and the reception of multiple signals in a communication channel, including means for positively identifying each signal (also referred to as an Addressable System).
- G. Supervisory Signal: Indicates abnormal status or need for action regarding fire suppression or other protective system.
- H. Trouble Signal: Indicates that a fault, such as an open circuit, ground, etc. has occurred in the system.
- I. Zone: A building area that has all initiating devices located within it programmed to initiate an alarm and to give a common location indication on the system FACP and annunciator.
- J. MNS: Mass Notification System

1.08 SYSTEM DESCRIPTION

- A. General: UL and FM listed. Complete, zoned, non-coded, addressable, microprocessor-based fire detection and alarm system with manual and automatic alarm initiation, intelligent analog

addressable smoke detectors, and automatic alarm verification for alarms initiated by certain smoke detectors as indicated.

- B. Signal Transmission: Multiplex signal transmission dedicated to fire alarm service only.
- C. Voice evacuation and Visual Alarm Indication: By sounding of audible notification devices and visual alarms.
- D. System connections for alarm-initiation and alarm-indicating circuits: Class B (Style 4) wiring.
- E. Existing Fire Alarm Equipment: Maintain fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire alarm equipment "NOT IN SERVICE" until removed from the building. Building owner shall be notified 48 hours in advance if normal building operations are to be interrupted - building interruptions shall occur only at the convenience of the owner.

1.09 RECORD DOCUMENTS

- A. The As-Built drawings shall include three (3) complete sets of 30" x 42" contract base sheet drawings with any and all changes included and noted. The approved contract panel drawings and annunciator panel drawings shall also be provided on 30" x 42" reproducible. The Conduit Plan shall show the device address for all intelligent/analog-initiating devices. The As-Built drawings shall be kept up to date continuously by the electrician in charge of the system installation. These drawings shall be reviewed on a weekly basis for accuracy and completeness.
- B. The Operation and Maintenance Manual shall include a complete set of equipment, component and device specification and data sheets as well as a reduced size paper copy (half-size or 11" x 17") of the complete set of system drawings described in paragraph 1.4. A copy of the NFPA 72 Test Report/Certificate, a printed record of all test activity including the sensitivity readings for all intelligent/analog smoke detectors, the required system and component warrantee papers, and the name and address of the installer shall be included. The manual shall be bound in a black three ring loose leaf binder with dividers and a table of contents. Three (3) duplicate sets are required.
- C. Five (5) sets of keys to all locks shall be provided in a proper key box or binder with each set of keys properly and legibly marked and tagged. Loose keys will not be accepted.
- D. All locks and keys for fire alarm panel and power booster panel shall be keyed alike and keyed to the master key system of the School District of Philadelphia. Locks and pulls for doors of cabinets shall be Corbin #15767. The master key shall be #CAT60.
- E. All documents and items described above shall be submitted for approval and turnover prior to the final testing and system certification with the exception of the NFPA 72 Test Report/Certificate which shall be delivered by hand to the owner within two (2) days of the actual test and acceptance. One copy of the Test Report/Certificate shall be submitted to the Engineer.
- F. THE PHILADELPHIA SCHOOL DISTRICT SHALL RETAIN COMPLETE RIGHTS AND OWNERSHIP TO ALL SOFTWARE RUNNING IN THE SYSTEM. This fire alarm equipment vendor shall provide useable hard and soft copies of the software database to the Philadelphia School District at the end of the warranty period. The database provided shall be useable by an authorized and certified distributor of the product line and shall include all applicable

passwords necessary for the total and unrestricted use and modification of the database. The database shall contain all information relevant to the installed system.

1.10 ACCEPTANCE OF SYSTEM

- A. Total acceptance of the system will only be made after the required tests, complete record document package and the instruction period have been provided.

1.11 GUARANTEE

- A. Guarantee the labor, materials and equipment provided under this contract against system defects for a period of three (3) years after the date of final acceptance of this work by the Owner.
- B. Provide service by the equipment supplier during the guarantee period, seven (7) days a week, including holidays, within four (4) hours after notification. Repairs shall be affected within twenty-four (24) hours of notification.
- C. Should the Contractor fail to comply with the above requirements, the Owner will then have the option to make the necessary repairs and back charge the Contractor without any loss of warranty or guarantee as provided by the contract.
- D. Any guarantee which is in conflict with the above will not be acceptable.

1.12 WARRANTY AND MAINTENANCE

- A. Warranty: Contractor shall warrant the complete fire alarm system installation against defective materials or faulty workmanship for a period of THREE (3) YEARS from the date of acceptance.
- B. Maintenance and Re-certification Service: Contractor shall also provide THREE (3) YEARS of factory-authorized maintenance and re-certification service from the date of acceptance, including any required maintenance or repairs, hardware and software updates, annual testing and re-certifications.
- C. Required Response:
 - 1. Emergency Calls: Contractor shall provide factory-authorized service within FOUR (4) HOURS after notification by the District's Maintenance Department of system trouble or failure.
 - 2. Non-Emergency Calls: Contractor shall provide factory-authorized service within EIGHT (8) HOURS after notification by the District's Maintenance Department of system trouble or failure.

