

SECTION 16010 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The General Conditions, Supplementary General Conditions, and Special Conditions of this Contract form a part of this Division of Specification.
- B. This section forms a part of all sections under Division 16 Electrical.
- C. Requirements herein augment or clarify articles specified under aforementioned General and Special Conditions.

1.2 QUALIFICATIONS FOR BIDDERS

- A. Before submitting bid, visit the site and examine all adjoining existing equipment and space conditions on which work is in any way dependent, for the best workmanship and operation according to the intent of specifications and drawings. Report to the Engineer any condition which might prevent the installation of the equipment in the manner intended.

1.3 CODES AND STANDARDS

- A. Latest effective publications of following standards, codes, etc., as they apply, form part of these specifications as if were written fully herein and constitute minimum requirements. Minimum requirements shall not relieve the Contractor of the responsibility of furnishing and installing higher grade materials and workmanship than herein specified. The following will be referred to throughout in abbreviated forms.
 - 1. National Electrical Code, (NFPA 70) (NEC)
 - 2. Standard Rules of Institute of Electrical and Electronic Engineers (IEEE)
 - 3. Rules and Regulations of Local Electric Utility Company
 - 4. Applicable Standards of the National Electrical Manufacturer's Association (NEMA)
 - 5. Applicable Standards of the American National Standards Institute (ANSI)

6. Applicable Local Codes
7. 2009 North Carolina Building Code
8. Applicable Standards and Lists of the Underwriter's Laboratories, Inc. (UL)
9. Applicable Standards of the National Fire Protection Association (NFPA)
10. International Building Code (IBC)
11. The Americans with Disabilities Act (ADA)
12. International Electrical Testing Association (NETA)

1.4 SCOPE OF WORK

- A. Provide all work required for this Division including all labor, materials, equipment, appurtenances and services to provide complete electrical systems as shown on the drawings and specified in this Division of the specifications. The word "Provide" shall mean "Furnish and Install Complete and Ready for Use". The work includes, but is not limited to the following:
 1. Interior and exterior electrical lighting system including fixtures, lamps, time switches, photoelectric cells, contactors and other control devices and equipment.
 2. Power wiring system, including outlets, receptacles, switches, wire, conduit, junction boxes, panelboards and new electric service.
 3. Disconnect switches and power wiring up to and including motor connections for all equipment provided under other Divisions of this specification shall be included in this Division. Where manual motor control switches for single phase motors are indicated, they shall be provided and wired complete under this Division. Motor controllers and motor starters furnished under other Divisions shall be set in place and connected to source and load under this Division. In general, motors will be provided with the equipment they drive and are not part of this work under this Division, except that they shall be connected hereunder.

4. System of cables, empty conduits, cabinets and outlets for telephone, computer and other communication systems.
5. Fire Alarm System and control center.
6. Exit and emergency lighting systems.
7. Emergency Generator System.
8. Temporary Construction Power and Lighting.

B. The following work is not included in this Division:

1. Heating, ventilating, and air conditioning equipment and all associated motors and magnetic motor starters.
2. Plumbing equipment except as specifically indicated.
3. Control, interlock, and internal equipment wiring regardless of voltage.
4. Cable, terminals, instrument wiring, and instruments for telephone, computer and other communication systems unless specifically addressed by other sections of the specification.

1.5 DRAWINGS AND SPECIFICATIONS

- A. The drawings are diagrammatic and indicate the general extent, character and arrangement of equipment, fixtures and conduit and wiring systems. If any departures from the contract drawings are deemed necessary, submit details of such departures and the reasons therefore as soon as practicable after award of contract to the Engineer for approval. Make no such departures without prior written approval of the Engineer.
- B. It is the intention of these specifications and drawings to fully cover all work and materials for a complete, first-class electrical installation, and any devices such as pull boxes and disconnect switches, usually employed in this class of work, though not specifically mentioned or shown on the drawings or in this specification, but which may be necessary for the satisfactory completion of the work, shall be furnished and installed by the Contractor as a part of his total work under this Division. Consult the specifications and drawings of all other trades and perform all electrical work required therein. Cooperate with all other contractors or subcontractors to furnish complete workable systems.

- C. In case of conflicting information on the drawings and/or in the specifications, the proper interpretation shall be made by the Engineer.
- D. Disagreements occurring between trades covering various phases of the work shall be referred to general Contractor for final decision.
- E. Changes and additions to scope of the work under this contract shall be submitted to the Engineer and his written approval obtained before proceeding with the changed work.
- F. During construction, the Electrical Subcontractor shall keep an accurate record of all deviations between the work as shown on the contract drawings and that which is actually installed. He shall secure a set of blue line prints of the electrical drawings for this purpose, and note changes thereon with red marks, in a neat and accurate manner, thus making a complete record of all changes and revisions in the original design which exist in the completed work. The cost of furnishing above prints and preparing these record drawings shall be borne by the subcontractor, and shall be included in the contract price. When all revisions have been shown on these prints to indicate the work as finally installed, the prints shall be delivered to the Engineer, before final payment.

1.6 PERMITS, INSPECTION AND TESTS

- A. The right is reserved to inspect and test any portion of the installation/equipment during the progress of its erection. Test all wiring for continuity and grounds before connecting any fixtures or devices. Perform insulation resistance tests on wiring #6 or larger. Test the entire system when the work is finally completed to insure that all portions are free from short circuits and grounds. Provide all equipment necessary to conduct the above tests.
- B. Secure and pay for all required permits and inspections. Inspection certificates from local authorities having jurisdiction shall be delivered to the Owner before final payment.

1.7 SUBMITTALS

- A. Submit Shop Drawings, Product Data and Samples within thirty (30) days of award of contract and in accordance with the General Conditions and Supplementary Conditions. Review of submittals by the Engineer and any associated action taken by the Engineer does not relieve the contractor of any requirements set forth by the contract documents. Submittals are required for the following items if and only if those items are specified herein.

1. Panelboards
2. Circuit Breakers
3. Lighting Fixtures and Occupancy Sensors
4. Surge Protection Device (SPD)
5. Back-up Power System
6. Fire Alarm System
7. Any Special Systems as specified herein (i.e. Access Control, CCTV, etc.)

B. Submittals shall contain:

1. The date of submission and of any previous submissions.
2. The project title and number.
3. Contract or project identification.
4. The names of:
 - a. Contractor.
 - b. Supplier.
 - c. Manufacturer.
5. Identification of the product, and specification section.
6. Field dimensions, clearly identified as such.
7. Relation to adjacent or critical features or materials.
8. Applicable standards.
9. Identification of deviations from Contract Documents.
10. Identification of non-complying features and reason for the non-compliance. The reason shall be specific in nature.

11. Identification of revisions on resubmittals.
12. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.

C. SUBSTITUTIONS

1. For a period of 10 days after Contract date, Engineer will consider written requests from Contractor for substitution of products.
2. Submit a separate request for each product, supported with complete data, with drawings and samples as appropriate, including:
 - a. Comparison of the proposed substitution with that specified.
 - b. Changes required elsewhere because of the substitution.
 - c. Effect on the construction schedule.
 - d. Cost comparison of the substitution and product specified.
 - e. Availability of maintenance service, and replacement parts.
3. The Engineer shall be the judge of the acceptability of the proposed substitution.
4. A request for a substitution constitutes a representation that the Contractor:
 - a. Has investigated the proposed product and determined that it is equal to or superior in all respects to that specified.
 - b. Will provide the same warranties or bonds for the substitution as for the product specified.
 - c. Will coordinate the installation of an accepted substitution into the work, and make such other changes as may be required to make the work complete in all respects.

- d. Waives all claims for additional costs, under his responsibility, which may subsequently become apparent.

PART 2 - PRODUCTS

2.1 MANUFACTURING STANDARDS

- A. Materials shall be new and approved and labeled by UL wherever standards have been established by that agency. Defective equipment or equipment damaged in the course of installation or test shall be replaced or repaired in a manner meeting the approval of the Engineer. Materials to be furnished under this specification shall be the standard products of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design. All items of the same type and rating shall be identical.

2.2 TRADE NAMES

- A. Unless specifically identified otherwise, manufacturers' names and catalog numbers indicated herein and on the drawings are not intended to be proprietary designations. They are to indicate general type and quality of materials and equipment required. Equipment and materials by other manufacturers which in the opinion of the Engineer are of equal quality and which will produce the same results with regard to both their ability to perform the required technical functions as well as to their appearance in the specific location on this project will be considered.

2.3 MOTORS AND EQUIPMENT

- A. All motors shall have disconnecting means, controller and thermal overload protection. All three phase motors shall have power loss, phase outage, and phase reversal protection features.
- B. Provide motors, controllers, integral disconnects, and contactors with their respective pieces of equipment. Motors, controllers, integral disconnects, and contactors shall conform to the requirements defined under the electrical provisions of the specifications. Extended voltage range motors shall not be permitted. Control voltage for controllers and contactors shall not exceed 120 volts nominal. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

- C. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment under the electrical provisions of the contract. Control wiring and conduit shall be provided under the section specifying the associated equipment. Wiring and conduit for power systems and control systems shall conform to the requirements defined under the electrical provisions of the specifications.

2.4 ELECTRICAL SERVICE

- A. Provide the electrical service as indicated. All arrangements shall be as indicated with proper extension, terminations, provisions and necessary materials for final connections by the local power company. Service and all metering shall be provided in accordance with the latest regulations of the local power company. The local power company may provide the meter and current transformers and may participate in the cost of supplying service to the building. Consult the local power company and determine limit of this participation. The bid on electrical work shall reflect this participation except that any charges which the local power company proposes to make for supplying service will be paid directly by Owner and will not be part of this contract.
- B. Short circuit ratings for all panelboards, main disconnect switches, etc. shall be suitable to accommodate the Power Company's available fault current.

2.5 TEMPORARY ELECTRICAL SERVICE

- A. Provide temporary electrical service at 240/120 volts, 60 Hertz, 1-phase, 3-wire, with solidly grounded neutral on the building site during construction until permanent service is activated. Make all necessary arrangements with the local power company for this temporary service. General Contractor will pay all charges which may be made by the local power company.

2.6 GROUNDING

- A. The entire electrical system, including equipment frames, conduit, switches, controllers, wireways, neutral conductors, and all other such equipment shall be permanently and effectively grounded in accordance with the NEC. Ground rods shall be copper clad steel, 3/4" diameter by 10'-0" long. Grounding of each transformer secondary shall be provided and each shall be considered as a separate service ground. Provide a separate ground conductor in all branch circuit conduits sized in

accordance with the N.E.C. Provide minimum #6 ground conductor in conduit from the building main service ground to the telephone backboard.

