SECTION 16010 - BASIC ELECTRICAL REQUIREMENTS

PART 1.00 GENERAL

1.01 SCOPE

A. The work to be performed under these specifications shall include the furnishing of all labor, materials, equipment and services required for a complete electrical system as specified herein and as shown by the Drawings. A state of Louisiana licensed Electrical Contractor shall perform the work specified herein. The work includes but is not limited to:

1. Furnishing and installing underground service conduits and pull boxes from utility company vault to new transformer pad for utility company high voltage service conductors in accordance with requirements of the utility company.

2. Furnishing and installing transformer pad and underground secondary service conduits and conductors from new utility company transformer to main service entrance equipment, and coordination with the utility company for installation of metering and buildings power.

3. Furnishing and installing switchboard, distribution power panels, power panels, transient voltage surge suppression, dry type transformers, and disconnect switches for use within building.

4. Furnishing and installing lighting fixtures, receptacles, toggle switches, special outlet boxes, and floor boxes for electrical systems shown on Drawings.

5. Furnishing and installing emergency lighting and exit lighting fixtures and circuits.

6. Furnishing and installing emergency power system including natural gas fired generator, transfer switch, remote annunciation panel, conduit, wiring, transformers and power panels.

7. Furnishing and installing site lighting conduits only for utility company installed lighting.

8. Furnishing and installing lighting control system control panels with relay switches, and control wiring.

9. Furnishing and installing electrical conduit and wiring required for connection of mechanical equipment furnished under other sections of these specifications.

10. Furnishing and installing voice and data conduits, and telephone service conduits as shown on the drawings, and coordination with

the local telephone company for service to the building.

11. Furnishing and installing intercom system including main racks and consoles, administrative telephones, speakers, call-in switches, emergency call-in switches, classroom handsets, conduit, and wiring.

12. Furnishing and installing Fire Alarm Systems including manual stations, smoke, duct, and thermal detectors, horn/strobe alarm units, strobe only alarm units, speaker/strobe alarm units, voice evacuation panel, and main fire alarm control panel.

13. Furnishing and installing classroom audio system.

14. Furnishing and installing voice and data system conduits, wiring, racks, fiber cables, patch panels, and all required mounting hardware.

15. Furnishing and installing cable TV wiring, splitters, amplifier and outlets.

16. Furnishing and installing service conduits for cable TV service to the buildings and coordinating with the local cable TV company for cable service to the buildings.

17. Furnishing and installing conduits and wiring for closed circuit TV system.

18. Furnishing and installing security system, including motion detectors, door contacts, control panel, and keypads.

19. Furnishing and installing off site monitoring service for monitoring fire alarm and security systems during the one-year warranty period.

20. Furnishing and installing dimming control system with preset controls.

21. Installation of temporary construction power required by the General Contractor and Sub-Contractors during the construction period.

1.02 GENERAL CONDITIONS

A. The General Conditions and Supplementary General Conditions are a part of this section of these Specifications. The Contractor is cautioned to read and be thoroughly familiar with all provisions of the General Conditions. These conditions shall be complied with in every aspect. The word "shall" where used, is to be understood, as mandatory and the word "should" as advisory. "May" is used in the permissive sense.

1.03 GENERAL REQUIREMENTS

A. The Contractor is referred to all of the Drawings for building construction as well as the electrical Drawings.

B. The Contractor shall examine the site and shall verify to his own satisfaction the location of all utilities, and shall adequately inform himself as to their relation to his work before entering into a Contract and he shall base his bid on any conditions, which may be encountered during the progress of the work.

C. The Contractor shall furnish and install properly all materials, devices, equipment, supports, controls, appurtenances, etc., mentioned or required to make complete or satisfactory installations in working order whether shown or not. All electrical equipment shall be connected in accordance with manufacturer's instructions. All work shall be executed in a workmanlike manner and shall present a neat and mechanical appearance when completed.

1.04 MINIMUM STANDARDS

A. Applicable rules of the National Electrical Code apply as a minimum standard for this contract, but do not replace or reduce any specific requirement herein.

1.05 DRAWINGS

A. Plans and detail sketches are submitted to limit, explain, and define structural conditions, specified requirements, conduit sizes, and manner of erecting work. The Contractor is cautioned to field check and verify all existing conditions before bidding, as no extra compensation will be allowed for conditions found different than represented in the construction drawings and/or specifications. Written approval of the Architect shall be obtained prior to any alterations or additions to specified work.

B. Structural or other conditions may require certain modifications from the manner of installation shown, and such deviations are permissible and shall be made as required, but specified sizes and requirements necessary for satisfactory operations shall remain unchanged.

C. The drawings and these specifications are complementary to each other and what is called for by one shall be binding as if called for by both.

D. General arrangement of work is indicated on plans. Due to the small scale of the drawings, offsets, fittings, and boxes required are not all indicated; provide fittings, boxes, etc., as needed in accordance with codes and accepted practices.

1.06 SUPERVISION

A. The Contractor shall personally or through an authorized and competent representative, constantly supervise the work from beginning to completion and final acceptance. So far as possible, he shall keep the same foreman and workmen throughout the project duration.

B. During its progress, the work shall be subject to inspection by representatives of the Architect, at which times the Contractor shall furnish required information.

C. It is not the Architect's or Engineer's duty to direct or guarantee the work of the Contractor, but to assist the Owner in obtaining a complete building in accordance with plans, specifications and addenda and to furnish engineering services in accordance with recognized practices.

1.07 PRIOR APPROVALS

A. The Contractor shall base his proposal on materials as specified herein. Any references to a specific manufacturer or trade name is made to establish a standard of quality and to define a type of product and in no way is intended to indicate a preference for a particular manufacturer. It is the intent of these specifications to allow all manufacturers of equipment, products, etc., judged equal to the specified product to bid on a competitive basis.

1.08 MEASUREMENTS

A. The Contractor shall verify all measurements and shall be responsible for the correctness of same, before ordering any materials or doing any work. No extra charge or compensation will be allowed for any differences between the actual measurements and those indicated on the drawings.

1.09 LAWS, PERMITS AND FEES

A. The entire electrical work shall comply with the rules and regulations of the City, Parish, and State, including the State Fire Marshal and State Board of Health, whether so shown on plans or not. The Contractor shall pay fees for permits, inspections, etc., and shall arrange with the inspecting authorities all required inspections.

B. When required, the Contractor shall contact the local utility company regarding connection of permanent service.

1.10 SITE INSPECTION

A. The Contractor shall visit the site and familiarize himself with difficulties attendant to the successful execution of the work before bidding. Failure to visit the site shall not relieve the Contractor of the extent or conditions of the work required of him.