1. SOFTWARE SERVICE AGREEMENT

- 2. THE PHILADELPHIA SCHOOL DISTRICT SHALL RETAIN COMPLETE RIGHTS AND OWNERSHIP TO ALL SOFTWARE RUNNING IN THE SYSTEM. The fire alarm equipment vendor shall provide useable hard and soft copies of the software database to the Philadelphia School District at the end of the warranty period. The database provided shall be useable by any authorized and certified distributor of the product line and shall include all applicable passwords necessary for total and unrestricted use and modification of the database.

1. DEMONSTRATION AND TRAINING

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Training shall be provided at project site for a period of 4 hours minimum.
2. The School District of Philadelphia requires that all prospective fire alarm manufacturers provide training, on their fire alarm product, to the Philadelphia School District, in order to be deemed acceptable for use. The School District employs a team of Life Safety technicians responsible for the upkeep of all Life Safety Systems within the Philadelphia School District and full system access to all Fire Alarm panels by this team is mandatory on all projects. Training is to include, but not be limited to:
 1. Training shall include all basic system operations of panel equipment as well as training of all peripheral equipment associated with the panel equipment. Complete system training from a technical, hands-on perspective for proper install, system operation & troubleshooting techniques will be the only acceptable training.
 2. All operating system software, used for programming of the system shall be provided to the school district as two (2) copies on CD-ROM prior to the closing of the project, as well as any programming keys, hasps, hand held programmers etc. used in the programming of the system. Any and all updates, patches, revisions to the operating software, etc. will be provided to the School District within 30 days of release at no additional cost to the School District.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers for the fire alarm system:
 1. Edwards System Technology (EST)
 2. Siemens Building Technologies
 3. Notifier by Honeywell
 4. Honeywell, Silent Knight.
- B. Manufacturers submitted by the bidder as equals or substitutions shall comply with specification Section 26 05 00.

2.02 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. Control of System: By the FACP. Provide all programming required for a complete and operating fire alarm and detection system, to the complete satisfaction of the Owner and the Engineer. Backup of program shall be provided.
- B. System Supervision: Automatically detect and report open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
- C. Fire Alarm Signals: The system shall have an automatic digitized voice fire alarm signal with emergency manual voice override. The digitized voice message shall provide a general evacuation fire alarm signal in accordance with ASA S3.41 to notify all occupants in the building to evacuate.

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- D. Priority of Signals: Automatic alarm response functions resulting from an alarm signal from one zone or device are not altered by subsequent alarm, supervisory, or trouble signals. An alarm signal is the highest priority. Supervisory and trouble signals have second- and third-level priority. Higher-priority signals take precedence over signals of lower priority, even when the lower-priority condition occurs first. Annunciate and display all alarm, supervisory, and trouble signals regardless of priority or order received.
- E. Noninterference: A signal on one zone shall not prevent the receipt of signals from other zones.
- F. Transient voltage Protection: Provide protection on all circuits in accordance with manufacturer's recommendation.
- G. System Reset: All zones are manually resettable from the FACP after initiating devices are restored to normal.
- H. Transmission to Remote Alarm Receiving Station: Automatically route alarm, supervisory, and trouble signals to a remote alarm station by means of a digital alarm communicator transmitter and two (2) telephone lines.
- I. Loss of primary power at the FACP initiates a trouble signal at the FACP and the annunciator. An emergency power light is illuminated at both locations when the system is operating on the secondary power supply.
- J. Basic Alarm Performance Requirements: Unless otherwise indicated, operation of a manual station, automatic alarm operation of a flame or heat detector, operation of a sprinkler flow device, or verified automatic alarm operation of a smoke detector initiates the following:
 - 1. Notification-appliance operation.
 - 2. Audible and visual annunciation of 'alarm' condition at the FACP and the remote annunciator(s).
 - 3. Identification, in plain-text English via alpha-numeric display, at the FACP and the remote annunciator(s) of the device originating the alarm.
 - 4. Transmission of an alarm signal to the remote alarm receiving station.
 - 5. Shutdown of fans and other air-handling equipment serving zone where alarm was initiated.
 - 6. Closing of smoke dampers in air ducts of system serving zone where alarm was
 - 7. Recording of the event in the system memory.
 - 8. Alarm Silencing, System Reset, and Indication: Controlled by switches on the FACP and the remote annunciator.
 - 9. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
 - 10. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
 - 11. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.
- K. Smoke detection for zones or detectors with alarm verification initiates the following:
 - 1. Audible and visible indication of an "alarm verification" signal at the FACP.
 - 2. Activation of a listed and approved "alarm verification" sequence at the FACP and the detector.
 - 3. General alarm, after the alarm condition is verified. Activation of a second smoke detection device during the verification period shall automatically activate general alarm.
 - 4. Cancellation of the FACP indication and system reset if the alarm is not verified.
- L. Supplemental extinguishing systems (Kitchen hoods) initiates the following:

1. A supervisory, audible, and visible "sprinkler trouble" signal indication at the FACP and the annunciator(s).
 2. Identification, in plain-text English via alpha-numeric display, at the FACP and the remote annunciator(s) of the device that has operated.
 3. Recording of the event by the system printer.
 4. Transmission of trouble signal to remote central station.
- M. Removal of an alarm-initiating device or a notification appliance initiates the following:
1. A "trouble" signal indication at the FACP and the annunciator(s).
 2. Identification, in plain-text English via alpha-numeric display, at the FACP and the remote annunciator(s) of the device or zone involved.
 3. Recording of the event by the system printer.
 4. Transmission of trouble signal to remote alarm receiving station.
- N. Permissible Signal Time Elapse: The maximum permissible elapsed time between the actuation of any fire alarm or fire-detection system alarm-initiating device and its indication at the FACP is ten seconds.
- O. Circuit Supervision: Indicate circuit faults by means of both a zone and a trouble signal at the FACP. Provide a distinctive indicating audible tone and (LED) indicating light. The maximum elapsed time between the occurrence of the trouble condition and its indication at the FACP is 200 seconds.
- P. FACP Alphanumeric Display: Plain-English-language descriptions of alarm, supervisory, and trouble events; and addresses and locations of alarm-initiating or supervisory devices originating the report. Display monitoring actions, system and component status, system commands, programming information, and data from the system's historical memory.

2.03 MANUAL PULL STATIONS

- A. Description: Fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions of contrasting color.
1. Single-action mechanism, with positive visual indication of activation, initiates an alarm. Pull stations shall incorporate a key reset device.
 2. Integral Addressable Module: Arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
 3. Pull station body shall be red, with clearly visible operating instructions provided on the cover. The word "**FIRE**" shall appear on the front of the station in raised letters of contrasting color.
 4. Provide a sign adjacent to each manual pull station. The sign shall read "**IN CASE OF FIRE: SOUND ALARM AND CALL THE FIRE DEPARTMENT**". The sign is 12" wide x 6" high plastic laminate. The sign is white with red letters. Firmly affix the sign with a stainless-steel screw at each corner. The lettering is no less than 1" tall.
 5. Provide sample of sign to owner, construction manager, and engineer for review before purchasing final signs. Refer to Specification Section on Submittals before submitting sample.
 6. Sign layout:

**IN CASE OF FIRE:
SOUND THE ALARM AND
CALL THE FIRE DEPARTMENT**

2.04 SMOKE DETECTORS

- A. General requirements:
1. Operating Voltage: 24-V dc, nominal.
 2. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 3. Plug-in Arrangement: Detector and associated electronic components are mounted in a module that connects in a tamper-resistant manner to a fixed base with a twist-locking plug connection. Terminals in the fixed base accept building wiring.
 4. Integral Visual-Indicating Light: LED type. Indicates detector has operated.
 5. Sensitivity: Can be tested and adjusted in-place after installation.
 6. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 7. Photoelectric Smoke Detectors include the following features:
 - a. Sensor: LED or infrared light source with matching silicon-cell receiver.
 - b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.
 - c. Where combination smoke/thermal detectors are noted to be utilized on the drawings, provide integral Thermal Detector: Fixed-temperature type with 135 degrees F setting.
 8. Beam-Type Smoke Detectors: Each detector consists of a separate transmitter and receiver with the following features:
 - a. Adjustable Sensitivity: More than a six-level range, minimum.
 - b. Linear Range of Coverage: 600 feet, minimum.
 - c. Tamper Switch: Initiates trouble signal at the central FACP when either transmitter or receiver is disturbed.
 - d. Separate Color-Coded LEDs: Indicate normal, alarm, and trouble status. Any detector trouble, including power loss, is reported to the central FACP as a composite "trouble" signal.
 9. Duct Smoke Detectors: Photoelectric type with duct-mounted housing.
 - a. Sampling Tube: Design and dimensions as recommended by the manufacturer for the specific duct size, air velocity, and installation conditions where applied. Sampling tube shall be sloped downward from the detector housing. Sampling tube holes shall be oriented toward the air stream in the duct.
 - b. Smoke Detector: Shall be photoelectric type with UL listed air velocity range of 300-4,000 feet per minute.
 - c. Relay Fan Shutdown: Isolated auxiliary contact, rated to interrupt fan motor-control circuit.
 - i. Wiring between aux. contact and ATC system provided by Contractor.
 - d. Locate duct detector remote test switch on adjacent wall at 5'-6" above floor.

2.05 HEAT DETECTORS

- A. Heat Detector, Fixed-Temperature/Rate-of-Rise Type: Actuated by temperature that exceeds a fixed temperature of 135 degrees F. Rate-of-rise element shall be rated at 15 degrees F per minute.
 1. Mounting: Plug-in base, interchangeable with smoke detector bases.
 2. Provide and install remote test switches for all heat detectors that are more than 10 feet above finished floor.
- B. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 135 degrees F.

1. Mounting: Plug-in base, interchangeable with smoke detector bases.
 2. Provide and install remote test switches for all heat detectors that are more than 10 feet above finished floor.
- C. Weatherproof Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 135 degrees F.
1. Mounting: Plug-in base, interchangeable with smoke detector bases.
 2. Provide and install remote test switches for all heat detectors that are more than 10 feet above finished floor.
 3. System Sensor Model 885WP-B or approved equal.
 4. Provide and install remoted test switches for all weatherproof heat detectors.