PART 3 - EXECUTION

3.1 SCHEDULE OF WORK

- A. The schedule of the electrical work shall be arranged to suit the progress of work by the other trades and shall in no way retard progress of construction of the project.
- B. Work under this Division shall proceed in advance of the work of others whenever possible, eliminating all cutting and patching. When such procedure is impossible, cutting and patching shall be done in an approved manner. Cutting shall not endanger structural integrity in any way. Patching shall exactly match contiguous work. Actual work of cutting and patching of existing surfaces shall be performed by the subcontractor who originally prepared these surfaces, e.g., cutting and patching of masonry wall will be performed by the masonry subcontractor. Costs of such cutting and patching shall be borne by the Electrical contractor. Cutting shall be carefully done and damage to building, piping, wiring or equipment as a result of cutting shall be repaired by skilled mechanics of trade involved.

3.2 STORAGE AND MATERIALS

- A. Space will be assigned to the Contractor by the Owner for the storage of materials. This Contractor will be responsible for the protection and safekeeping of materials, tools, and equipment. All materials and equipment shall be kept in its assigned place until the time of its installation. Excess materials, dirt and refuse shall be promptly removed from the work site.

3.3 LABELING OF EQUIPMENT

- A. All panelboards, cabinets, transformers, safety switches, motor disconnect switches, and motor controllers shall be identified by machine engraved laminated plastic designation plates permanently attached thereto with self-tapping screws or rivets. All component parts of each item of equipment or device shall bear the manufacturer's nameplate, giving name of manufacturer, description, size, type, serial and model number and electrical characteristics in order to facilitate maintenance or replacement. The nameplate of a subcontractor or distributor will not be acceptable. Self-adhesive, plastic laminate labels are not acceptable.

- B. All panelboards, industrial control panels, and motor control centers shall be field marked to warn personnel of the potential for Arc Flash. Labels shall state “WARNING – ARC FLASH AND SHOCK HAZARD APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT (PPE) REQUIRED”.

3.4 OTHER TRADES

- A. Excavation shall be performed in accordance with the section of these specifications which cover excavating, filling and backfilling.
- B. Concrete work shall be performed in accordance with the section of these specifications which cover concrete.
- C. Painting shall be performed in accordance with the section of these specifications which cover painting. Paint all exposed conduit as well as cabinets and related items which are not supplied with a factory finish. Touch up all factory finishes damaged during installation or by adjacent construction work.

3.5 COORDINATION

- A. Cooperate and coordinate efforts with all Contractors on the project. This is especially important in determining exact locations of all switches, receptacles and lighting fixtures. Arrange lighting fixtures in accordance with the architectural reflected ceiling plans unless otherwise indicated. Coordinate lighting fixture locations with grilles, diffusers, access panels, etc. Verify ceiling and wall construction and material prior to ordering lighting fixtures or other devices to ensure proper fixture or device is furnished to match construction. This verification must be executed regardless of information placed on the drawings. Any cost incurred which in the opinion of the Engineer, could have been avoided by this step shall be the responsibility of the Contractor. Coordinate switch locations with thermostats, control switches, etc.
- B. Carefully check space requirements with the other subcontractors to insure that electrical equipment can be installed in the spaces allotted for them. Sufficient access and working space shall be provided and maintained about all electrical equipment as required by the National Electrical Code. Consult all applicable drawings for details. Where interferences occur and work must be relocated, relocate without additional cost.
- C. No conduit, outlet box, conduit stub-up, or any other electrical devices shall be installed until the exact location has been determined by the

coordinated effort of all Subcontractors and other parties concerned. Any relocating of devices or cutting or patching which becomes necessary due to improper coordination shall be done at this Contractor's expense.

- D. Determine electrical requirements of other Divisions in order to fully understand wiring, and provide as required for complete and satisfactory operation of project. Make connections for other Divisions where indicated.
- E. Obtain approved shop drawings showing wiring diagrams, connection diagrams, roughing-in and hookup details, from other involved contractors for all equipment and comply therewith.

3.6 GUARANTEE OF WORK

- A. Contractor guarantees by his acceptance of the contract that all work installed is free from any and all defects in workmanship and/or materials, and that the apparatus will develop capacities and characteristics specified, and that if, during the period of one year or as otherwise specified, from date of certificate of completion and acceptance of the work any such defects in workmanship, material or performance appear, he will, without cost to the Owner, remedy such defects within a reasonable time to be specified in notice from Engineer. In default thereof, the Owner may have such work done and charge cost to Contractor. Equipment guarantees from date of "start-up" will not be recognized.
- B. Comply, also, with the General Conditions and the Supplementary Conditions and the applicable Sections of Division 1 General Requirements.
- C. Provide service for the installation for one year from date of final acceptance. This shall include all emergency service and adjustment. Provide evidence upon request by the Engineer that a factory authorized local service organization is in existence to service and furnish spare and replacement parts for all equipment under this Division of the specifications.
- D. Compile and assemble and provide all shop drawings, maintenance manuals, operation manuals and warranties in a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

3.7 CLEANING

- A. Refer to the Division 1 Section "PROJECT CLOSEOUT" or "FINAL CLEANING" for general requirements for final cleaning.

- B. Clean all light fixtures, lamps and lenses prior to final acceptance.
Replace all inoperative lamps.

END OF SECTION

SECTION 16210 - RACEWAY, FITTINGS AND BOXES

PART 1 - GENERAL

- 1.1 Provide raceways and fittings for all electrical and related systems where indicated, specified or required to form continuous raceways from the various service entrances to the various outlets.
- 1.2 Provide each outlet in the raceway system with an outlet box to suit the conditions encountered. Each box shall have sufficient volume to accommodate the number of conductors and conduits entering the box.
- 1.3 All wiring shall be in conduit. As an exception, metal-clad type MC cable shall be allowed for branch circuits #8 AWG and smaller, where allowed by the NEC.

PART 2 - PRODUCTS

2.1 RACEWAYS

- A. Conduit shall be hot-dipped, zinc coated or sherardized rigid steel (RS), intermediate metal conduit (IMC), electrical metallic tubing (EMT), or schedule 40 polyvinyl chloride (PVC).
- B. Flexible conduit shall be galvanized, continuous spiral, single strip type. Flexible conduit shall be covered with PVC jacket in wet or damp locations. Provide suitable fittings with ground connector.
- C. Surface metal raceway system shall be WIREMOLD 2000. It shall consist of an 0.040 inch thick formed steel assembly and an 0.025 inch thick steel, snapping cover plate. Finish shall be enamel inside and out over a corrosion-resistant metal treatment undercoat. Colors shall be custom to match adjacent surfaces. Surface metal raceway shall be complete with end caps, coupling devices, wire clips, device plates, box connectors and accessories.

2.2 FITTINGS

- A. All conduit entering or leaving outlet, junction or pull boxes, and cabinets and all conduit stubs shall have bushings. Provide insulating bushings where required by NEC.
- B. Provide expansion fittings with bonding jumper where conduits cross expansion joints.

- C. Fittings for RS and IMC shall be threaded type.
- D. Fittings for EMT shall be threadless, approved for the conditions encountered and may be cast setscrew type or compression type.
- E. Fittings for PVC shall be PVC, primed and glued.
- F. Provide insulating wedge type cable supports in riser conduits in multi-story buildings.

2.3 SLEEVES

- A. All electrical system conduit shall have sleeves where conduit passes through concrete slabs except concrete slabs in contact with grade. All conduit 1 1/4 inch and larger running concealed above ceiling shall have sleeves where the conduit passes through masonry, tile and gypsum wall construction. All conduit running exposed below ceiling or in area without finished ceiling construction and passing through masonry concrete, tile and gypsum wall construction shall be provided with sleeves.
- B. Sleeves shall be constructed of galvanized steel pipe, Schedule 40.
- C. Provide escutcheon plates for all exposed conduit passing through walls, floors and ceilings. Plates shall be nickel plated, of the split ring type of size to match the pipe or conduit. Where plates are provided for conduits passing sleeves which extend above the floor surface, provide deep recessed plates to conceal the sleeves.

2.4 OUTLET BOXES AND JUNCTION BOXES

- A. Outlet boxes shall be pressed steel, electro-galvanized or cadmium plated with clean cut, easily removable knockouts. Except as noted hereinafter minimum size outlet box shall be 4" square, 1 1/2" deep, and shall be increased in dimensions to accommodate conductors, conduits, and devices as required by the NEC. Shallower boxes may be used where required by structural conditions and when specifically approved by the Architect/Engineer. Provide suitable plaster-rings to match wall construction and device. Ceiling and bracket outlet boxes shall not be less than 4" octagonal, 1 1/2" deep except that smaller boxes may be used where required by particular fixture to be installed.
- B. Floor boxes shall be manufactured by Walker, and shall be of the rectangular cast iron type, fully adjustable, and shall be provided with all

necessary carpet rings and other fittings as required. All floor boxes shall be of the maximum depth possible for the locations indicated.

- C. Non metallic outlet boxes may be provided in PVC raceway systems.
- D. Outlet boxes in wet or damp locations shall be cast-metal, threaded hub-type with gaskets.
- E. Outlet boxes in masonry-block or tile walls shall be square-cornered masonry-type with tile type covers.
- F. Junction or pull boxes not over 100 cubic inches in volume shall be standard outlet boxes. Junction boxes over 100 cubic inches in volume shall be constructed of code gage, galvanized sheet steel. Junction boxes shall have removable covers and shall be accessible after completion of buildings.

2.5 CABINETS

- A. Cabinets shall be zinc-coated sheet steel, constructed with interior dimensions not less than those indicated on drawings, arranged for flush or surface mounting as indicated. Removable trim shall be provided with a hinged door and flush latch and lock. Locks shall be keyed same as panelboards.

2.6 ACCESS PANELS

- A. This Contractor shall furnish and General Contractor shall install access doors where required for electrical access, style as necessary for surface in which placed, sized as required, with cylinder lock. Interior doors shall be steel and exterior doors shall be aluminum. Access doors shall have same fire rating as ceiling, walls and/or partitions in which they are to be installed.

PART 3 - EXECUTION

3.1 RACEWAY AND FITTING INSTALLATION

- A. Conduits within building shall be GRS, IMC or EMT unless otherwise noted. Run conduits concealed within finished walls, ceilings and floors where possible, except where indicated on drawings to be run exposed. In addition, conduits may be run exposed in mechanical rooms and spaces with exposed construction when approved by the Engineer. Conduit shall be supported at intervals of not more than 8'. Run exposed conduit

parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceiling. Conduit in areas with suspended ceilings shall be located when practicable between the structural system and the ceiling. All conduit to be run under the floor shall be run under the slab. Conduit shall not be run in the floor slab, except as required to feed floor boxes. Do not stack conduits beneath slab. Changes in direction of runs shall be made with symmetrical bends or cast metal fittings.