PART 2.00 PRODUCTS

2.01 MATERIAL AND EQUIPMENT

A. All materials, equipment, and accessories installed under this Contract, whether approved or not, shall be new and shall conform to all rules, codes, etc., as recommended or adopted by the National Association(s) governing the manufacture, rating and testing of such materials, equipment, and accessories.

2.02 SHOP DRAWINGS

A. The Contractor shall submit to the Architect complete descriptive and dimensional data on the following items for review and approval:

1. Service Entrance Disconnect Switches
2. Distribution Panelboards
3. Panelboards
4. Disconnect Switches
5. Lighting Fixtures, Lamps and Ballasts
6. Switchboard
7. Flush Floor Boxes and Stage Pocket Boxes
8. Fire Alarm and Voice Evacuation System Equipment, Wiring, and Devices
9. Telephone System Wiring, Jacks, Terminal Blocks
10. Data System Jacks, Fiber Cables, Fiber Panels, Patch Panels, and Racks
11. Intercom System including Control Panel, Speakers, Call-In Switches and Wiring
12. Audio, Video, and Voting Systems Equipment and Devices
13. Cable TV System Coaxial Cable, Connectors, Amplifiers, Splitters, and Couplers
14. Dry Type Transformers
15. Occupancy Sensors
16. Security System Devices
17. Lighting Control Panels
18. Transient Voltage Surge Suppression Devices
19. Diesel Generator
20. Automatic Transfer Switch
21. Pull Boxes
22. Dimmer System with Preset Controls

PART 3.00 METHODS OF INSTALLATIONS

3.01 CONTRACTOR COORDINATION

A. The Drawings are diagrammatic in nature. Cooperate with other trades so the interferences of facilities and equipment will be avoided.

3.02 OPENINGS, CUTTING AND PATCHING

A. Cut all openings as required for the electrical work. Patching will be done by the various crafts whose work is involved. Furnish and install all necessary sleeves, thimbles, hangers, inserts, etc., at such times and in such a manner as not to delay or interfere with the work of other Contractors. Caulk, flash or otherwise make weatherproof all penetrations through the roof and exterior walls.

B. Where conduit, cable or other items that are provided for under this contract penetrate fire rated walls or floors, the Contractor is to seal around the item to maintain the integrity of the rated system.

3.03 PAINTING

A. Painting shall be performed as described in the painting specifications. No painting will be required by the Contractor except for touch-up of factory finishes on equipment furnished under this contract.

3.04 APPLICABLE GENERAL CODES AND REGULATIONS

A. All electrical work and equipment, in whole or in part, shall conform to the applicable portions of the following specifications, codes and regulations in effect on that date of invitation for bids, and shall form a part of this specification.

1. National Electrical Code, 2008 Edition
2. National Electrical Manufacturers Association Standards
3. National Fire Protection Association Recommended Practices
4. Local, City and State Codes and Ordinances
5. National Board of Fire Underwriter's Recommended Practices
6. Life Safety Code
7. Standard Building Code

B. Equipment that has been inspected and approved by the Underwriter's Laboratory shall bear its label or appear on its list of approved apparatus.

3.05 TESTS AND INSPECTIONS

A. The Contractor shall assist in making periodic inspections or tests required by the Architect or Engineer. When requested, the Contractor shall provide the assistance of foremen and qualified craftsmen for reasonable duration of each test, etc.

3.06 SAFETY PRECAUTIONS DURING CONSTRUCTION

A. It shall be the Contractor's responsibility to furnish and install proper guards and instruction signs for prevention of accidents and to provide and maintain for the duration of construction any installations needed for safety of life and property.

3.07 HEATING AND AIR CONDITIONING SYSTEM

A. This Contractor shall be responsible for providing electrical service to all devices of the heating and air conditioning system, and is referred to the mechanical plan for the exact location of the various devices.

3.08 EQUIPMENT NAMEPLATE

A. Each item of electrical equipment installed by the Contractor shall be provided with an engraved nameplate noting the equipment's function or designation. Nameplates shall be engraved laminated plastic with black letters on a white background. Letters shall be 1/4" high, all caps.

3.09 PANELBOARD SCHEDULES

A. The Contractor shall provide and affix typed panelboard schedules for each panelboard. Schedule will accurately list equipment served by each branch circuit. Schedules shall identify the circuit type (RECEPTACLES, or LIGHTING, etc.) and accurately list room numbers of area circuit serves. Reproducing schedules as listed on the plans shall not be acceptable.

3.10 COMPLETION

A. The Contractor shall leave all electrical equipment with proper connections, and in proper working order. He shall test the entire electrical system to show that it is properly installed. Contractor shall leave all panels and switches completely fused or complete with circuit breakers.

3.11 RECORD DRAWINGS

A. The Contractor shall furnish one (1) complete set of drawings on which any changes in the work shall be shown. These drawings must be turned over to the Architect prior to final acceptance of the work.

3.12 GUARANTEE

A. The Contractor shall guarantee to keep the entire electrical system as installed by him or his subcontractors in repair and in perfect working order for one (1) year from the date of the final Certification of Final Acceptance, and shall furnish free of cost to the Owner, all material and labor necessary to comply with the above guarantee; said guarantee shall be based upon defective material and workmanship. In any case where equipment has a factory warranty exceeding this one-year limit, the full extent of the warranty shall apply.

3.13 CLEANING

A. When all work has been finally tested, the Contractor shall clean all

fixtures, equipment, conduits, ducts, and all exposed work. All cover plates and other finished products shall be thoroughly cleaned.

3.14 INSTRUCTION MANUALS

A. The Contractor shall provide three (3) operating and maintenance instruction manuals on all systems and equipment installed in the electrical work.

3.15 CONTRACTOR SPECIAL NOTE

A. The Contractor is again cautioned to refer to all parts of these Specifications and all Drawings, not just electrical sections, and the individual cross references made to other standard specifications or details describing any electrical work, which may be required under these other sections. The Contractor is cautioned to note carefully any other sections which may reference electrical work in order for this Contractor to fully understand the wiring requirements and electrical work that is required. Any conflicts found between the electrical sections of these Specifications or Drawings shall be immediately directed to the General Contractor for clarification.