2.06 NOTIFICATION DEVICES

- A. Description: Equip for mounting as indicated and have screw terminals for system connections.
- B. Fire Alarm speakers shall operate on either 25 VRMS or 70.7 VRMS inputs with field selectable output taps from 0.25 to 2 watts. Speakers shall provide a minimum sound output of 80 dBA at 10 feet with the 1/2-watt tap. Speaker shall have frequency response of 400 to 4,000 Hz and be UL Listed for fire alarm voice evacuation use. Speakers shall be designed to be wall or ceiling mounted.
- C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971 with clear polycarbonate lens. Mount lens on an aluminum faceplate. Housing shall be red in color, with the word "FIRE" clearly printed in white.
1. Strobe Leads: Factory connected to screw terminals.
 2. Minimum strobe intensity for devices is noted on drawings.
 3. All strobe lights visible within the same area shall be fully synchronized.
 4. Device shall have field selectable output for visual settings.
 5. Strobe light shall produce a minimum of 15 candelas at approximately one flash per second with continuously applied voltage.
- D. Combination Fire Alarm Speaker/Strobes: Comply with applicable requirements listed above for fire alarm speakers and visible alarm devices. Combination devices shall be designed to be either wall or ceiling mounted.

2.07 CARBON MONOXIDE DETECTORS

- A. Carbon monoxide detector shall be listed to UL 2075 for Gas and Vapor detectors and sensors. The detector shall be equipped with a trouble relay.
- B. The detector shall provide dual-color LED indication which blinks to indicate normal standby, alarm or end-of-life. When the sensor supervision is a trouble condition, the detector shall send a signal to the control panel.
- C. The detector shall provide a means to test CO gas entry into the CO sensing cell. The detector shall provide this with a test mode that accepts CO gas from a test agent and alarms immediately upon sensing CO entry.
- D. The detector shall be operated at 24 volts DC.
- E. The detector shall be mounted to a single gang back box.

- F. End of life timer: When the carbon monoxide detector's internal sensor has reached the end of its life, a trouble signal shall be sent to the control panel.
- G. Provide combination carbon monoxide and smoke detectors where indicated on the Drawings and complying with applicable requirements of this Article and Article 2.04.

2.08 REMOTE DEVICE LOCATION-INDICATING LIGHTS AND IDENTIFICATION PLATES

- A. Description: LED indicating light near each smoke detector that may not be readily visible, and each sprinkler water-flow switch and valve-tamper switch. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single gang plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located.
- B. Mounting: Mounted at an accessible location in ceiling/wall in close proximity to smoke detector.

2.09 FIRE ALARM CONTROL PANEL (FACP) / AUDIO CONTROL UNIT

- A. Fire alarm audio control panel shall provide complete voice annunciation of the fire alarm system. Panel shall include ability to select paging zone by area or all call. The panel shall support both live paging and prerecorded digital messages. The fire alarm control panel shall include the following performance features:
 - 1. Audio Channels: one simultaneous 70.7 VRMS channel, minimum
 - 2. Audio Levels: As required by NFPA 72
 - 3. Digital Message: As recorded by Owner's representative
 - 4. Preamp supervision and Automatic changeover.
 - 5. Amplification: supports 3 distributed or central bank amplifiers.
 - 6. Remote microphone for all-call paging.
- B. Cabinet: Lockable steel enclosure. Arrange interior components so operations required for testing or for normal maintenance of the system are performed from the front of the enclosure. If more than one unit is required to form a complete control panel, fabricate with matching modular unit enclosure to accommodate components and to allow ample gutter space for field wiring and interconnecting panels.
 - 1. Identify each enclosure with an engraved, red, laminated, phenolic-resin nameplate with lettering not less than 1 inch high. Identify individual components and modules within cabinets with permanent labels.
 - 2. Mounting: As noted/shown on drawings.
 - 3. Locks for all fire alarm system panels shall be keyed to the District's master key system.
- C. Alarm and Supervisory Systems: Separate and independent in the FACP. Alarm-initiating zone boards consist of plug-in cards. Construction requiring removal of field wiring for module replacement is unacceptable.
- D. Control Modules: Include types and capacities required to perform all functions of fire alarm systems.
- E. Indications: Local, visible, and voice signals announce alarm, supervisory, and trouble conditions. Each type of audible alarm has a different sound.
- F. Resetting Controls: Prevent the resetting of alarm, supervisory, or trouble signals while the alarm or trouble condition still exists.