- B. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways.
- C. Support conduits by pipe straps, wall brackets, strap hangers, or ceiling trapeze.
- D. Conduit run outside of building shall be buried a minimum of 24" below finished grade.
- E. Do not install EMT outdoors, or underground, or encased in concrete, or in hazardous areas, or in areas subject to severe physical damage.
- F. Do not install PVC in or through fire rated assemblies, in or through any walls, in or through any ceilings, in hazardous areas, in areas subject to severe physical damage, or exposed anywhere in the project.
- G. Conduit run underground, under slab, or within concrete encasement may be polyvinyl chloride (PVC) or RS or IMC conduit protected with 2 coats of bitumastic paint at the Contractor's option, unless another specific type of conduit is indicated. Convert PVC to RS or IMC before rising through floor slab or rising out of soil where conduit will be exposed. Where conduit is to be concealed within a wall, PVC may be stubbed up to the first outlet box or panelboard back-can. All conduit from that point on shall be metallic. Conduit run beneath slab shall be properly suspended from slab such that sub-slab settlement will not adversely affect electrical system.
- H. Service entrance conduits shall be concrete encased PVC or direct-buried RS.
- I. Flexible conduit shall be used to connect all motors, transformers and all equipment subject to vibration.

3.2 SLEEVE INSTALLATION

- A. Check floor and wall construction and finishes to determine proper length of sleeves for various locations. Make actual lengths to suit the following:
 - 1. Terminate sleeves flush with wall, partitions and ceilings.
 - 2. In areas where conduits are concealed, as in chases, terminate sleeves flush with floor.
 - 3. In finished areas, where conduits are exposed, extend sleeves 1/2 inch above finished floor, except in rooms having floor drains extend sleeves 1 inch above floor.
- B. Fasten sleeves securely in floors and walls, so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials being forced into the spaces between conduit and sleeve during construction.
- C. Where sleeves pass through floors or fire rated walls provide proper sealant around conduit to maintain fire rating.

3.3 BOX INSTALLATION

- A. Support boxes for fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

END OF SECTION

SECTION 16220 - CONDUCTORS

PART 1 - GENERAL

- 1.1 Provide a complete system of conductors as indicated or necessary to accomplish the required connections. All conductors shall be installed in a neat and workmanlike manner, with care being taken that conductors are not kinked, scarred, or damaged during installation.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND INSULATION

- A. Wire and cable shall be soft drawn, annealed copper with 600 volt insulation. Minimum wire size shall be #12 AWG. Insulation for conductor sizes #12 and #10 shall be type THHN-THWN, THW or RHW for installation in ordinary dry locations and type THWN or RHW-2 for installation in wet locations. Wet locations shall include service conduits, conduit underground, raceways installed in concrete floor slabs in direct contact with the earth and raceways regularly subject to moisture or condensation. Conductors sizes larger than #10 shall have type XHHW-2 insulation. Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote-control and signal circuits, classes 1, 2, and 3, may be stranded.
- B. Branch circuit conductors in fluorescent fixture raceways and drops to single fluorescent fixtures shall be type THHN or XHHW.
- C. Provide a separate ground conductor in all raceways sized in accordance with the N.E.C.

2.2 COLOR CODING

- A. All branch circuit, feeder and control wiring shall be color coded in accordance with NEC. Color shall be integral with sheath for sizes 12 through 8. Provide minimum 1/2 inch wide color coded plastic tape strips for conductors size 6 and larger. Strips shall be placed minimum 6 inches on center in all panelboards, junction boxes, pull boxes, conduit fittings, disconnect switches and anywhere the conductors are accessible and visible. Wire shall be color coded as noted below. All other conductors shall be of other colors. Color schedule shall be as follows:

208/120 Volt System

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green

2.3 JOINTS AND TERMINATIONS

- A. Leave at least 6 inches of free conductor in each outlet- or junction- box for making up joints and making connections to fixtures, devices or equipment.
- B. For conductors #12 and #10 all fixture and branch circuit joints in junction and outlet boxes shall be made with UL listed pressure type connectors rated at 600 volts and 105 degrees C. Connector body shall consist of a cone-shaped, expandable, square-edged, coil-spring insert, insulated with a color-coded, self-extinguishing nylon shell with two wings placed opposite to each other to serve as a "built-in" wrench. Shell shall be molded of one piece. Connectors shall be IDEAL INDUSTRIES "Wing-Nut" or BUCHANNAN "B-CAP", 3M "SCOTCH-LOK" connectors or equal. Wire #8 and larger shall be joined or terminated with solderless pressure connectors properly taped in layers to form a moisture-tight joint.

PART 3 - EXECUTION

3.1 CONDUCTOR INSTALLATION, GENERAL

- A. Conductors shall be continuous from outlet to outlet, and no splices shall be made except within outlet or junction boxes. Junction boxes shall be provided where required. Home runs may be combined in one conduit, provided all connections are in accordance with NEC requirements and the maximum unbalanced current in the neutral does not exceed the capacity of the conductor. All parallel feeder runs shall be laid out and cut to exact same lengths before pulling into conduits to insure load balance. No additional trimming of parallel conductors will be accepted. Conductors #8 and smaller shall be pulled by hand and without aid of block and tackle or other mechanical device. Only approved equipment for pulling conductors shall be used for #6 and larger conductors. Only approved pulling compounds which will in no way damage the insulation on the conductors or hasten its aging may be used to facilitate pulling of

wire into conduit. Circuiting shown shall be followed unless specific changes are approved by the Engineer.

- B. Where several feeders pass through a common pull box or junction box, the feeders shall be tagged to indicate clearly their electrical characteristics, circuit number, and panel designation. This same information shall be permanently marked on cover of the box.
- C. All conductors shall be in conduit unless otherwise indicated or allowed.
- D. All conductors and cables shall be labeled.

END OF SECTION

SECTION 16230 - WIRING DEVICES

PART 1 - GENERAL

- 1.1 Provide wiring devices complete with all necessary trim rings or wall plates as shown or as required.

PART 2 - PRODUCTS

- 2.1 Wiring devices shall be as manufactured by LEVITON, ARROW-HART, BRYANT, HUBBELL or PASS & SEYMOUR. All wiring devices provided on this project shall be by the same manufacturer and shall be "specification grade".
 - A. Local switches shall be single pole, double pole, three way and four way as shown on the drawings, black plastic cup with red plastic cover and white plastic handle, back or side wired, 20 ampere, 120-277 volts.
 - B. Duplex convenience receptacles shall be white plastic, 20 ampere, 125 volts, 2 pole, 3 wire NEMA and ASA Standard, grounding type.
 - C. Weatherproof receptacles shall be in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Caps shall be provided with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations."
 - D. Ground fault circuit interrupting receptacles shall conform to NEC, shall be UL listed, white plastic, shall have a "push-to-test" button and visible indication of a tripped condition, and shall detect a current imbalance in device or equipment plugged-in of approximately 5 milliamperes and trip out under that condition.
 - E. Special devices shall be as shown on drawings.
 - F. Device plates on unfinished walls and on fittings, shall be zinc-coated sheet steel having rounded or beveled edges. On finished walls, plates shall be satin finished type 302, Alloy 18-8 stainless steel with beveled edges. Plates shall be of one piece type to suit device or devices covered. Sectional plates will not be permitted. Junction boxes in finished areas shall have blank satin finish stainless steel plates as specified above. Telephone outlets in finished areas shall have satin finish stainless steel plates, as specified above, with single bushed hole in center. Screws shall be machine-type with countersunk heads in color to match finish of plate.

- G. Time Switches shall be TORK, INTERMATIC, SANGAMO or equal with contact arrangement as indicated or as necessary to operate devices indicated including electrically held or mechanically held devices. Provide astronomical dial and omitting device.
- H. Contactors shall be electrically operated and electrically-held or mechanically-held if indicated, of NEMA size and other characteristics as shown; in enclosure with hand-off-automatic switch in cover. Mechanically held contactors shall have integral coil clearing contacts.
- I. Photocell switch shall be hermetically sealed cadmium-sulfide cell with single pole double-throw (SPDT) contacts for control of mechanically held contactors rated 1000 watts and 120 volts. Provide switch in a high-impact-resistant noncorroding and nonconductive molded plastic housing with a locking-type receptacle. Switch shall turn on below 3 footcandles and off at 3 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Aim switch according to manufacturer's recommendations.

PART 3 - EXECUTION

- 3.1 Devices shall be installed in a rigid manner in outlet boxes. Device plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed vertically and with an alignment tolerance of 1/16 inch.
- 3.2 GROUND-FAULT RECEPTACLE TEST
 - A. Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

END OF SECTION

SECTION 16250 - SAFETY SWITCHES

PART 1 - GENERAL

- 1.1 Provide safety switches wherever shown and whenever required whether specifically shown or not.

PART 2 - PRODUCTS

2.1 SWITCHES

- A. Safety switches shall be rated at 240 volts as required for voltage of system with number of poles and current rating as indicated. Switches shall be fused or non-fused type as indicated, NEMA type GD or HD as required, with full cover interlocks and quick-make, quick-break mechanism.
- B. All fused switches shall be provided complete with fuses and shall have horsepower ratings when serving motor loads.

2.2 FUSES

- A. All fuses 600 amperes and below shall be true dual-element time delay fuses with separate spring-loaded thermal overload elements in all ampere ratings. All ampere ratings shall be designed to open at 400 degrees Fahrenheit or less when subjected to a non-load oven test. RK-1 fuses shall be Littelfuse fuses, type LLN-RK or LLS-RK. RK-5 fuses shall be Littelfuse "Slo-Blo" fuses, type FLN-R or FLS-R. Fuses shall be sized as indicated on the drawings or as required by the equipment provided, whichever provides maximum protection.

PART 3 - EXECUTION

- 3.1 Switches shall be securely mounted to wall, structure or equipment. Provide miscellaneous accessories for mounting switches, including steel angles or channels where required.

- 3.2 Spare fuses. At the completion of the project the contractor shall deliver to the Owner (and obtain receipt for) spare fuses of each size and type equal to 20 percent of the number installed but not less than 3 or more than 9 of any size and type.

END OF SECTION

SECTION 16255 - ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

- 1.1 Provide enclosed circuit breakers with ratings as indicated.

PART 2 - PRODUCTS

2.1 CIRCUIT BREAKERS

- A. Circuit breakers shall be molded case type having over-center, tripfree, toggle-type operating mechanisms with quick-make, quick-break action and positive handle indication. Two and three-pole breakers shall be common trip. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole. The circuit breaker shall be constructed to accommodate the supply connections at either end. Circuit breaker operating handles shall assume a center position when tripped.
- B. Breakers shall have removable lugs. Lugs shall be UL listed for copper and aluminum conductors. Breakers shall be UL listed for installation of mechanical screw type lugs or crimp lugs.
- C. Neutral bars shall be furnished for circuit breakers as indicated. Neutral bars shall be insulated and be groundable for use in service equipment applications. Neutrals shall have same current rating as circuit breaker.