B. These Specifications and the electrical Drawings size equipment, wire, conduit, etc. based on the horsepower of motors and/or wattages of equipment as shown on the plans or specified herein. The Contractor shall install electrical raceways, conductors, fuses, safety switches, breakers, contactors, starters or any other electrical equipment with the capacities to suit the horsepower and/or wattages of the equipment actually furnished and installed. The Contractor shall not furnish or install any electrical raceways, conductors, safety switches, contactors or motor starters of sizes smaller than those shown on the Drawings or specified herein. The Contractor shall coordinate with the various sections of the Specifications and/or Drawings and with the various Sub-Contractors to provide the properly sized equipment without additional cost to the Owner.

C. The Contractor shall be required to install electrical services underground. Contractor is cautioned to exercise extreme care when digging to not damage any new or existing utilities or equipment. Contractor shall be required to repair any utilities or equipment he may damage during construction.

3.16 SPARE DEVICES AND CIRCUITS

A. The Contractor shall include in pricing the furnishing and installing the following "spare" devices and/or circuits. Devices not installed during construction shall be delivered to the Owner for future use.

B. Additional Devices and Circuits:
   a. Four (4) exit signs.
   b. Eight (8) smoke detectors with base, conduit and wiring, and panel

programming changes.

c. Five (5) horn/strobe alarm devices with base, conduit and wiring and panel programming changes.
d. Five (5) strobe alarm devices with base, conduit and wiring and panel programming changes.
e. Eight (8) junction boxes located above the ceiling with 120 volt circuit at box.
f. Fifteen (15) duplex outlets connected to circuit in vicinity of new receptacle.
g. Ten (10) 120 volt, 20 amp circuits including additional breaker, conduit and wiring.
h. Fifteen (15) data station outlets including jacks, wiring, cable termination and identification.
i. Five (5) voice station outlets including jacks, wiring, cable termination and identification.
j. Five (5) intercom speakers complete with mounting back box, wiring and cable termination.
k. Five (5) intercom system call-in switches including mounting box, conduit and wiring.
l. Five (5) security system motion detectors including conduit and wiring and connection to the security system detection zone.
m. Two (2) manual fire alarm stations with back box, conduit, wiring and programming changes.

END OF SECTION

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1.00 GENERAL

1.01 GENERAL REQUIREMENTS

A. All material furnished shall be new and shall conform to all rules and codes as recommended or adopted by the National Association governing the manufacture, rating and testing of the material. All electrical equipment shall be UL listed for the intended use.

PART 2.00 PRODUCTS

2.01 RACEWAYS AND FITTINGS

A. Raceways permitted on this project shall be hot dipped galvanized rigid steel conduit; electrical metallic tubing (EMT); flexible metallic tubing; liquid-tight flexible metal conduit; and rigid polyvinyl chloride (PVC) conduit. All conduits shall be new and shall bear the inspection label of the Underwriter's Laboratories, Inc.

B. Metallic conduit shall be metalized, or hot-dipped galvanized. Non-metallic conduit shall be schedule 40 PVC.

C. Fittings for conduit shall be an approved type specially designed and manufactured for their purpose. EMT fittings shall be water tight, compression type. Rigid metal conduit fittings, bushings, and other components shall be galvanized. All fittings for rigid steel or aluminum conduit shall be threaded and coupled unless specifically approved otherwise by the Engineer.

2.02 EXPOSED CONDUIT

A. Exposed conduit shall be firmly supported on galvanized hangers; on brackets, hangers, or pipe straps; or by beam clamps. Conduit installed exposed shall be neatly aligned and run at right angles to the building walls or walls of the rooms in which they are installed. All exposed conduit shall be located to avoid all conflicts with architectural or mechanical components.

2.03 FLEXIBLE CONDUIT

A. Liquid-tight flexible metal conduit shall have a spiral wound, flexible, galvanized steel core and a tough extruded synthetic moisture-tight outer covering. All flexible conduits shall be UL listed.

2.04 GALVANIZED CONDUIT

A. Galvanized conduit furnished in accordance with these specifications shall

be of mild steel piping, galvanized inside and outside, and shall conform in all respects to the American Standard Association rigid Steel Conduit Specification C80.1-1959 and Underwriter's Laboratories Specifications.

B. The galvanized coat of zinc shall be of uniform thickness applied by the hot-dipped process to not only the inside surfaces of the conduit, but also to the threads of the conduit. It shall be further dipped in a chromic acid bath so as to chemically form a corrosive resistant protective coating of zinc chromate over hot-dipped galvanized surface. Each piece of conduit shall be straight, free from blisters and other debris, cut square and taper reamed, and furnished with coupling in 10 foot length threaded each end. The interior threaded surface of each coupling shall be galvanized to insure 100% galvanic protection on all surfaces. The hot galvanized zinc chromate on the inside and outside surfaces shall be sufficiently elastic to prevent cracking or flaking when sample of finished conduit is bent 90° at a minimum temperature of 60°F, the inner edge of the bend having a radius of six (6) times the inside diameter of the conduit.

2.05 RACEWAYS

A. Lay-in duct, JIC Wireway and troughs shall be NEMA 1 for indoor application and NEMA 3R for out door or applications exposed to weather or water. Raceways shall be sized as noted on Drawings, and shall have hinged or screw covers with captive screws. Finish shall be gray enamel. All components shall be UL listed for steel enclosed wireway or auxiliary gutter.

2.06 OUTLET AND SWITCH BOXES

A. Outlet boxes in concealed conduit systems shall be flush mounted. Boxes shall be galvanized steel of sufficient size to accommodate devices shown and shall have raised covers where required to meet requirements of NEC Article 314.

B. All boxes shall be stamped, one piece, galvanized steel, of proper size and shape for conduits entering them, and shall be UL listed and NEC approved for the intended use. Boxes shall be installed so that device and/or coverplates shall be tight and plumb with wall finish, have all unused openings closed with knock-out plugs, and be weatherproof for exterior locations.

C. Boxes for lighting fixtures shall be 4 inches octagon, not less than 1-1/2 inches deep, with fixtures stud fastened through from back box. Where boxes are installed in a concrete slab, boxes designed for this application shall be used.

D. Outlet boxes for switches in concealed work shall be standard switch boxes of required number of gangs. Outlet boxes for receptacles, telephone, and communication use in concealed work shall be 4 inch square, not less than 1-1/2 inches deep. Outlet boxes for switches and

receptacles installed in exposed conduit system shall be cast type FS or FD, number of gang as required. Outlet boxes for telephone and communication use in exposed systems to be cast, 4 inches square, not less than 1-1/2 inches deep.

E. Boxes are not to be installed back to back in walls. Offset with connecting conduit as specified. Do not use long, extended boxes that would effectively couple light and sound between adjoining spaces.