- G. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components, including annunciation, supervision, and control.
 - 1. Display: Back-lit, 80-character minimum LCD display, utilizing plain-text English, for alarm, supervisory, and component status messages; and indication of control commands to be entered into the system for control of smoke detector sensitivity and other parameters.
 - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- H. The fire alarm control panel shall be capable of operating remote displays and/or printers. The output shall be serial ASCII from an EIA RS-232-C connection with an adjustable baud rate of 300, 1200, 2400, 4800 or 9600 to allow use of compatible UL864 listed display, keyboard or printer.
- I. The fire alarm control panel shall be provided with a coded one-man walk test feature and program the fire alarm control panel for this feature.
- J. Provide signature device programming / service tool to allow programming of signature devices with using the PC and use for retrieving information from signature device history log and trouble codes. Also provide necessary accessories including communication and power cables.
- K. Provide memory stick with complete copy of points list.
- L. The FACP cannot have a map fault feature.
- M. Speaker Circuit Control Unit: The speaker circuit control unit shall include switches to manually activate or deactivate speaker circuits grouped by floor in the system. The speaker circuit control unit shall include visual indication of active or trouble status for each group of speaker circuits in the system.
 - 1. A trouble indication shall be provided if a speaker circuit group is disabled.
 - 2. A lamp test switch shall be provided to test all indicator lamps.
 - 3. A single "all call" switch shall be provided to activate all speaker circuit groups simultaneously.
 - 4. A push-to-talk microphone shall be provided for manual voice messages.
 - 5. A voice message disconnect switch shall be provided to disconnect automatic digitized voice messages from the system. The system shall be arranged to allow manual voice messages and indicate a system trouble condition when activated.
- N. Speaker Circuit Arrangement: Speaker circuits shall be arranged such that there is one speaker circuit per floor or smoke zone. Audio amplifiers and control equipment shall be electrically supervised for normal and abnormal conditions. Speaker circuits and control equipment shall be arranged such that loss of any one speaker circuit will not cause the loss of any other speaker circuit in the system.
- O. Digitized Voice Module (DVM): The Digital Voice Module shall provide prerecorded digitized evacuation and instructional messages. The messages shall be professionally recorded and approved by the District prior to programming.
 - 1. The DVM shall be configured to automatically output to the desired circuits/smoke zones following a 10-second slow whoop alert tone. The digitized message capacity shall be not less than 15 seconds in length. Message shall be transmitted three (3) times.
 - 2. The DVM shall be supervised for operational status. Failure of the DVM shall result in the transmission of a constant alarm tone.

3. The DVM memory shall have a minimum of 50 percent spare capacity after those messages identified in this section are recorded. Multiple DVM's may be utilized to obtain required capacity.
- P. Audio Amplifiers: Audio Amplifiers shall provide a minimum of 50 watts at either 25 or 70.7 VRMS output voltage levels. Amplifiers shall be continuously supervised for operational status and configured for either single or dual channel application.
- Q. Tone Generator(s): Tone Generator(s) shall be capable of providing a distinctive 3-pulse temporal pattern fire alarm signal as well as a slow whoop. Tone generators shall be continuously supervised for operational status.
- R. System Expansion: Control units, amplifiers, power supplies, and enclosures shall be designed such that the system can be expanded in the future (to include the addition of a minimum of 20 percent more alarm initiating and alarm notification devices) without disruption or replacement of the existing control unit, NAC panels, or secondary power supply(s).

2.10 REMOTE ANNUNCIATOR

- A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also, duplicate manual switching functions of the FACP, including acknowledging, silencing, reset, and test.
- B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.11 EMERGENCY POWER SUPPLY

- A. General: Components include valve-regulated, recombinant lead acid battery; charger; and an automatic transfer switch.
 1. Battery Nominal Life Expectancy: 20 years, minimum.
 2. Battery Capacity: Comply with NFPA 72. Batteries shall be sufficient to operate the system for a minimum of 24 hours in 'Standby', followed by 15 minutes in 'Alarm.' If required, provide remote power panels with battery backup same as the main control panel. Extend 120 VAC source from the main control panel. Coordinate location of remote power supply panel(s) in the field with the Owner/Architect.
- B. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining batteries at full charge. If batteries are fully discharged, the charger recharges them completely within four hours. Charger output is supervised as part of system power supply supervision.
- C. Integral Automatic Transfer Switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

2.12 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module listed for use in providing a multiplex system address for alarm-initiating devices (with normally open contacts).
- B. Provide an Integral Addressable Interface (IAI) device or relay and associated circuitry, etc., for each fire protection alarm initiating device as required.
 1. Provide additional addressable relays/addressable monitors, and associated circuitry, to perform auxiliary functions indicated on the drawing or required by applicable codes.

- C. Locate Addressable Interface Device in conditioned spaces. Do not locate Addressable Interface Device in Boiler Rooms, Fan Rooms, or Basement type areas.

2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Listed and labeled under UL 864 and NFPA 72.
- B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP panel, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising two lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.
- C. Provide standalone digital alarm communicator transmitter (DACT) to transmit alarm signals to a Central Monitoring Station (CMS). The DACT shall be a manufactured by Silent Knight, model 5129 or an approved equal by the school district. Provide (2) CAT6 cables from the fire alarm control panel to the telephone demarcations station in the Main Mechanical Room to transmit alarm signal to the security officer at School District Main Office.
- D. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity shall be adequate to comply with NFPA 72 requirements.
- E. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.
- F. The digital alarm communicator transmitter (DACT) and the fire alarm control panel shall be arranged to transmit all zones to the central monitoring station. Zones to be transmitted shall be defined by the Owner. The system shall be capable of transmitting a distinct signal for each zone to the monitoring station's facilities, including spare zones. A trouble or low battery condition associated with the DACT shall be transmitted to the monitoring station.
- G. The supplier of the DACT shall coordinate compatibility with the central monitoring station. All labor and hardware required to obtain compatibility with the monitoring station shall be included. Forward a letter to the Architect/Engineer stating that this coordination has been done and that the proposed communicator system is completely compatible with the central monitoring station's equipment.
- H. Provide two CAT6 cables, in conduit, from the DACT to the telephone demarcation point. Coordinate requirements with Owner's Representative.