2.2 ENCLOSURES

- A. Enclosures shall be the NEMA type indicated on the plans.

PART 3 - EXECUTION

3.1 CIRCUIT BREAKERS

- A. Circuit breakers shall be securely mounted to wall, structure or equipment. Provide miscellaneous accessories for mounting switches, including steel angles where required.

END OF SECTION

SECTION 16310 - PANELBOARDS

PART 1 - GENERAL

1.1 PANELBOARDS

- A. Panelboards shall be provided with number and size of mains and branch circuits as shown on drawings, shall be mounted as indicated and shall have incoming lugs arranged to receive the conductors shown. Panelboards shall conform to latest UL and NEMA standards and shall bear UL labels.

PART 2 - PRODUCTS

2.1 PANELBOARDS

- A. Panelboards shall be dead-front, circuit breaker type equipped with single, double, or three pole thermalmagnetic quick-make, quick-break trip-free on overload or short circuit alternating current circuit breakers with trip ratings and frame size as shown on the drawings.
- B. Main and branch circuit breakers shall provide inverse time delayed tripping on overloads and instantaneous tripping on short circuits. Trip indication shall be clearly shown by the breaker handle taking position between ON and OFF when the breaker is tripped. Double and three pole breakers shall be common trip type. HACR type circuit breakers shall be provided for all circuits serving mechanical equipment.
- C. Bussing shall be such that any three adjacent single-pole breakers are individually connected to each of the three different phases in such a manner that two to three-pole breakers can be installed at any location. All current-carrying parts of the bus assembly shall be plated.
- D. Sub-feed breakers are acceptable, however, if used must be clearly labeled on front panel and on interior of panel enclosure with machine engraved label mechanically attached.
- E. Where a “space, space-only, or provision” is indicated on the drawings or elsewhere, the “space, space-only, or provision” shall be “fully equipped” and ready for the direct insertion of a circuit breaker. Additional hardware, bus extension kits, strap kits, and so forth shall not be required in order to properly add a circuit breaker to a designated “space”.

- F. Each panelboard shall be provided with a hinged cover with a flush latch and lock with two keys and keyed the same as all other panelboards.
- G. Each panel shall be equipped with typewritten directory card, card holder, transparent protection and complete identifying data on inside of door. Each circuit shall be identified specifically with load and location spelled out on the directory, i.e. "lighting Rooms 204, 206, 208" - (not merely "lighting"). Room numbers shall match Owner's final signage designations, and not the numbers shown on contract drawings, as they are often different.
- H. Provide an isolated neutral bus for each panel for connection of both feeder and branch circuit neutral wires. Neutral bus shall have same current ratings as panel mains.
- I. Provide a separate equipment ground bus, bonded to the steel cabinet for each panel for connection of all ground wires and mark with a green stripe along the front of the bus. Equipment ground bus shall have same rating as panel mains.
- J. Ground fault circuit interrupting breakers shall be sized as indicated, shall conform to NEC, shall be UL listed, shall have a "push-to-test" button and visible indication of a tripped condition, and shall detect a current imbalance of approximately 5 milliamperes.
- K. Circuit breakers shall have 100% AIC rating (no series ratings allowed), unless stated otherwise on drawings.
- L. Panelboards shall be equal to SQUARE-D, Type NQOD, NF, or I-LINE (HCN, HCM, HCP, HCW, HCWM, HCP-SU, HCR-U), or equal products by Cutler Hammer or Siemens.

PART 3 - EXECUTION

3.1 PANELBOARDS

- A. Panelboards shall be so mounted that operating handle of top breaker is not more than 78" above the floor. Load on each panel shall be divided as evenly as possible between the phases in the panel.

END OF SECTION

SECTION 16323 - MOTORS AND MOTOR CONTROL

PART 1 - GENERAL

1.1 GENERAL

- A. Provide motors, motor controllers and motor control systems as required to serve all motorized equipment.
- B. See the general requirements defined in Section 16010 "ELECTRICAL GENERAL PROVISIONS", the paragraph entitled "MOTORS AND EQUIPMENT".

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Motors: Motors shall comply with NEMA MG 1; hermetic-type sealed motor compressors shall also comply with UL 984. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.
- B. Motor Sizes: Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.
- C. Motor Controllers: Motor controllers shall comply with UL 508, NEMA ICS 1, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position.

Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in “hand” and “automatic” positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer’s approved wiring diagram. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case.

- D. Control Circuits: Control circuits shall have maximum voltage of 120 volts. The circuit may be derived directly by use of the neutral conductor in 120/208V, 3-phase, 4-wire electrical systems; or shall be derived from control transformer in same enclosure. Transformers shall conform to UL 506. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. Provide fuses in each ungrounded primary feeder. One secondary lead shall be fused; other shall be grounded.
- E. Manual Motor Starters and Motor Rated Switches: Provide number of poles indicated. Provide motor overload protection when specifically indicated on the drawings or where required by the NEC and in conjunction with the actual motor type provided. Voltage and amperage ratings shall be coordinated with the actual electrical systems and motor loads connected. Provide surface mounted enclosures in utility type spaces and flush mounted enclosures in finished rooms. (Coordinate with concealed conduit requirements.)
- F. Miscellaneous Features: Enclosures shall be specifically approved for the environments in which they are installed and shall comply with NEMA ICS 6. Pushbutton stations shall have “start/stop” momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design. Pilot and indicating lights shall be transformer, resistor, or diode type. Terminal blocks shall comply with NEMA ICS 4.
- G. Power Loss Relays: Power loss relay shall protect all multi-phase motors from phase loss (single phasing), phase reversal (phase sequence), and low

voltage (brownout). Relay shall be heavy duty type rated 10 amps at 120 volts (control contact rating), plug-in style with a separate NEMA enclosure, and shall include adjustable feature and indicator light. Coordinate voltage sensing rating with the actual motor voltage(s). Provide with integral transformers as required.

1. Phase loss shall activate when any one of the three line voltages drop to 83% or less of setting. Phase reversal shall activate when improper phase sequence is applied to the equipment. Low voltage shall activate when all three line voltages drop to 90% or less of setting. Indicator light shall stay-on when voltages are normal and shall turn-off when any of the voltage faults occur.
2. Voltage sensing shall occur on the loadside of the motor overload elements. Activation of the power loss relay shall open the motor controller.
3. Operation: When phase sequence is correct and full line voltage is present on all three phases, the relay shall be energized. When incorrect phase sequence or phase loss occurs or the phase voltages drop below the drop-out voltage, the relay shall de-energize. Both delta and wye systems may be monitored. In wye systems, connections to neutral shall not be required.
4. The power loss relays shall be provided under the electrical provisions of the contract.

PART 3 - EXECUTION

- 3.1 Coordinate final locations of motor controllers, disconnect switches, motor rated switches, control components, and other similar equipment with all involved parties including the Owner's Construction Representative (OCR). Fulfill all requirements of Article 430: "Motors, Motor Circuits, and Controllers" of the National Electrical Code. All equipment shall be installed in a secured and approved manner.
- 3.2 Motor and Equipment Connections: Provide and fulfill all instructions and recommendations of the manufacturer of the equipment connected. All circuits shall be concealed in finished spaces. In finished spaces, exposed circuits may only be provided as specifically approved by the OCR. Such exposed circuits shall be installed in surface metal raceway. The raceway shall be painted to match the adjacent surfaces. Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control

devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

END OF SECTION

SECTION 16410 - LIGHTING FIXTURES

PART 1 - GENERAL

1.1 LIGHTING FIXTURES

- A. Fixtures shall be UL approved, listed and labeled for the particular installation. Lighting fixtures shall be provided complete with lamps, mounting hardware, accessories, canopies, necessary guards, straps, supports or hangers and other miscellaneous materials and devices to assure satisfactory installation and desired function where installed and shall be approved before installation.

PART 2 - PRODUCTS

2.1 FIXTURES

- A. Fixtures shall be as indicated as detailed on drawings. Cuts and descriptions of all fixtures shall be submitted for approval before ordering. When requested, samples of the fixtures, shall be provided.

2.2 LAMPS

- A. Provide as indicated on fixture details.

2.3 BALLASTS

- A. Fluorescent ballasts shall be ETL and UL approved and shall be energy saving electronic type compatible with lamps specified. Fixtures shall be designed for use with these electronic ballasts and shall have thermal characteristics that will minimize operation of ballast over-heat devices under all normally expected operation conditions. Ballasts shall have a Class A sound rating.
- B. HID ballasts shall be of the constant wattage, high power factor type.
- C. Ballasts which are not quiet and hum-free will be rejected and shall be replaced by the Contractor at no additional cost to Owner.
- D. Ballasts in unconditioned spaces or outdoors shall be rated for operation in high or low temperature environments.

2.4 FLUORESCENT EMERGENCY LIGHTING UNITS

- A. Each unit shall consist of an automatic power failure device, test switch operable from outside of the fixture, pilot light visible from outside the fixture, and fully automatic solid-state charger in a self-contained power pack. Charger shall be either trickle, float, constant current or constant potential type, or a combination of these. Battery shall be sealed electrolyte type with capacity as required to supply power to two lamps for 90 minutes at a minimum of 25 percent of the lamps rated lumen output. Battery shall operate unattended and require no maintenance, including no additional water, for a period of not less than 5 years. Emergency ballasts which are provided with fixtures containing solid-state ballasts shall be suitable for use with solid-state ballasts.

PART 3 - EXECUTION

3.1 LIGHTING FIXTURES

- A. Locations of fixtures in ceiling shall be in accordance with the reflected ceiling plan. Contractor's attention is directed to coordinating with lighting fixtures and mechanical equipment in all spaces. Where recessed lighting fixtures are indicated, this Contractor shall be responsible for coordinating the type fixtures with the actual ceiling being installed. This shall include all changes resulting from substitute items, change orders, etc.
- B. All surface mounted fluorescent lighting fixtures shall be mounted independent of ceiling construction. All fluorescent lighting fixtures mounted in or on plaster ceiling shall also be mounted independent of ceiling construction. Where recessed fluorescent lighting fixtures occur in lay-in tile or concealed spline ceiling the electrical contractor shall have the ceiling contractor install additional supporting hangers where fixtures occur.
- C. No fixtures shall be hung with zip-clips.
- D. Recessed and flush mounted fixtures shall be of type which can be relamped from bottom except as otherwise specified. Trim for exposed surface or flush mounted fixture shall be as detailed for that fixture.
- E. Flush or recessed fixtures shall be provided with separate junction boxes, and fixtures shall be readily removable for access to the boxes or ceiling access panels shall be provided.