2.07 WIRE (600 VOLT AND BELOW)

A. All conductors used in the work shall be of soft drawn annealed copper having a conductivity of not less than 98% of that of pure copper. Conductors shall be standard code gauge in size, insulated and shall have insulation rated for use at 600 volts.

B. Unless noted otherwise or specified, insulation shall be type THW, THWN, or THHN for sizes up to and including No. 2 AWG. Insulation for wire sizes larger than No. 2 AWG shall be type THW, XHHW, or THHN. Lighting fixture wire shall be heat resistant type TF (150°C) with 300-volt insulation minimum. Wires shall be of the single conductor type. Sizes No. 8 AWG and larger shall be stranded. Sizes No. 12 thru No. 14 shall be single strand solid copper.

C. Throughout the system, all conductors shall be identified as to the phase and voltage of the system by color-coding in accordance with NEC 210.5. Color-coding shall be continuous the full length of the wire with surface printing at regular intervals on all conductors and for neutral conductors.

D. Color coding shall be as follows:

3phase, 480V System	3phase, 208V System
Phase 1-Brown	Phase 1-Black
Phase 2-Orange	Phase 2-Red
Phase 3-Yellow	Phase 3-Blue
Neutral-Gray	Neutral-White
Ground-Green	Ground-Green

2.08 WEATHERPROOF RECEPTACLES

A. Weatherproof receptacles shall be GFCI duplex receptacles as specified under WIRING DEVICES, mounted in a cast iron type FD conduit box and fitted with gasketed metal cover with spring. Weatherproof receptacles shall be flush mounted in exterior walls.

2.09 WIRING DEVICES

A. Wiring devices shall be as listed. The color of device shall match color of outlet cover plate. It shall be the responsibility of the Contractor to provide plugs, receptacles and fittings required for any equipment furnished or installed or connected under the contract.

	Leviton	P & S	Hubbell
Toggle Switches:			
20A 120/277V			
Single pole	1221-I	20AC1-I	1221-I
Three-way	1223-I	20AC3-I	1223-I
Duplex Receptacle:			
20A, 125V,			
NEMA 5-20R	5362-I	5362-I	5363-I
Ground Fault Circuit Interrupter:			
20A, 125V, Feed Through,			
NEMA 5-20R	6899-I	2091-S	GF-5362-I

B. Quad receptacles shall be 20 amp, 125 volt rated, NEMA 5-20R, with two (2) duplex receptacles or single four-plex device.

C. Toggle switches for lights in corridors shall be key switch type.

D. Wiring devices connected to emergency power circuits shall be RED and shall include RED cover plate.

2.10 OUTLET COVER PLATES

A. Unless otherwise specified, all outlets including voice/data outlets shall be fitted with cover plates. Cover plates shall be standard size, uniform in design and finish for switches, receptacles and other outlets requiring cover plates. Plates shall be one piece of the required number of gangs. All cover plates shall be high-impact, thermoplastic. Cover plates for devices connected to emergency power circuits shall be RED.

2.11 SPECIAL PURPOSE RECEPTACLE

A. Provide receptacles for special purpose devices as indicated on the plans. Refer to equipment specification for proper receptacle to be supplied. Provide stainless steel cover plate.

2.12 FLOOR BOXES

A. Multiple service floor box unit shall be stamped steel, concrete tight, and have fixed box partition. Floor box shall be fully adjustable and UL listed. Box shall have four (4) wiring compartments for separate communications services and power services. Box shall permit tunneling from end power compartment to end power compartment. Box shall include conduit knockouts from 1/2" through 1-1/4". Box shall be furnished with carpet or tile trim plate. Floor box shall be Walker RFB4 series and shall include: RFB-RB-SS internal duplex receptacle bracket, and RFB-4TKO-SS internal bracket for four (4) RJ jack opening. Power compartments shall contain 20 amp, 125 volt, AC rated, duplex receptacle. Communication compartment shall contain provisions for telephone and computer

connections and other communications wiring. Communications wiring shall terminate onto communications outlet jacks as specified in other sections of these specifications. Boxes shall contain a UL listed, die-cast aluminum trim ring with textured, aluminum coated finish and two-partition feed doors to allow multiple workstation feeds. Activation kits shall be Walker #S36PPALTC, or approved equal.

B. For floor boxes located in the board room, see product specifications listed in the Audio, Video, Voting section.

2.13 FIRESTOPPING PRODUCTS

A. The Contractor shall provide and install at all fire-rated wall through-penetrations, a non-hardening, conformable firestop system. The system shall consist of a water insoluable putty and suitable damming materials (where required). The non-hardening putty shall be a two-staged intumescent and capable of expanding up to 8 times its original volume. This putty shall contain no asbestos, no fiberglas, no solvents nor corrosive mineral salts of any kind. It shall remain soft during its installed life and shall be capable of being removed and reinstalled to facilitate the addition of cables or pipes. The putty shall exhibit aggressive adhesion to all common building materials and penetrants and shall allow reasonable movement of penetrants without being displaced. The firestop system shall be tested to the time/temperature requirements of ASTM E119 and shall be tested to UL 1479 (ASTM E814) and Classified for up to 3 hours.

B. The Contractor shall provide and install at all fire-rated floor through-penetrations, a permanent firestop system. The system shall consist of a lightweight, cementitious mortar and suitable temporary damming materials (where required). The dry mortar shall be fast drying and low in density (<45lb/cu. ft.). The mortar shall not shrink or crack during its cure. It shall be pigmented red for ease of inspection and shall form a surface capable of being sanded or painted to match surrounding floor surfaces. The dry seal shall be capable of being bored using a standard wood bit or screwdriver. The firestop system shall be to the time/temperature requirements of ASTM E119 and shall be tested to UL 1479 (ASTM E814) and Classified for up to 3 hours.

2.14 METERING

A. The contractor shall install metering equipment on the main electrical service as shown on the drawings. Contractor shall contact the utility company to determine the metering equipment requirements and installation requirements. Contractor shall coordinate installation of main building power with the utility company.

2.15 PULL BOXES

A. Pull boxes shall be heavy duty, traffic bearing type. Boxes shall be polymer concrete and fiber reinforced polyester construction. Boxes shall

be furnished complete with bottom and cover with logo. All pull boxes shall be sized 48" wide x 78" long x 48" deep. Boxes shall be factory assembled.

B. Power pull boxes for power system shall be approved by Entergy for use with high voltage services to be installed. Cover shall have POWER legend. Boxes shall be CDR Systems Corporation #PA12-4878-48B.