2.14 INTERNET & 4G COMMERCIAL FIRE COMMUNICATOR

- A. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP panel, and automatically dials a preset number for remote central station. When contact is made with the central station, the signal is transmitted. The unit is capable of using either cellular or voice over internet protocol (VOIP). The unit is set up for VOIP primary and cellular backup. The unit transmits the signal to a central monitoring station (CMS).
- B. Provide standalone internet and 4G commercial fire communicator as manufactured by Honeywell Security model iGSMCFP4G or approved equal by the school district. Provide (2) CAT6 cables from the communicator to the main telecommunications room in the building. Terminate the cable at both ends with RJ-45 jacks. Test the cabling per the TIA standards.

- C. Primary power: Provide 120-volt to 12-volt transformer. Connect to adjacent branch circuit feeding fire alarm control panel. Secondary power: Integral rechargeable battery and battery charger. Battery capacity shall be adequate to comply with NFPA 72 requirements, but no less than 24 hours.
- D. Encryption: Furnish a unit with 256-bit encryption.
- E. Diagnostic LED: Furnish a unit diagnostic LED that show signal strength and status indications. Status indications to include: Power, VOIP Available, and Cellular Available.
- F. The communicator and the fire alarm control panel shall be arranged to transmit all zones to the central monitoring station. Zones to be transmitted shall be defined by the Owner. The system shall be capable of transmitting a distinct signal for each zone to the monitoring station's facilities, including spare zones. A trouble or low battery condition associated with the communicator or FACP shall be transmitted to the monitoring station.
- G. The supplier of the communicator shall coordinate compatibility with the central monitoring station. All labor and hardware required to obtain compatibility with the monitoring station shall be included. Forward a letter to the Architect/Engineer stating that this coordination has been done and that the proposed communicator system is completely compatible with the central monitoring station's equipment.

2.15 GUARDS FOR PHYSICAL PROTECTION

- A. Wire Guards: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 1. Utilized on all devices in gymnasium and on other devices as noted on drawings.
 - 2. Factory fabricated and furnished by the manufacturer of the device.
 - 3. Finish: Paint of color to match the protected device.
 - 4. Provide guards for audio, visual, and/or initiation devices in gymnasiums and elsewhere, as indicated.
- B. Pull Station Covers: For each manual pull station located in an area accessible to students, provide and install a clear polycarbonate cover with local horn. The horn is powered by a 9-volt dc battery and produces a sound of no less than 95db.
 - 1. STI Stopper II, STI-1130; or approved equal.

2.16 EXTRA EQUIPMENT - INSTALLED AND WIRED

- A. Manual Fire Alarm Pull Stations: Provide one (1) manual pull station install, wired, and programmed, at location determined by the Owner in the field. If the Owner chooses not to add an additional manual pull station to the project, the pull station shall become the property of the School District of Philadelphia.
- B. Fire Alarm Strobes: Provide two (2) fire alarm strobe units installed, wired, and programmed, at locations determined by the Owner in the field. If the Owner chooses not to add any fire alarm strobes to the project, the fire alarm strobes shall become the property of the School District of Philadelphia.
- C. Fire Alarm Speaker/Strobes: Provide two (2) fire alarm speaker/strobe units installed, wired, and programmed, at locations determined by the Owner in the field. If the Owner chooses not to add any fire alarm speaker/strobes to the project, the fire alarm speaker/strobes shall become the property of the School District of Philadelphia.

- D. Fire Alarm Speakers: Provide two (2) fire alarm speaker units installed, wired, and programmed, at locations determined by the Owner in the field. If the Owner chooses not to add any fire alarm speakers to the project, the fire alarm speakers shall become the property of the School District of Philadelphia.
- E. Smoke Detectors: Provide five (5) fire alarm smoke detectors, with bases, installed, wired, and programmed, at locations determined by the Owner in the field. If the owner chooses not to add any smoke detectors to the project, the smoke detectors and bases shall become the property of the School District of Philadelphia.
- F. Heat Detectors – Fixed Temperature / Rate-of-Rise: Provide two (2) heat detectors, with bases, installed, wired, and programmed, at locations determined by the Owner in the field. These heat detectors are rated for 135 degrees F fixed temperature and 15 degrees F rate-of-rise. If the Owner chooses not to add any of these heat detectors to the project, the heat detectors and bases shall become the property of the School District of Philadelphia.
- G. Heat detectors – Fixed Temperature: Provide one (1) heat detector, with base, installed, wired, and programmed, at location determined by the Owner in the field. This heat detector is rated for 135 degrees F fixed temperature. If the Owner chooses not to add this heat detector to the project, the heat detector and base shall become the property of the School District of Philadelphia.
- H. Heat detectors – Weatherproof: Provide one (1) heat detector, with base, installed, wired, and programmed, at location determined by the Owner in the field. This heat detector is a weatherproof device rated for 135 degrees F fixed temperature. If the Owner chooses not to add this heat detector to the project, the heat detector and base shall become the property of the School District of Philadelphia.

2.17 WIRE

- A. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 degrees C, color-coded insulation.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum.
 - 3. Power-Limited Circuits: NFPA 70, Types FPL, FPLR, or FPLP, as recommended by manufacturer.