- F. Pendant mounted fixtures and devices shall be supported with swivel type hanger to ensure plumb installation.

END OF SECTION

SECTION 16470 - SURGE PROTECTIVE DEVICES (SPD)

PART 1 - GENERAL

1.1 The work required under this division shall include all materials, labor and auxiliaries required to install complete surge suppression for the protection of building electrical and electronic systems from the effects of line and electromagnetic induced transient voltage surges and coupled lightning discharged transients as indicated on drawings and as specified in this section.

1.2 STANDARDS

- A. The following standards and publications referenced in various parts of this specification shall apply.
1. UL 1449 – Third Edition; effective May, 2008; UL Standard for Safety for Surge Protective Devices.
 2. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low Voltage AC Power Circuits.
 3. NEMA LS-1, Specification Format for Low Voltage AC Surge Protective Devices (1000 volts or less).
 4. CSA - C22.2 and NOM Approvals for TVSS.

1.3 SUBMITTALS

- A. Contractor shall provide submittal data as defined in Section 16010 “ELECTRICAL GENERAL PROVISIONS”, and as required in the Division 1 section governing submittal requirements. Also, Contractor shall provide NEMA LS-1 document for submittal to the Engineer.

1.4 QUALIFICATIONS

- A. All surge protective devices shall be manufactured by a single ISO-9001 registered company normally engaged in the design, development and manufacture of such devices for electrical and electronic system equipment protection. The said firm shall offer a ten-year (10) warranty for its hard-wired surge protective devices.
- B. The surge protective device manufacturer shall offer at no cost technical assistance through support from factory representatives and local

authorized distributors and maintain a 24-hour toll free technical support hotline.

- C. Equipment certification: Items shall be "Listed" by Underwriters Laboratories, Inc. and shall exhibit the UL Listing Mark for the category "Surge Protective Devices" or SPD. UL Listing Card under category SPD shall be provided to confirm compliance to UL1449 Third Edition Standard and assigned Voltage Protection Ratings.
- D. Surge Protective Devices shall be installed and located in accordance with the requirements of all applicable National Fire Protection Association (NFPA) codes. The device shall be installed on the load-side of the main service disconnect per the scope of UL 1449, and classified as a Type 2 device.
- E. All surge protective devices shall be warranted to be free from defects in materials and workmanship under normal use in accordance with the instructions provided for a period of ten (10) years.
- F. Any surge protective device that exhibits evidence of failure or incorrect operation during the warranty period shall be repaired or replaced by the manufacturer.
- G. Manufacturers shall provide third party nationally recognized national laboratory verification of performance data including Maximum Surge Current testing.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All Surge Protectors shall be designed for the specific type and voltage of the electrical service as indicated on the drawings, and provide suppression for all phases (L-N), all phases (L-G), and (N-G).
- B. All Surge Protectors shall be of a parallel-operated hybrid circuit design and include full cycle tracking clamping capability.
- C. All Surge Protectors shall be designed to withstand a maximum continuous operating voltage (MCOV) rating of not less than 115% of the system rms line voltage to which they are connected.
- D. All Surge Protectors shall provide minimum -30dB noise attenuation across the 5k - 100MHz frequency spectrum.

- E. All Surge Protectors shall contain internal safety fusing to disconnect surge protective components from the electrical source of supply in the event of SPD failure in order to prevent catastrophic failure.
- F. All Surge Protectors shall not allow follow-current or "crow-bar" components, which may disconnect power to connected equipment during surge diversion.
- G. All Surge Protectors shall be UL 1449, 3rd Edition Listed and shall be approved for the location in which they are installed.
- H. All Surge Protectors shall have operating temperature range of -10 to +60 degrees C.
- I. Loss of Protection Diagnostic lights for each phase shall be provided. In addition, separate visual and audible fault indication shall be provided. Provision for remote monitoring shall be provided via a dry contact.
- J. Surge protection devices shall be provided in minimum NEMA 12 enclosures.

2.2 REPLACEABLE MODULAR SURGE PROTECTOR MINIMUM RATINGS:
(Main Service)

- A. Maximum Surge Current (8x20 us waveform): 200kA (L-N), 200kA (L-G), 200kA (N-G) UL 1449 VPR: 1000V peak (120V)

2.3 ACCEPTABLE MANUFACTURERS

- A. EFI Electronics
- B. LEA International
- C. Current Technology

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Surge Protectors shall be installed as close as practical to the electrical panel or switchboard to be protected. The SPD shall be close coupled to the equipment in a position near the equipment neutral bus bar or positioned so that the overall lead length is as short as possible.

- B. The Surge Protector shall be installed in a manner consistent with proper and acceptable industry wiring practice. SPD connection leads shall be as short and straight as possible while avoiding sharp bends.
- C. Surge Protectors provided with terminals shall be wired with largest stranded conductor permitted within rating of lugs. At least 8 AWG conductor shall be used.
- D. The Surge Protector shall be installed with a means for disconnecting the device for servicing via a dedicated three-pole circuit breaker, size as indicated on the drawings, unless manufacturer's recommendations differ.

END OF SECTION

SECTION 16621 - BACK-UP POWER SYSTEM (DIESEL)

PART 1 - GENERAL

1.1 ELECTRICAL GENERAL PROVISIONS

- A. It is the intent of these specifications to secure for this project a diesel engine driven generator set and automatic transfer switch of the latest commercial type and design as specified herein. All material and equipment shall be new and undamaged. All equipment shall be supplied which meets the requirements of NFPA-110 standards. Generator set shall be UL 2200 listed. Generator set shall meet the emissions requirements set forth by the latest EPA regulations in effect at the time of manufacture.

1.2 WORK INCLUDED

- A. Provide a standby power rated emergency generator set and automatic transfer switch, with accessories and attachments in strict accordance with the specifications contained herein. Additional services shall include installation supervision, initial start-up and checkout, and acceptance testing as detailed herein.

1.3 SYSTEM DESCRIPTION

- A. Provide a new, automatically start/stopped, packaged generator set within a weatherproof sound attenuated enclosure for supply of electrical power in event of failure of normal utility supply, consisting of liquid-cooled diesel engine directly coupled to AC generator, complete with control panel, auxiliaries, meters, and safety devices necessary for a complete operating system.
- B. Provide fully automatic operation upon receipt of signal from automatic transfer switch. On resumption of normal power after time delay of transfer switch, automatically retransfer load to normal power and automatically shut down generator, returning to starting condition ready for another operating cycle.
- C. The unit shall be capable of delivering KW required at installed location after consideration of applicable derating factors.

1.4 EXPERIENCE

- A. The engine-generator set shall be the product of a firm regularly engaged in the manufacture of engines and generator sets and shall meet the requirements of specifications set forth herein. The proposed equipment must be a standard model in regular production at the manufacturer's place of business. The generator set supplier shall also be the manufacturer of either the engine, the generator, or both major components. Acceptable manufacturers are Caterpillar, Cummins Onan or Generac.
- B. The engine-generator supplier shall be factory-authorized sales and servicing dealership for the equipment to be supplied under this procurement, maintaining a local parts and service facility within 50 miles, with an inventory of maintenance and repair parts for the equipment to be provided, as well as a staff of trained service technicians. The supplier shall furnish all installation and test supervision necessary for final approval and acceptance.

1.5 WARRANTY

- A. Equipment furnished under this section shall be guaranteed against defective parts or workmanship under terms of the manufacturer's standard warranty. Warranty shall be for a period of two years from date of initial start-up of the system. In addition, contractor shall include with his proposal complete details and pricing on any optional extended warranties available for the generator sets to be supplied.

1.6 SUBMITTALS

- A. In addition to full descriptive data, dimensional drawings, and wiring diagrams, the following information must be furnished for proper evaluation and approval of all equipment proposed:
 - 1. Name and location of engine-generator supplier's parts and service facilities within a 50 mile radius of the project site. Parts and service shall be available on a 24 hour basis for engine and generator.
 - 2. Manufacturer's Published Warranty.
 - 3. Manufacturer and Model of Engine.
 - a. Bore, stroke, and number of pistons.
 - b. Engine displacement.

- c. Piston speed.
 - d. Engine rating at 1800 RPM.
 - e. BMEP.
 - f. Exhaust emissions data.
4. Manufacturer of generator, make and type of generator, and generator electrical rating.
 5. Manufacturer and type of voltage regulator.
 6. Manufacturer and model of batteries and battery charger.
 7. Manufacturer and type of governor.
 8. Manufacturer and type of Automatic Transfer Switch.
- B. Operations and Maintenance Manual: Provide complete manual including all submittal data; testing reports, etc. Manual shall include names, addresses, location, phone number, e-mail address, and fax phone number, of supplier, installer and factory. Additionally provide complete schedule of maintenance. Provide four copies in 3-ring binder with commercially printed cover.

PART 2 - PRODUCTS

2.1 EMERGENCY GENERATOR UNIT

- A. Furnish an engine-generator set completely installed, piped, and wired as specified herein, of the latest commercial type and design for intended application.
- B. All materials, equipment and parts comprising the units specified herein shall be new and unused, of current manufacturer and of highest grade, free from all defects or imperfections affecting performance. Workmanship shall be of the highest grade in accordance with modern practice.
- C. The design and construction of the electric set shall be such that it is neat and clean in appearance, and the normal adjustments and maintenance can be effected without the use of special tools. The engine, generator and all

major items of auxiliary equipment shall be products of U. S. manufacturers regularly engaged in the production of such equipment, and shall be assembled, tested and shipped to the job site by the engine manufacturer or his authorized distributor maintaining a parts and service facility in the area.