PART 3.00 EXECUTION

3.01 WIRING - GENERAL

A. Unless otherwise specified, all wiring shall be installed in conduit. No wire shall be smaller than No. 12 unless noted otherwise. Wiring for low voltage control may be #14 AWG. Wire for each branch circuit shall be of single size and type from the branch circuit protective device the last outlet of the circuit. BX wiring shall not be allowed.

B. Feeders, motor circuit conductors and main service entrance conductors shall run their entire length without joints or splices. Wiring for branch circuits shall run the entire length without splices, with splices and joints made only at outlets or in accessible junction boxes only when absolutely necessary and approved by the Engineer. Joints and splices in branch circuit wiring shall be made with compression type solderless connectors.

C. Connectors of the non-metallic screw on type are not acceptable. Terminations or splices for conductors No. 6 AWG and larger shall utilize bolted connecting lugs. All splices and terminations shall be insulated in an approved manner by an integral or separate cover or by taping to provide insulating value equal to that of the conductors being joined.

D. Type THW or THWN conductors may be connected directly to recessed fixtures only when the fixtures are equipped with outlet boxes listed by Underwriter's Laboratories, Inc. for use with wire having insulation rated for maximum operating temperatures of 75°C (167°F); otherwise, for fixtures not rated for 75°C directly connection, use 125°C insulated conductors from the fixture to an outlet box placed at least one (1) foot, but not more than four (4) feet from the fixture.

E. Branch circuit home run numbers shown on the drawings shall be used as a guide for connection of circuit wiring to similarly number protective devices in branch circuit panelboards. Requests for changes in the plans shall be directed to the Architect. No changes shall be made without approval from the Architect.

3.02 ELECTRICAL SERVICE GROUNDING

A. Main electrical service equipment, conduit work, motors, panelboards and all other electrical equipment shall be effectively and permanently

grounded. Grounding connections and conductor sizes shall be in accordance with requirements of the National Electrical Code, Article 250 and local or State ordinances.

B. All conduit entering panelboards shall be grounded to the panelboard by means of a grounding type locknut installed on the inside of the panelboard. Where the continuity of the metallic conduit system is interrupted by a run of non-metallic conduit, a separate grounding conductor, sized in accordance with NEC Table 250.122 shall be run in the conduit with the insulated conductors. A separate grounding conductor as described above or as called for on the plans shall be run in the conduit with the circuit conductors for all circuits serving multi-outlet assemblies.

C. Conduit runs shall be increased in size where necessary to accommodate the grounding conductor in addition to circuit conductors. The grounding screw on all grounding type receptacles shall be securely grounded to the outlet box using a No. 12 green insulated conductor attached to the outlet box with lug screw.

D. All switch legs shall include a green ground conductor connected to the circuit ground conductor and terminated in the switch outlet box.

3.03 CONDUIT - MATERIALS AND METHODS

A. Conduit shall be installed as per NEC and NEMA regulations and the manufacturer's recommendations. Conduit shall be as follows:

B. Rigid Steel Conduit shall be used for all conduits exposed to the weather, and underground conduit except where non-metallic conduit is specified or approved. Underground and under slab runs are to be watertight. All horizontal runs of underground conduit shall utilize rigid steel elbows on vertical risers. Conduits used for receptacles and run under the building slab, shall be hot dipped galvanized rigid steel and shall be 3/4" minimum size.

C. All conduits routed underground shall not be placed in building slab. Conduits larger than 1" routed under building slab shall be routed below the vapor barrier. Minimum conduit size allowed to be routed underground shall be 3/4". Conduits routed under building slab may be PVC. All conduits rising vertically out of slab or out of ground shall be rigid steel.

D. Electrical Metallic Tubing shall be used for all other feeders, branch circuit and communications and control wiring where rigid steel or non-metallic conduit is not specified.

E. Non-metallic conduit, minimum schedule 40 PVC, shall be permitted to be installed underground. Non-metallic conduit shall not be used in any environmental air plenum. If PVC conduit is run, a full sized grounding

conductor shall be pulled with the circuit conductors. PVC conduit shall not be run exposed. Where PVC conduit is run underground, it shall be encased in concrete or run minimum 24" below grade, or at the depth below grade shown on the drawings.

F. Flexible metallic tubing and EMT shall only be permitted in spaces above finished ceilings and within enclosed walls within the interior of buildings. Flexible metallic tubing shall only be permitted for the final six (6) feet of conduit runs to fixtures located above finished ceilings. No flexible metallic tubing or EMT will be permitted exposed. Also, EMT may not be installed in or below concrete slabs.

G. Flexible metal conduit or liquid-tight flexible metal conduit shall be used for the final connection of runs to motors. Flexible conduit shall be at least twelve (12) inches, but not more than 48 inches long. Where used, an external grounding conductor shall be run with conduit unless conductor is made as a part of the conduit.

H. Conduits installed underground and used for communications system wiring shall be reviewed with the communications contractor prior to installation. Conduits below the vapor barrier may require moisture proof wiring to comply with the structured connectivity solution. Conduits may need to be installed above the vapor barrier to maintain connectivity solution compliance.

3.04 CONDUIT - GENERAL

A. Fittings for rigid steel conduits shall be hot-dipped galvanized steel and shall be of a type especially designed and manufactured for their purpose. Fittings for EMT shall be die cast zinc type. Rigid conduit joints for single conduit runs shall be made with threaded fittings made tight with at least five threads fully engaged. Fittings for rigid non-metallic conduit shall be solvent welded.

B. Where they enter boxes or cabinets that do not have threaded hubs, conduits shall be secured in place with galvanized locknuts inside and outside the cabinet and shall have bushings inside. Conduits larger than 1-1/4 inch shall have galvanized locknuts and galvanized bushings.

C. All conduits shall be installed concealed or as indicated or scheduled on the drawings and shall be of sufficient size to accommodate the required number of insulated conductors including equipment grounding conductor where such grounding conductor is required or specified.

D. Conduit runs shall be straight; elbows and bends shall be uniform, symmetrical and free from dents or flattening. Exposed conduit shall be firmly supported on galvanized hangers; on brackets, hangers, or pipe straps; or by beam clamps. Conduit installed exposed shall be neatly aligned and run at right angles to the building walls or walls of the rooms in which they are installed. All exposed conduit shall be located to avoid

all conflicts with architectural or mechanical components.

E. Pull boxes shall be installed as required to permit proper installation of conductors and expansion fittings installed where conduit runs cross building expansion joints.