2.18 PULL BOXES AND TERMINAL CABINETS

- A. Pull boxes shall be Pentair NEMA type 1 hinged cover cabinets only. Sizes as shown on the fire alarm system drawings. Paint all pull box doors red and label F/A PULL BOX. Pull boxes shall be rated for the environment they are placed in (i.e. NEMA 1, NEMA 3R, NEMA 4X, etc.)
- B. Terminal cabinets shall be Pentair NEMA type 1 hinged cabinets with a painted steel removable subplate and 'T' handle latch. No locks are required. Each terminal cabinet shall have a factory painted red finish. Provide on the door of each terminal cabinet a red lamacoid nameplate with ¾ inch white letters to read Fire Alarm Terminal Cabinet #__. Flush cabinets shall be the same type except for factory supplied flush mounting trim. Provide one (1) IDEAL (389-061) terminal block per wire entering and leaving the terminal cabinet, plus 10% spare terminal blocks. Mount terminal blocks vertically and use the appropriate terminal block mounting channel and terminal block end plates (89-062) as recommended by the manufacturer. Each terminal shall be properly identified and the respective Terminal Cabinet Directory as shown in the drawings shall be attached to the inside cover with an adhesive backed vinyl envelope.

2.19 PRINTER

- A. Provide and install a system printer where indicated on the drawings. The printer shall print messages that appear on the fire alarm control panel screen and be programmable to either alarm only or full event logging output.
- B. The printer shall show all operator commands and shall be capable of providing a printer list of system conditions, such as: detector sensitivities, thresholds, analog voltages, device type, and custom messages. A *TROUBLE* condition shall be generated when the printer paper has run out. An internal buffer shall continue to store events when paper is out.
- C. Power supply for external printers shall be coordinated with the District and taken from the existing building emergency service, as applicable and as directed. Provide external printers with a printer and paper stand.

2.20 REMOTE POWER SUPPLIES FOR NOTIFICATION APPLIANCES

- A. Provide notification appliance circuit power extenders (NAC panels) when required for voice and/or visible alarm notification appliances to ensure compliance with applicable codes.
- B. If a NAC panel is installed in an area that does not have NFPA-72 area smoke coverage, then provide an additional system smoke detector above the panel location.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. The system shall electrically supervise all wiring between the control panel and all initiating and indicating devices.
 - 2. The system shall be capable of differentiating between a system trouble condition and the activation of a supervisory device.
 - 3. A complete NFPA 72 test shall be performed, and a system status report issued, prior to the start of any demolition of the existing functioning fire alarm systems.
- B. Installation – Equipment:
 - 1. All wiring shall be installed in metallic conduit. No exposed cabling shall be permitted at any location.
 - 2. Utilize rigid galvanized steel (RGS) conduit on the basement level of the building and in all mechanical / electrical rooms or spaces. RGS shall also be utilized where wiring is subject to damage.
 - 3. Electrical metallic tubing (EMT), with compression fittings, may be utilized in all other locations not specified above.
 - 4. The entire conduit system housing fire alarm cabling shall be red in color unless otherwise directed. Prepainted EMT conduit shall be as manufactured by Allied Tube and Conduit; or approved equal.
 - 5. All conduits, cabinets, and device back boxes shall be surface mounted unless otherwise specified, shown on the drawings, or directed by the Architect or Engineer.
 - a. Where accessible ceilings exist, conduits shall be concealed above the existing ceiling
 - b. Devices installed on accessible ceilings shall be flush mounted.
 - 6. Provide smoke detector above fire alarm control panel and each auxiliary power supply (if not shown on floor plans).

7. All spot type detectors shall be located on the suspended ceilings, except as noted. If suspended ceilings do not exist, the detectors shall be mounted on the slab.
8. All detectors shall be centered in the ceiling tiles and back boxes and conduits shall be recessed in areas with suspended ceilings. The back boxes and conduits for detectors on the slab shall be surface mounted with conduits run perpendicular/parallel to the walls.
9. All detectors shall be located at the highest point on the ceiling or slab except as specifically noted.
10. Exact location of all automatic detectors shall be as directed by the manufacturer's representative.
11. Smoke detectors shall not be located within three (3) feet of or in the direct air stream from supply air diffusers. Additionally, smoke detectors shall not be located within three (3) feet of return air grilles.
12. Automatic detectors shall not be mounted on or within three (3) feet of doorways, beams, columns, or walls, except smoke detectors at doors with door holders shall be mounted between two (2) and four (4) feet from the doors.
13. The Electrical Contractor shall furnish and install duct smoke detectors utilizing workmen skilled in appropriate trades. The Electrical Contractor shall provide all fire alarm wiring and interconnections. All power and/or control wiring required for the operation of smoke dampers or for the shutdown of air handling units shall be provided by this Contractor.
14. All manual stations located at egress doors shall be located adjacent to and within five (5) feet of the respective egress doors.
15. All detectors mounted on suspended ceilings shall be connected to pull boxes mounted on the slab with flexible conduit that shall be long enough to move the detector five (5) feet in any direction.
16. Detector bases shall be mounted on ceiling outlets so that indicator lamps are visible from the floor below, or from the nearest equipment aisle, or from the doorway entering the room, as applicable.
17. The conduit, device back boxes, pull boxes, terminal cabinets, panels and wiring as shown on the Fire Alarm System drawings shall be installed as shown. Device back box conduit size / wire fill shall comply with the National Electrical Code.
18. Provide white lamacoid nameplates on the ceiling grid with ¼ inch red letters to identify all above ceiling devices.
19. The fire detection and alarm system shall be operational at all times, except that when work is being performed on the system during normal working hours only those portions actually undergoing modification shall be out of service. All detectors in the construction area shall be bagged with plastic bags during the working hours and de-bagged after working hours.
20. At the end of each workday, and before workmen leave the site, proper operation of the system shall be demonstrated to the designated Owner's representative.