- D. The unit shall each have a power rating as indicated on the drawings at 0.8 power factor and a frequency of 60 Hz and shall operate at a speed of 1800 RPM. Ratings shall be substantiated with manufacturer's standard published curves and related data. Special ratings for a particular application are not acceptable. Ratings shall reflect the net power available after deducting all engine-driven or motor-driven accessories.
- E. The generator output voltage shall be as indicated on the drawing, 60 Hz, AC. The regulator shall be of the three-phase sensing type. Voltage regulation shall be plus or minus 1.0 percent from no load to full load. An adjusting rheostat shall provide a plus or minus 5 percent voltage adjustment. Steady state frequency regulation shall be plus or minus 0.25 percent. It shall also provide for instantaneous field overcurrent trip to protect the voltage regulator in the event of output short circuit or improper connections.
- F. The generator shall be sized to provide the specified output under job site conditions and shall be built to NEMA, IEEE and ANSI standards. It shall be a three- phase, 4-wire, 60 Hz, 0.8 power factor, single bearing, rotating field synchronous type. Readily accessible voltage level and voltage drop controls shall be provided.
- G. The engine shall be a full compression ignition diesel, four stroke cycle, single acting, solid injection, water cooled, in-line type. The engine shall be turbo-charged and after-cooled in accordance with the manufacturer's standards as required to perform the specified duty. The engine shall be equipped with an electronic governor for 1% regulation. The engine shall be capable of full load duty when operating on a commercial grade of fuel such as No. 2 off-road diesel fuel and No. 2 domestic fuel oil. Engines requiring a premium grade of fuel will not be acceptable. The engine shall be equipped with reliable fuel, lube oil, and air intake filters, lube oil cooler, fuel transfer pump, fuel priming pump, and any other attachments required for continued, dependable, and low maintenance cost operation. Filter arrangements designed for light duty standby service are not acceptable.
- H. Furnish an engine mounted radiator of sufficient capacity to maintain a safe engine operating temperature at the specified power load when the ambient temperature is 110 degrees F and the generator set is supplied

with antifreeze as specified and installed in the weather protective enclosure specified herein. The radiator shall be equipped with a blower type fan with fan guard, and the fan belts shall have a tension adjustment. The engine shall also be equipped with engine mounted jacket water pump and thermostat to properly control engine temperature. The radiator and engine cooling system shall be filled with a solution of ethylene glycol as required to protect against freezing when the ambient is -20 degrees F. A suitable rust inhibitor shall also be installed.

- I. The engine generator set shall be mounted on structural steel base rails and equipped with linear type vibration isolators.
- J. Provide a critical grade exhaust silencer, properly sized according to the manufacturer's recommendations for the specific engine installed. A stainless steel flexible exhaust fitting shall also be provided for mounting between the engine and exhaust silencer. The exhaust system shall be sized to ensure against loss of power due to excessive back pressure. The exhaust silencer shall be installed within the enclosure. Silencer shall be constructed of a minimum of stainless steel for corrosion resistance.
- K. Furnish and install, complete with electrical wiring and connections, an engine mounted thermal circulation type electric water heater to maintain engine jacket water at 90 degrees F in an ambient of 0 degrees F. The heater shall be suitable for single phase operation, voltage as indicated on the drawings, and shall include adjustable thermostat.
- L. Furnish and install a 12 or 24 volt DC electric starting system. The starting system shall include two lead-acid batteries complete with cables. The ampere-hour capacity shall be a minimum of 135 ampere-hour. Batteries shall be mounted inside the enclosure adjacent to the engine.
- M. Furnish and install a two- rate 12 or 24 volt DC battery charger suitable for use with lead-acid batteries. The charger shall be furnished with an automatic equalize charge timer for fast recharge, a low DC voltage alarm contact, and shall be suitable for operation on single phase, 120 volts, 60 Hz, AC. Battery charger output shall be 10 amperes with corrosion resistant enclosure. Mount charger on the generator set.
- N. An automatic engine starting and control system shall be furnished by the engine manufacturer and included in a NEMA-1 generator control panel factory installed with vibration isolators on the generator set. The digital control panel shall be a Caterpillar EMCP 3 (or equal by Cummins or Generac) and shall meet UL508A. The automatic starting controls shall be actuated manually or automatically by the engine starting contacts in the automatic transfer switches. The engine automatic starting controls shall

be solid state and shall include, as a minimum, the following functions and equipment:

1. Instruments, including ammeter, voltmeter, frequency meter, tachometer, and hour meter.
 2. Automatic start-stop control module with adjustable cycle cranking and engine cooldown timer.
 3. Ammeter - Voltmeter phase selector switch.
 4. Engine control switch for auto, start/run, off/reset, and stop.
 5. Oil pressure and water temperature gauges.
 6. Safety shutoffs with individual alarm lights for low oil pressure, high water temperature, overspeed, and overcrank.
 7. Emergency stop push-button.
 8. Voltage adjust rheostat.
 9. System diagnostic codes, digital readout.
 10. DC panel illumination lights with switch.
- O. In addition to the functions and equipment listed above, the generator control panel shall incorporate an automatic prealarm module in accordance with NFPA-110 with individual alarm lights and common alarm horn for:
1. Approach low oil pressure.
 2. Approach high water temperature.
 3. Low water temperature.
 4. Low battery voltage (from battery charger contact).
 5. System not-in-automatic.
- P. A molded case circuit breaker, ratings as indicated on the drawing, shall be provided and mounted at the generator to provide overload protection and disconnect means. The breaker shall be installed in a NEMA-1 enclosure within the generator set enclosure and shall be equipped with

copper output bus bars to accommodate the quantity and size of conductors per phase as shown on the drawings, plus the neutral and ground conductors as indicated. Neutral leads shall be brought out and terminated to an isolated bus bar mounted within the circuit breaker enclosure.

- Q. The generator set shall be enclosed in a factory installed UL2200 listed 14 gauge marine grade aluminum weather protective enclosure with polyester powder finish. The enclosure shall have an internally mounted silencer and a minimum of four lockable, gasketed personnel doors for maintenance, along with fixed air intake and radiator discharge louvers. The enclosure shall have the manufacturer's standard sound attenuating insulation applied to the interior of the enclosure. The unit shall produce output no more than 75 dBA at 23 feet.
- R. The generator set shall be installed on top of a UL 142 listed double wall subbase mounted fuel tank. The tank shall be constructed of primed/painted structural steel and be provided with all required accessories such as: venting, manual fill provisions, fuel level gauge, low level and tank rupture alarm contacts. Tank shall be sized to provide a minimum of 48 hours of continuous operation at full rated load. A primary fuel filter/strainer shall be provided and mounted between the tank supply fitting and the engine fuel inlet. Flexible fuel lines shall be provided between all components. The tank base shall be equipped with four-point lifting provisions designed to allow safe unloading and setting of the complete generator set and tank/enclosure assembly.

2.2 AUTOMATIC TRANSFER SWITCH

- A. An automatic transfer switch, ratings as indicated on the drawings, shall be provided with the unit. The transfer switch shall be a Cutler-Hammer AT series with exerciser with/without load.

The switch shall be provided with a microprocessor based control panel with the following minimum items:

1. Time delay on engine start
2. Time delay on normal to emergency transfer
3. Time delay on retransfer to utility
4. Time delay cooldown

5. Time delay for switch in neutral position during transfer (delay between make and break)
6. 7 day programmable exerciser with or without load switch
7. Voltage/Frequency relay - 90% on emergency
8. 3 phase sensing of voltage and frequency of utility

PART 3 - EXECUTION

3.1 COORDINATION

Coordinate with all trades and vendors to provide an efficient and well coordinated system.

3.2 INSTALLATION

Install generator set and automatic transfer switch as indicated on the drawings and in accordance with the manufacturer's instructions and recommendations. Installation shall be in accordance with all applicable local, state, and federal codes and regulations.

3.3 WIRING AND CONNECTIONS

Provide conduit, wiring, and connections within the enclosure packages. Field wiring shall consist of power and control wiring between the genset package and the building service.

3.4 TESTING

- A. The electric set shall receive the manufacturer's standard testing at the factory. The factory testing shall be at 0.8 power factor. Certified copies of the factory test shall be supplied to the Engineer. Prior to acceptance of the installation, the equipment shall be field tested to show it will start automatically, and shall be subject to full load test, shut down and reset as required in these specifications. Prior to acceptance, any defect which becomes evident during this test shall be corrected. The test shall be performed in accordance with the following minimum requirements and shall include any other tests that may be recommended by the manufacturer for the purpose of evaluation. A portable resistive (1.0pf) loadbank shall be utilized for the field test. The generator shall be started and operated at 50% of rated load for a period not less than ½ hour, after which the load shall be increased to 75% of rated load and operated for the

second ½ hour. The load will be then increased to 100% and held continuously for a period of not less than two hours, then operated at no load for a period of 15 minutes prior to shutting down the generator set. A full written report indicating KW output, voltage, current, frequency, oil pressure, water temperature, and ambient temperature variations taken at 15 minute intervals during the test shall be provided to the Engineer for evaluation and disposition. All tests shall be performed in the presence of the Owner's authorized representatives and the manufacturer's representative who shall validate the report. Fuel for testing shall be furnished by the Contractor.

- B. On completion of the field testing, operating instructions and maintenance procedures shall be thoroughly explained to the Owner's operating personnel. Three sets of operating and maintenance instruction books shall be supplied for the electric sets and auxiliary equipment.
- C. Upon final acceptance, Contractor shall fill the generator's fuel tank to capacity for final delivery to Owner.

END OF SECTION

SECTION 16710 - COMMUNICATIONS CONDUIT SYSTEMS

PART 1 - GENERAL

- 1.1 Provide complete system of empty conduit, outlets, fittings, appurtenances, equipment backboards and equipment cabinets for installation of the telephone, audio/visual (A/V), and other communication systems.

PART 2 - PRODUCTS

- 2.1 Provide outlets, fittings and minimum 3/4" conduit in all runs in accordance with Section entitled "RACEWAY, FITTINGS AND BOXES".
 - A. Provide 3/4" thick plywood backboards with (2) coats of insulating fire retardant varnish, secured to walls for mounting of telephone terminals and equipment.

PART 3 - EXECUTION

- 3.1 Provide nylon pull string in each conduit run.
 - A. Install telephone conduits, outlet boxes, cabinets and backboards, including point of service in accordance with requirements of local telephone company.
- 3.2 GROUNDING
 - A. Provide grounding conductor in conduit from main building ground to the main telephone backboard and all remote located telephone backboard.

END OF SECTION

SECTION 16721 - ADDRESSABLE FIRE DETECTION & ALARM SYSTEM

PART 1 – GENERAL

1.1 SCOPE

- A. The control panel is to be intelligent device addressable, analog detecting, low voltage and modular, with digital communication techniques, in full compliance with all applicable codes and standards. The features and capacities described in this specification are required as a minimum for this project and shall be furnished by the successful contractor.
- B. The system shall be in full compliance with applicable National Codes and the 2006 Virginia Uniform Statewide Building Code.
- C. The system shall include all required hardware, raceways, interconnecting wiring and software to accomplish the requirements of this specification, the contract drawings, and applicable local, state, and federal code, whether or not specifically itemized herein.
- D. All equipment furnished shall be new and the latest state of the art products of a single manufacturer engaged in the manufacturing and sale of analog fire detection devices for over five years.
- E. The system as specified shall be supplied, installed, tested, and approved by the local authority having jurisdiction (AHJ), and turned over to the owner in an operational condition.
- F. In the interest of job coordination and responsibilities the installing contractor shall contract with a single supplier for fire alarm equipment, engineering, programming, and final connections.
- G. It shall be the responsibility of the Contractor to ensure that all devices are installed according to their ratings and specifications (i.e. operating temperature, humidity, etc.). Should device(s) be shown on the engineered contract drawings that are not rated for the environment where they are shown or are a misapplication, it shall be the responsibility of the Contractor to provide the proper device that is rated for the location and bring it to the attention of the Engineer.