F. Conduit shall be run no closer than six (6) inches to covering of hot water or steam piping except where crossings are unavoidable. Conduit shall be kept at least one (1) inch from crossing steam and hot water piping.

G. Conduit shall be held securely in place by hangers and fasteners of appropriate design and dimensions for the particular application. Support shall be such that no strain will be transmitted to outlet box and pull box supports. Wire shall not be used, with or without spring steel fasteners, clips or clamps, for the support of any conduit. Conduit shall not be supported by or attached to duct work unless specifically allowed otherwise.

H. Hangers and other fasteners shall be supported on solid masonry with inserts or expansion sleeves and bolts, on wood with wood screws, hollow masonry with toggle bolts, on steel with machine screws or welded threaded studs. Fastenings shall be proof tested by the Contractor for secure mounting.

I. All conduits shall be cut square and reamed at the ends. The conduit system shall be complete and cleaned before any conductors are installed. Open ends of all conduits shall be capped until conductors are installed. A non-metallic fish wire shall be installed in all empty conduits. Empty conduit shall remain capped.

J. Contractor shall refer to National Electrical Code Appendix C, Conduit and Tubing Fill Tables for Conductors and Fixture Wire of the Same Size. Contractor shall refer to the appropriate table for the conduit and wire condition and shall install wiring in accordance with code requirements.

3.05 FLEXIBLE CONDUIT

A. Flexible metal conduit may be used for short final connections to equipment where permitted by governing codes. Flexible metal conduit shall be sized and supported in accordance with Article 350 of the NEC or more stringent local codes. A separate equipment-grounding conductor sized in accordance with NEC Table 250.122 shall be installed in flexible conduit unless exceptions are allowed by governing codes and if the fittings used are UL listed for the purpose.

B. Liquid-tight flexible metal conduit shall be used where flexible conduit is permitted and desired and conditions of installation, operation, or maintenance require protection from liquids, vapors, or solids and in other hazardous locations where specifically approved. Flexible conduit for all exterior motor connections shall be liquid-tight. Liquid-tight flexible conduit shall be used with terminal fittings approved for the purpose.

3.06 FIRE-RATED WALL AND FLOOR THROUGH-PENETRATIONS

A. All fire-rated walls or floors penetrated by this Contractor shall be properly sealed with fire stopping materials. All floor through-penetrations shall be fire stopped with a light-weight mortar material. Wall through-penetrations shall be fire stopped with a non-hardening putty material. Contractor shall see that all penetrations are fire stopped and seals are inspected.

3.07 SUPPORTS AND FITTINGS

A. The Contractor shall furnish and install all supports for equipment under this contract. Supports shall be spaced at intervals of eight (8) feet maximum for rigid conduit and five (5) feet maximum for EMT and as necessary to obtain rigid support. Perforated strap supports will not be permitted.

B. All conduits shall be firmly secured with pipe clamps, conduit straps, or suspension hangers as appropriate. Fasten to steel with screws in tapped holes, to wood with wood screws, and to masonry with expansion anchors. Expansion anchors shall have a minimum pull out load of 1,200 pounds and an ultimate shear load of 1,950 pounds.

C. All conduit, fixtures, and accessories shall be rigidly supported to form a firm, well-braced installation.

D. Joints shall be made tight with standard galvanized or sheradized couplings; corners turned with fittings, elbows, or long radius bends.

E. Low voltage wiring installed above accessible ceilings shall be supported on J-hooks. J-hooks installed for communications system wiring shall not be used for other low voltage system wiring (fire alarm, security, EMS controls, etc.).

3.08 WEATHERPROOF EQUIPMENT

A. All disconnect switches, starters, and other electrical equipment located on the exterior of the building or exposed to the outside shall be enclosed in a rain-tight enclosure.

B. All lighting fixtures or other devices located on an exterior wall of the building shall be mounted on a flush-mounted, cast outlet box.

3.09 MOUNTING HEIGHTS

A. Unless otherwise noted on the drawings or required by the Architect, the following mounting heights shall apply:

Toggle Switches	4'-0"
Receptacles	1'-6"
Panelboards	6'-0" to top
Telephone Outlets	1'-6" (48" for wall phone)

Safety Switches	5'-0" to top
Motor Control Equipment	5'-0" to top
Wiring Devices above counters	0'-6" above counter top
Fire Alarm Manual Stations	4'-0"
Fire Alarm Annunciation Devices	80" or 6" below ceiling (whichever is lower)

B. Upon permission of the Architect, mounting heights may be adjusted to simplify cutting of masonry units or to facilitate furniture and cabinet arrangements. Dimensions above refer to the centerline of the device unless noted otherwise.

3.10 UNDERGROUND CONDUIT

A. Conduit run underground shall be routed at least 24" below top of grade. Underground conduits with 480-volt services shall be a minimum of 30" below top of grade. Conduit shall be securely supported on plastic spacers placed at intervals of 4' maximum and tied in place securely. Maintain 2" separation between conduits. Conduit joints shall be made up watertight to prevent the entrance of moisture. Provide warning tape approximately 12" above buried conduits.

B. Horizontal portions of conduit installed underground 1" and larger may be schedule 40 PVC plastic. Vertical portions of underground conduit shall be rigid galvanized steel with an approved metallic bushing at point of entry. Termination elbows shall be rigid galvanized steel installed using a plastic-to-metal adapter. A full sized copper, grounding conductor shall be provided for the full length of each non-metallic conduit, terminated with an accessible connection to a ground lug on the cabinet or steel conduit extension.

C. Underground conduits shall be installed pitched to drain away from the building and shall use long radius bend instead of standard elbows. Empty conduits shall be capped with an approved plug. Where conduits, ducts, etc., pass under sidewalks, roads, or curbs, this Contractor shall use schedule 40 PVC conduit. The conduit shall extend at least 3' on either side of the sidewalk, road, etc.

D. Before installing cables in underground conduits, the Contractor shall have a mandrel 1/4" smaller than the conduit inside diameter pulled through each conduit. All underground conduits shall be swabbed before cables are pulled.

END OF SECTION

SECTION 16400 - SERVICE AND DISTRIBUTION

PART 1.00 GENERAL

1.01 SYSTEM VOLTAGE

A. The distribution voltage shall be 277/480 volt, 3 phase, 4 wire, as provided from the new utility company service transformers. Power shall be transformed to 120/208 volt, 3 phase, 4 wire, via dry type transformers to be furnished and installed as part of this project, as described on the drawings.

1.02 TERMINATIONS

A. All wiring shall be sized based on 75°C rated conductors. All connectors shall be rated for 75°C in accordance with N.E.C. Article 110-14 requirements.