C. Installation – Wiring:

1. All alarm initiating devices and supervisory initiating devices shall be connected on Class B (Style 4) two-wire Signaling Line Circuits (SLC). Unsupervised wiring (point wires) shall not be permitted. T-tapping and parallel branch circuit wiring shall be permitted on the addressable SLCs, in accordance with the manufacturer's recommendations.
2. All alarm indicating devices shall be connected on Class B two-wire electrically supervised circuits and on a minimum of two active circuits.
3. Wiring to initiating and supervisory devices and to fire alarm annunciators shall be with two-conductor, twisted solid copper UL listed fire alarm system wire subject to manufacturer's recommendations (#16 AWG minimum).
4. Wiring to alarm indicating devices shall be with two-conductor twisted solid copper UL listed jacketed fire alarm system wire subject to manufacturer's recommendations (#14 AWG minimum).
5. All other wiring shall be as recommended by the system manufacturer.
6. No splicing of wires is permitted except on terminal blocks in annunciators, control panels or properly labeled terminal cabinets as shown on the drawings. The use of wire nuts or

similar type devices is not permitted. All devices shall have terminals for each wiring connection. No splicing of any type shall be permitted in pull boxes, to include crimp terminals.

7. All wires shall be labeled at both ends with 3/4" x 1-3/9" ScotchCode SWD Write-On Tape and SMP Write-On Marking Pen only.
8. Use plastic wire ties and wire tie mounts to ensure a neat quality appearance.

3.02 TESTS

- A. Prior to the acceptance test of the project by the Owner, a factory-trained technician from the equipment supplier shall inspect, test and adjust the complete Fire Alarm System according to NFPA-72, including, but not limited to, the following:
 1. Visual inspection of all equipment.
 2. Verification of alarm, supervisory and trouble signals at all receiving locations and circuits, including audible and visual alarms, annunciators, control panels, and central monitoring control panel.
 3. Test each alarm initiation device for alarm and correct annunciation.
 4. Test each alarm strobe light for proper operation.
 5. Test the sensitivity of each smoke detector with a manufacturer's detector test set (the fire alarm control panel shall be UL listed for this purpose). Retain a printed recorded of all firing voltages. Correlate firing voltage records to the device addresses as shown on the as-built drawings.
 6. Check all end of line devices for proper installation and polarity.
- B. All smoke detector sensitivity adjustments and tests shall be performed:
 1. From the Fire Alarm Control Panel with each detector in its exact operating location and not at some convenient place.
 2. Only under normal, balanced and completed maximum air flow conditions, with supply air systems constant and not undergoing balancing or other alterations, and air conditioning refrigeration systems operating properly.
 3. A complete printout showing all sensitivity readings shall submitted.
- C. After the system has been installed, the DACT shall be completely tested by the equipment manufacturer's representative for proper operation. A letter shall be provided to the Owner by the manufacturer's representative confirming the test, indicating their approval and that all zones are capable of being transmitted to and satisfactorily received by the central monitoring station.
- D. The Owner's acceptance test will only be made after the above tests are made and the copy of the NFPA 72 Test Report/Certificate results is turned over to the Owner for evaluation. The Owner's test will be the same as the above Contractor's tests. Demonstrate to the Owner that no wire nuts or similar devices have been used in the system. Perform these tests in the presence of the Owner or the Owner's representative.
- E. Per NFPA 72, submit to the owner, construction manager, and engineer – FIRE ALARM SYSTEM RECORD OF COMPLETION.
- F. Per NFPA 72, submit to the owner, construction manager, engineer, and Pennsylvania Department of Labor & Industry – FIRE ALARM SYSTEM INSPECTION & TESTING. This form must be accepted with no exceptions.

3.03 FIELD ADJUSTMENTS

- A. Repair or replace at his expense any defective devices, equipment or wiring and perform additional testing required to demonstrate that the system is in full compliance with the drawings and specifications.
- B. The cost of any re-testing as a result of the failure of the system to operate in accordance with these specifications and/or non-compliance with the drawings or applicable codes shall be paid by the Contractor to the Owner. A purchase order shall be delivered to the Owner before the re-testing is scheduled or started.

3.04 TRAINING

- A. Upon the completion of all work and of all tests, furnish the necessary skilled labor for providing operating instructions of all systems and equipment for a period of one (1) day of eight (8) hours for each building or as otherwise directed. During this period, instruction will be given to the owner or his representative(s) in the full operation, adjustment and maintenance of all equipment furnished or provided.
- B. The contractor will provide video taping of all the training, and three (3) copies of the training on a DVD to the owner.

END OF SECTION