1.2 RELATED WORK

- A. Division 01, Bidding Requirements and Conditions Of The Contract

- B. Division 16 Electrical, Section 16010, “ELECTRICAL GENERAL PROVISIONS”
- C. Division 15 Mechanical, Energy Monitoring & Control (HVAC)

1.3 STANDARDS & CODES

- A. The publications listed below form a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation only. The latest version of each listed publication shall be used as a guide unless the authority having jurisdiction has adopted an earlier version.
- B. Factory Mutual (FM)
 - 1. FM AG Approval Guide.
- C. National Fire Protection Association (NFPA)
 - 1. NFPA 13 - 2007 Standard For The Installation of Sprinkler Systems.
 - 2. NFPA 70 - 2005 National Electrical Code.
 - 3. NFPA 72 - 2007 National Fire Alarm Code.
 - 4. NFPA 90A Standard For The Installation of Air Conditioning And Ventilating Systems.
 - 5. NFPA 101 Life Safety Code.
 - 6. NFPA 170 Standard Fire Safety and Hazmat Symbols
- D. Underwriters' Laboratories, Inc. (UL) Appropriate “UL” equipment standards.
 - 1. “UL” 864 Control Panels.
 - 2. “UL” 268 Smoke Detectors.
 - 3. “UL” 268A Smoke Detectors (HVAC).
 - 4. “UL”1076 Security.
 - 5. “UL” 1971, Standard for Visual Signaling Appliances.

E. Building Codes

1. 2002 North Carolina Building Code
2. State and Local Building Codes as adopted and/or amended by The Authority Having Jurisdiction.
3. ADA, and/or State and local equivalency standards as adopted by The Authority Having Jurisdiction.
4. ADAAG Americans with Disabilities Act Accessibility Guidelines

1.4 QUALIFICATIONS OF INSTALLERS

- A. Before commencing work, submit data showing that the contractor has successfully installed fire alarm systems of the same scope, type and design as specified.
- B. The contractor shall submit copies of all required Licenses and Bonds as required in the State having jurisdiction within the submittals.
- C. The contractor shall employ on staff a minimum of one NICET level II technician and provide proof of such employment within the submittals.

1.5 MANUFACTURER'S REPRESENTATIVE

- A. Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation, maintenance and service of the type of system provided. The representative shall be licensed in the State if required by law. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation, maintenance and programming. Provide copies within the submittals of all applicable certifications of training only from technicians that will actually be assigned and deployed to this project. Engineer may at any time visit site to ensure the technicians on site are the ones that were submitted on.
- B. The contractor shall include the following information in the equipment submittal:
 1. Power calculations. Battery capacity calculations. Battery size shall be a minimum of 125% of the calculated requirement.

2. Supervisory power requirements for all equipment.
3. Alarm power requirements for all equipment.
4. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25% spare capacity.
5. NAC circuit design shall incorporate a 15% spare capacity for future expansion.
6. Complete manufacturers catalog data including supervisory power usage, alarm power usage, physical dimensions, finish, and mounting requirements.
7. Complete drawings covering the following shall be submitted by the contractor for the proposed system:
 - a. Floor plans in a CAD compatible format showing all equipment and raceways, marked for size, conductor count with type and size, showing the percentage of allowable National Electric Code fill used. Wiring for the fire alarm system is not shown on the contract drawings. The contractor shall lay out the wiring arrangement between the system components in the most convenient form for their installation and show it on the floor plans. At the conclusion of the project, the contractor shall correct and modify this wiring layout to conform with the actual runs and connections for inclusion into the final set of record drawings.
 - b. A complete fire alarm job specific riser diagram showing all addressable, notification, communication, shutdown, and power circuits and their relative service areas in the building (i.e. 2nd floor notification circuit) that are attached to the fire alarm system. Include all candela ratings, device addresses, and room numbers.
 - c. Typical job specific wiring diagrams for all field devices used in the proposed system. Diagrams shall be sized and laid out so that individual wire detail can be determined.

- d. A job specific wiring diagram of the fire alarm control panel and all associated control panels (i.e. transponders, NAC extender panels, communicators, remote annunciators, etc.)
- e. Provide a fire alarm system function matrix as referenced by NFPA 72, Figure A-7-5.2.2 (9). Matrix shall illustrate alarm input/output events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions. Include any and all departures, exceptions, variances or substitutions from these specifications and/or drawings at time of bid.

8. Incomplete submittals may be returned without review.

1.6 SYSTEM REQUIREMENTS

- A. The system shall be a complete, electrically supervised fire detection and notification system, microprocessor based operating system having the following; capabilities, features and capacities:
 1. Communication between network nodes, each supporting an interactive, self-standing, intelligent local control panel, with system wide displays.
 2. The local system shall provide status indicators and control switches for all of the following functions:
 - a. Audible and visual notification alarm circuit zone control.
 - b. Status indicators for sprinkling system water-flow and valve supervisory devices.
 - c. Any additional status or control functions as indicated on the drawings, including but not limited to; emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.
 3. Each intelligent addressable device or conventional zone on the system shall be displayed at the main fire alarm control panel and any local fire alarm control panel by a unique alphanumeric label identifying its location.
 4. All control panels and transponders within the system that require a 120 VAC connection shall be provided with an AC hard-wired

transient voltage surge suppressor that conforms to UL and IEEE C62.41B and have the following characteristics.

Connection Method: Hardwire parallel connection
Continuous Current: Unlimited (Parallel Installation)
<5nSec Installed, <1nSec Component
Response Time: Level
MCOV: 130 VRMS/185 VPK
Operating Frequency: 50/60Hz
AC Protection Modes: L - N, L - G, N - G
Service Voltage: 110 / 125 VAC
Diagnostics: Indicator Light
EMI/RFI Noise Filtering: Yes
Max Surge Current: 22,500 Amps
Max Energy Dissipation: 190 Joules
Suppressed Voltage Rating: 600V
Operating Temperature
Range: -40 degrees C. to +85 degrees C.

Be certain that all units are grounded properly and connected to a good source of building ground.

1.7 SYSTEM OPERATION

- A. Activation of any system fire, security, supervisory, trouble, or status initiating device shall cause the following actions and indications at all alphanumeric displays in the system.
- B. Fire Alarm Condition:
 - 1. Sound an audible alarm and display a custom screen/message defining the building in alarm and the specific alarm point initiating the alarm.
 - 2. Log to the system history archives all activity pertaining to the alarm condition.
 - 3. Sound the ANSI 117-1 signal with synchronized audibles and synchronized strobes throughout the facility.
 - 4. Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmable to flash until system reset or alarm silencing, as required.

5. A signal dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
6. The alarm information shall be displayed on an annunciator located where shown on drawings.
7. Activation of any smoke detector in a single elevator lobby, shaft, or an elevator equipment room shall cause the recall of that bank of elevators to the 1st floor and the lockout of controls. In the event of recall initiation by a detector in the first floor lobby, the recall shall be to the alternate floor.
8. HVAC shut down shall be accomplished by system operated duct detectors as per local requirements.

C. Supervisory Condition:

1. The supervisory information shall be displayed on an annunciator located where shown on drawings.
2. Activate supervisory audible and dedicated visual signal.
3. Audible signals shall be silenced from the control panel by the supervisory acknowledge switch.
4. Record within system history the initiating device and time of occurrence of the event.

D. Trouble Condition:

1. The trouble information shall be displayed on an annunciator located where shown on drawings.
2. Activate trouble audible and visual signals at the control panel and as indicated on the drawings.
3. Audible signals shall be silenced from the fire alarm control panel by a trouble acknowledge switch.
4. Record within system history, the occurrence of the event, the time of occurrence and the device initiating the event.

PART 2 – PRODUCT

2.1 CONTROL PANEL

- A. The fire alarm control panel shall be microprocessor based using the multiple microprocessors throughout the system providing rapid processing of smoke detector and other initiation device information to control system output functions. There shall be a watchdog circuit, which shall verify the system processors and the software program. Problems with either the processors or the system program shall activate a trouble signal, and reset the panel. The system modules shall communicate with an RS 485 network communications protocol. All module wiring shall be to terminal blocks.
- B. The basic system shall have supplied at least twice as many intelligent initiation device addresses as are shown on the contract drawing floor plans and can be expanded up to 240 intelligent initiation devices minimum. SLC loops shall not be loaded past 80% of their capacity to allow for potential unexpected additions.
- C. The 240 initiation devices shall be distributed between separate loops capable of class “A” or “B” operation. Any trouble on one loop circuit shall not affect the other circuit. Any of all of the 240 devices on the loops shall be capable of activating one device (relay base, audible base, or remote lamp). These accessories shall not take away from the 240 addresses in the system.
- D. The Signal Line Circuits (SLC) shall be tested for opens, shorts, ground faults, before connection to the control panel.
- E. The user interface display shall provide a minimum 80 character backlit LCD alphanumeric annunciator. Switches are to be provided for acknowledging fire alarms, supervisories, security conditions, and system troubles.
- F. All system cards and modules shall have flash memory for downloading the latest module firmware.

2.2 POWER SUPPLY, BATTERY, & BATTERY CHARGER

- A. The system power supply shall be a minimum 6-amp supply with battery charger. The power supply shall be filtered and regulated. The power supply shall be rated for 120/240 VAC 50/60 Hz.

- B. Standby power shall be supplied by gel cell or sealed lead acid batteries sized to provide complete functionality of the system for a minimum period of 24 hours in a quiescent state and 10 minutes (at the end of the 24 hour period) in full alarm. In addition, the battery shall further be sized to provide a minimum of 125% of the calculated requirement.
- C. The battery charger shall be able to charge the system batteries up to 100 AH batteries. Battery charging shall be microprocessor controlled and programmed with a special software package to select charging rates and battery sizes.

2.3 SYSTEM ENCLOSURES

- A. Provide the enclosure needed to hold all system equipment plus spare capacity for additions. The enclosures shall be either black or red. Provide the color as to the local AHJ requirements. System enclosure doors shall provide where required ventilation for the modules or cards in the enclosure.

2.4 REMOTE ANNUNCIATORS

- A. The remote annunciator shall be a system display as indicated on the drawings.
 - 1. The System Status Display shall be an 80 character backlit display screen for easy viewing. The module shall be connected to the network allowing it to be placed any where on the system. The system display shall have local sounder with silence control, local acknowledgement, local scrolling.
- B. The annunciators shall receive vectored information such as; all events, Alarm only, Supervisory only, Trouble only, or Security only.