PART 2.00 PRODUCTS

2.01 SAFETY SWITCHES

A. Furnish and install safety switches as shown on the Drawings. All switches shall be fused NEMA Heavy Duty Type HD and Underwriter's Laboratories listed. All switches shall have blades that are fully visible in the "OFF" position with the door open. Switches shall be dead-front construction with permanently attached arc suppressers. Lugs shall be UL listed for copper and aluminum conductor and front removable. All current carrying parts shall be plated to resist corrosion. Switches shall be quick-make, quick-break type. During operation of the switch, the movable contacts shall not be able to be restrained by the handle once the closing or the opening action of the contacts has been initiated. Switches shall have cover interlocks to prevent opening of the switch door while the switch is in the "ON" position or closing the switch with the door open. Switch shall have padlocking capabilities in the "OFF" position.

B. Safety switches shall be rated 600 volts for 480 volt service and rated 240 volts for 208 volt service. Switches shall be motor rated when used for motor loads. Switches shall be NEMA 1 enclosed for indoor applications and NEMA 3R for outdoor or wet area locations.

C. Switches used for service entrance shall be service entrance rated. Safety switches shall be furnished complete with fuses.

D. Safety switches shall be Square D Heavy Duty Class 3110 type, Cutler-Hammer type DH, or Siemens Heavy Duty Vacu-Break type.

2.02 FUSES

A. All fuse holders shall be provided with dual-element, time-lag fuses as scheduled on the Drawings or as recommended by the equipment manufacturer. Fuses shall be rated 200,000 AIC. Fuses shall be Buss Fusetron, Economy Econ, or Gould Shawmut Tri-Onic for component protection and Buss Limitron, Economy Econolin, or Gould Shawmut Amp-Trap for circuit protection.

2.03 CIRCUIT BREAKER PANELBOARDS

A. Panelboards shall be sized as shown on the drawings and schedules, and shall be the bolted breaker panelboard type.

B. All branch breakers are to be quick-make, quick-break (over center toggle device) with trip indication and common trip on all multiple breakers. Trip indication shall be clearly shown by breaker handle taking a position between "ON" and "OFF" position. Breakers shall be ambient compensated to carry full NEC load in 120 degree F room temperature. Panelboards shall have distributed phase busing throughout. Any two adjacent single pole breakers shall be replaceable by a two pole breaker, and any three adjacent single pole breakers shall be replaceable by a three pole breaker.

C. Minimum interrupting capacity of breakers shall be as shown on panel schedules. No breakers shall be rated less than 10,000 RMS symmetrical amperes.

D. Branch breakers shall be numbered 1, 3, 5, etc. from top to bottom beginning at the top of the left hand column so that #1 shall be on phase A, #3 on phase B, and #5 on phase C.

E. All breakers shall be bolt on type. Panelboards for 120/208 volt or 120/240 volt service shall be GE type NLAB, Square D type NQOD, Siemens type CDP-7, Cutler-Hammer POW-R-LINE series, or equal. Panelboards for 480/277 volt service shall be Square D type NEHB, Siemens type Sentron, Cutler-Hammer POW-R-LINE series, or equal.

F. Refer to transient voltage surge suppression specifications for requirements of TVSS equipment to be included in panelboards.

2.04 DISTRIBUTION PANELBOARDS

A. Distribution Panelboard sections shall be of the NEMA panel mounted type, with louvers at the front, both top and bottom. Wiring gutters for the branch devices shall be per NEC 373-6 as a minimum, with removable cover plates. The panelboard section shall be designed so that molded case circuit breakers, fusible switches, and motor starters may be installed in the same distribution section. The branch protective devices shall meet the requirements as described below.

B. Panelboard shall be Square-D I-Line Panelboards, Siemens Sentron Panelboards, Cutler-Hammer Pow-R-Line Panelboard, or approved equal. All panelboards shall meet the requirements of the latest National Electrical Code (NEC) and applicable UL and NEMA standards.

C. The panelboard shall be floor or surface mounted, as shown on the Drawings. Structure shall be bolt-together construction. The enclosure shall not be less than 32 inches wide, constructed of code gauge steel, painted ANSI-61.

D. Bus bars and breaker branch bus shall be manufactured from 98% conductivity copper. Bus bars shall be supported using glass-filled polyester type insulators. Porcelain insulators or supports shall not be used. Panels shall be completely bussed for ease of installing future protective devices in the entire panel spaces. All bolts or supports used to connect current-carrying parts together shall be of the case hardened, thread forming type, and be accessible for tightening from the front of the panel. Locate next to each breaker, or provision, and individual circuit card for proper identification of circuits. Numbering tape, painted numbers, or use of more than one number per breaker is unacceptable. Riveted to the front cover shall be a metal nameplate which identifies: the name of the panel manufacturer, the manufacturer's shop order number, panelboard type, system voltage and bus ampacity.

E. Install main breaker panels as indicated on the drawings. Main breaker shall include ground fault protection as required by National Electrical Code. The connection from the load side of the main breaker to the panel bus shall be bus bar - the use of insulated wire shall not be permitted. Panelboards for use as service entrance equipment shall be so labeled.

F. An individual terminal or lug shall be provided for each neutral wire. The practice of connecting several neutral wires to a common terminal, or using several terminals to terminate a single neutral conductor, shall not be permitted.

G. Branch Protective Devices - Branch protective devices shall be molded case circuit breakers. Molded case circuit breakers shall be of the quick-make, quick-break, trip-free, thermal magnetic type with frame, trip, and voltage rating, either 2-pole or 3-pole, as indicated on the plans. All breakers shall have an interrupting capacity of not less than 10,000 amperes RMS symmetrical at the system voltage, or as shown on the drawings. All breakers shall be removable from the front of the power panelboard without disturbing adjacent units. The power panelboard shall have space or provision for future units, as shown on the plans.

2.05 DRY TYPE TRANSFORMERS

A. Contractor shall install dry type transformer(s) in the size and at the location(s) as shown on the drawings. Transformers will be used to step down voltage from 480 volts to 120/240 volts. All transformers shall

comply and must be tested in accordance with UL, NEMA and ANSI standards. Transformers shall be energy efficient and shall meet NEMA Standard TP-1 requirements.

B. Transformers shall have the KVA ratings shown on the drawings. Transformers shall be three phase type rated for 480 volts primary and 120/240 volt secondary as shown on the drawings. Transformers shall be self-cooled. When transformer is delivering full KVA load continuously, temperature rise shall not exceed 150 degrees C above a 40 degree C ambient with 200 degrees C temperature class insulation system. The average sound level shall not exceed NEMA standards. Transformers shall have four external type taps, two 2-1/2% FCBN and two 2-1/2% FCAN.