2.5 DIGITAL ALARM COMMUNICATION TRANSMITTER (DACT)

- A. A digital alarm communication transmitter for the purpose of communicating system point status off site shall be provided. The unit shall be listed with the system and shall communicate alarm / trouble / supervisory for all points within the system. The monitoring company shall be selected by the Owner prior to final test. Contractor to coordinate this information with the owner and program DACT with monitoring company information for proper operation.

2.6 INTELLIGENT INITIATION DEVICES

- A. The smoke detector shall be an intelligent digital photoelectric detector with a programmable heat detector. Detectors shall be listed for use as open area protective coverage, in duct installation and duct sampling assembly installation and shall be insensitive to air velocity changes. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds. The intelligent smoke detector shall be capable of providing three distinct outputs from the control panel. The system controlled output functions shall be from an individual or unique input of smoke obscuration, a thermal condition or a combination of obscuration and thermal conditions. The detector shall be designed to eliminate calibration errors associated with field cleaning of the chamber. The detector shall support the use of a relay and LED remote indicator at the same time.
1. Where smoke detectors are provided in elevator machine rooms for elevator recall functionality, and the ceiling is such that it is divided into separate compartments (formed by intersecting beams, or other solid obstructions) provide a detector within each compartment and program system to recall elevator(s) on any of those smoke detector activations.
- B. The duct smoke detector shall be an intelligent digital photoelectric detector. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds. The detector shall be mounted in a duct detector housing listed for that purpose. The duct detector shall support the use of a remote test switch, relay or LED remote indicator. Provide remote indicator lamps or LED's in clearly visible locations for duct detector units that are hidden from view while standing on the floor. Detectors shall also be provided with enough auxiliary relay contacts to interface to any peripheral equipment as shown on contract drawings. Relays shall be capable of activating either by following the state of the associated detector or be globally controllable from any point in the system. The duct detector shall be supplied with sampling tubes that are specifically sized to the width of the duct at the location where the unit is to be installed. In no case should a larger sampling tube that is meant for larger ducts be cut down to accommodate a smaller duct where a smaller standard size tube is available. Where duct detectors are exposed to the weather provide a weatherproof enclosure. Duct detector units shall be provided and connected under this division and mounted by the mechanical contractor.

- C. Detector bases shall be low profile twist lock type with screw clamp terminals and self-wiping contacts. Bases shall be installed on an industry standard, 4" square or octagonal electrical outlet box.
 - 1. Where selective localized control of electrical devices is required for system operation, furnish and install detector base with software programmed addressable relay integral to the base. The relay shall switch electrical loads within relay ratings, as indicated on the drawings. Operation of the addressable control circuit shall be independent of the number of detectors and relays on the circuit or the number in an alarm state. Relay bases shall be rated for resistive or inductive load (120VAC or 30VDC) 3 amps.
 - 2. Where indicated on the drawings, furnish detector base with integral approved audible evacuation alarm signal having an output of 85db. The audible signal shall be individually addressable and software programmed for operation.
- D. Provide double action addressable manual stations where shown on the drawings, to be flush or surface mounted as required. Manual stations shall contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control panel. The manual station communications shall allow the station to provide alarm input to the system and alarm output from the system within less than four (4) seconds. The manual station shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring. Surface mounted stations where indicated on the drawings shall be mounted using a manufacturer's prescribed matching red enamel outlet box.
- E. Addressable Interface Devices (monitor modules) shall be provided to monitor contacts for such items as water-flow, tamper, and PIV switches that are required to be connected to the fire alarm system. Provide the connection to these devices whether they are shown on the electrical contract drawings or not. These interface devices shall have single or dual contact monitoring capabilities. Where remote supervised relay is required the interface shall be equipped with a SPDT relay rated for 4 amps resistive and 3.5 amps inductive.

2.7 NOTIFICATION APPLIANCES

- A. The horn or horn/strobe appliance as indicated on the drawings shall be a synchronized temporal horn with a synchronized strobe light with multiple candela taps to meet the intended application. The strobe light taps shall be adjustable for 15, 30, 75, and 110 candela. The strobe shall flash at a

rate between 1/3 and 3 flashes/second. The sound output shall be rated at a minimum of 95 dBA at 10 ft. when tested in an anechoic chamber. The appliance shall be red for wall mounted and white for ceiling mounted. Ceiling mounted appliances shall be rated for that application.

- B. The strobe only appliance as indicated on the drawings shall be a synchronized strobe light with multiple candela taps to meet the intended application. The strobe light taps shall be adjustable for 15, 30, 75, and 110 candela. The appliance shall be red for wall mounting and white for ceiling mounted. Ceiling mounted appliances shall be rated for that application.
- C. An alarm extender panel shall be provided where needed. The power supply shall be a minimum of 6 amps. The power supply shall contain four supervised notification circuits maximum of 3 amps each circuit. The power supply shall contain built-in synchronizing modules for strobes and audibles. There shall be a 3 amp filtered auxiliary power limited output. There shall be a minimum of 8 options as to the operations of the inputs and outputs.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Perform work in accordance with the requirements of NFPA 70 and NFPA 72.
- B. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.
- C. All fire alarm cabling shall be supplied in conduit.

3.2 BOXES, ENCLOSURES AND WIRING DEVICES

- A. Boxes shall be installed plumb and firmly in position.
- B. Extension rings with blank covers shall be installed on junction boxes where required.
- C. Junction boxes served by concealed conduit shall be flush mounted.
- D. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.

3.3 CONDUCTORS

- A. Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.
- B. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.
- C. Wiring for strobe and audible circuits shall be a minimum 14 AWG, signal line circuits shall be minimum 18 AWG.
- D. All splices shall be made using solderless connectors. All connectors shall be installed in conformance with the manufacturer recommendations.
- E. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.
- F. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.
- G. A consistent color code for fire alarm system conductors shall be used throughout the installation.
- H. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

3.4 DEVICES

- A. Relays and other devices to be mounted in auxiliary panels are to be securely fastened to avoid false indications and failures due to shock or vibration.
- B. Wiring within sub-panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.
- C. All devices and appliances shall be mounted to or in an approved electrical box.

3.5 FIELD QUALITY CONTROL

A. Testing, general

1. All Alarm Initiating Devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.
2. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.
3. A systematic record shall be maintained of all readings using schedules or charts of tests and measurements. Areas shall be provided on the logging form for readings, dates and witnesses.
4. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector shall be corrected.
5. Test reports shall be delivered to the acceptance inspector as completed.
6. The installing contractor shall make instruments, tools and labor required to conduct the system tests available.
7. The following equipment shall be a minimum for conducting the tests:
 - a. Ladders and scaffolds as required to access all installed equipment.
 - b. Multimeter for reading voltage, current and resistance.
 - c. Two way radios, and flashlights.
 - d. A manufacturer recommended device for measuring airflow through air duct smoke detector sampling assemblies.
 - e. Decibel meter.

- B. In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the Engineer of Record and the AHJ.

3.6 ACCEPTANCE TESTING

- A. The contractor shall be responsible for demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.
- B. A program matrix shall be prepared by the installing contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input.
- C. The installing contractor, prior to the final test shall prepare a complete listing of all device labels for alphanumeric annunciator displays.
- D. The Contractor shall be responsible for contacting the local authority having jurisdiction to coordinate their witness of the below tests (at a minimum).
- E. The acceptance inspector shall use the system record drawings in combination with the documents specified during the testing procedure to verify operation as programmed. In conducting the acceptance test, the inspector may request demonstration of any or all input and output functions.
- F. The items tested shall include but not be limited to the following:
 - 1. System wiring shall be tested to show the following results and the system subsequence operation:
 - a. Open, Shorted or Grounded Circuits.
 - b. Primary and Battery power disconnected.
 - 2. System notification circuits and appliances operate as programmed. Audibility and Visual levels meet required standards.
 - 3. System shall demonstrate the correct messages at the FACP and Remote Annunciator.
 - 4. System off site reporting shall be verified for alarm, supervisory and trouble.

5. System shall be tested for stand-by battery back up as outlined in this specification.

3.7 DOCUMENTATION

- A. System documentation shall be supplied to the owner and shall include but not be limited to the following:
 1. System record drawings and wiring details (4 copies) including one set of reproducible drawings, and a CD ROM with copies of the record drawings in DXF format for use in a CAD drafting program.
 2. System Operating, Installation and Maintenance Manuals (4 copies).
 3. System matrix showing input signals to output commands.
 4. Provide a copy of the system program on a CD/DVD.
 5. **Warranty letter that details what is covered under the warranty and the start and end dates.**
 6. **NFPA 72 record of completion form filled out in its entirety by the fire alarm contractor.**

3.8 SPARE PARTS

- A. Provide 1 of each of the components listed. Spare devices must be the exact identical product of those submitted for the initial system operation:
 1. Audible/visual notification device.
 2. Visual only notification device.
 3. Manual pull station.
 4. Smoke detector and base (each type).
 5. Addressable relay module.
- B. Turn over spare part devices to customer representative at the beginning of the fire alarm installation so that they can be kept separate from the to be installed quantities.

3.9 WARRANTY AND SERVICES

- A. The contractor shall warranty the entire system for electrical and mechanical failures for a period of one year. This warranty shall include all parts, labor, maintenance, and software upgrades. The warranty shall begin with the completion of the acceptance testing or when beneficial use to the owner is determined.
- B. The fire alarm system subcontractor or manufacturer shall offer for the owner's consideration at the time of system submittal a priced inspection, maintenance, testing, and repair contract in full compliance with the requirements of NFPA 72, broken out annually for a period of 3 years after the initial warranty period has expired. If applicable, include any and all optional levels of support ranging from minimum (i.e. time and materials) to complete turnkey coverage (i.e. 4 hour response time). Submittals that do not include this offering shall be considered incomplete and be returned without review.
- C. Any future system additions shall include a separate breakdown of both parts and labor. Labor breakdown must include anticipated number of technician hours necessary to complete the addition. Future submittals or cost proposals that do not include this information shall be considered incomplete and be returned without review.
- D. The contractor performing the contract services shall be qualified, factory trained, and certified in the service and maintenance of the system provided and listed to maintain ongoing certification of the completed system to the "UL" installed system listing.
- E. The installation contractor shall furnish training as follows:
 - 1. Training in the receipt, handling, and acknowledgment of alarms.
 - 2. Training in the system operation including manual control of output functions from the system control panel.
 - 3. The total training requirement shall be a minimum of 2 hours, but shall be sufficient to cover all items specified. The contractor shall provide two such training sessions.

END OF SECTION