C. Transformers shall be floor mounted on isolation pads. Enclosure shall be heavy gauge steel with ventilation openings protected against falling dirt and drip, and shall be shielded against actual touching of live parts. A nameplate in accordance with NEMA standards shall be permanently affixed to the enclosure.

D. Transformers shall be equal to Siemens ITE Dry Type, Square D Class 7400 Dry Type, General Electric type QL, Cutler-Hammer type DT, or approved equal.

2.06 SWITCHBOARD

A. GENERAL CONSTRUCTION: Switchboards shall be dead front type, completely metal enclosed, with self supporting structure independent of wall supports. Voltage rating shall be 277/480 volt, 3 phase, 4-wire, as indicated on the drawings. It shall consist of the required number of vertical sections bolted together to form one rigid switchboard. Enclosure shall be NEMA 1 indoor construction. The sides shall be covered with removable screw-on plates. All edges of front cover panels shall be formed.

B. Equipment shall comply with the latest applicable standards of NEMA PB2 and UL 891. Where switchboards are used as service entrance equipment, they shall comply with all NEC and UL requirements for service entrance and a UL service entrance label shall be provided.

C. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. All control wires shall be marked.

D. Switchboard shall be provided with adequate lifting means and shall be capable of being rolled or moved into installation position.

E. Switchboard shall be Square-D Power Style QED Switchboards, General Electric AV-Line, Siemens Sentron Switchboards, Cutler-Hammer Pow-R-

Line C Switchboard, or approved equal.

F. BUSSING: All bus bars shall be silver plated copper with bolted connections at joints. The bus bars shall be of sufficient size to limit the temperature rise to 65°C rise based on UL tests, and rated to withstand mechanical forces exerted during short circuit conditions when directly connected to a power source having an available fault current of 65,000 amperes symmetrical at rated voltages.

G. A ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard. An incoming ground lug shall be furnished. Other ground lugs for feeder circuits shall also be supplied as shown in the schedules on the drawings. All hardware used on conductors shall be high-tensile strength and plated. All terminals shall be of the anti-turn solderless type suitable for copper or aluminum cable of sizes indicated for 75°C cable.

H. Copper busway, sized as shown on the Drawings shall be the main service feeder for each switchboard. The switchboard manufacturer shall be responsible for coordination, proper phasing, and internal bussing to the incoming busway.

I. All switchboard sections shall be fully bussed at rated switchboard capacity. Bussing shall extend the full length of each section.

J. CONSTRUCTION: Switchboard sections shall be front and rear accessible, not less than 38" deep, and both the front and rear of all sections shall align. The branch devices shall be front removable and panel mounted with line and load side connections front accessible. Provide lugs on all devices for cable sizes shown on drawings.

K. Feeder devices 150 ampere frame through 1200 ampere frame shall be panel mounted type construction. Devices over 1200 ampere frame or main devices shall be individually mounted when required. Devices rated 1000 ampere or greater shall include ground fault protection in accordance with N.E.C. requirements.

L. MAIN PROTECTIVE DEVICES: Main protective devices to be installed in the main device section shall be rated for 277/480 volts, short circuit rating of 65,000 amps, and sized as shown on the Drawings. Breakers shall be rated 100% continuous duty and approved for reverse connection. Breakers shall be stationary type, insulated case circuit breaker construction with manual operation. Breakers shall be equipped with micropressor-based trip units designed for true RMS sensing and with fully adjustable characteristics necessary for a selective coordinated system.

M. BRANCH PROTECTIVE DEVICES: Branch protective devices shall be molded case circuit breakers. Molded case circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free, with

frame, trip, and voltage rating, either 2-pole or 3-pole, as indicated on the plans. All breakers shall have an interrupting capacity of not less than 100,000 amperes RMS symmetrical at the system voltage. All breakers shall be removable from the front of the power panelboard without disturbing adjacent units. The power panelboard shall have space or provision for future units, as shown on the plans.

N. Branch circuit breakers rated below 70 amps shall be thermal-magnetic trip units with inverse time-current characteristics. Breakers rated 70 amp through 250 amps shall have thermal-magnetic trip units with inverse time-current characteristics, and shall have interchangeable trip units. Breakers rated 225 amp and above shall be provided with interchangeable trip units. The interchangeable trip unit shall be selected to carry 100% of circuit rated current.

O. NAMEPLATES: Engraved nameplates shall be furnished for all mains and feeder circuits with designation and circuit number as indicated on the drawings. Furnish master nameplate giving voltage, ampere rating, short circuit rating, manufacturer's name, general order number and item number.

P. ENCLOSURES: Enclosures shall be of indoor ventilated construction as shown on the drawings. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 and use the manufacturer's standard process.

2.07 TRANSIENT VOLTAGE SURGE SUPPRESSION

A. Tansient voltage surge suppression (TVSS) shall be in accordance with the following standards:
   a) Underwriters Laboratory (UL)
   b) American National Standards Institute (ANSI)
   c) Institute of Electrical and Electronics Engineers (IEEE)
   d) National Electrical Manufacturers Association (NEMA)
   e) National Fire Protection Association (NFPA)
   f) Occupational Safety and Health Act (OSHA)
   g) Federal Information Processing Standards, Pub 94 (FIPS)
   h) ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits, Category C
   i) ANSI/IEEE C62.45, Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
   j) UL 1449, Current Edition - Transient Voltage Surge Suppressors
   k) NEMA LS-1 (1992), Low Voltage Surge Protective Devices
   l) NEC Article 285

B. Manufacturers meeting these requirements will be accepted. Submittal information must include Test Reports from a NRTL (R&B Labs preferred) showing single impulse testing matching label rating, including fuses, UL documents showing SVR ratings and symmetrical fault current withstand

ratings, and NRTL report showing the device capable of surviving a minimum of 5,000 impulses using 10x1000□s waveform.

C. Electrical Requirements:
   a) System voltage shall be as indicated on drawings.
   b) The TVSS shall be UL Tested and labeled as a complete assembly to a symmetrical fault current rating greater than or equal to the rating of the connected panel, in accordance with NEC Article 285, without the requirement of a dedicated breaker feeder to obtain the fault current withstand rating.
   c) The Suppression Voltage Rating (SVR) shall be tested with the integral disconnect in accordance with UL-1449, Second Edition. The UL SVR values shall not exceed the following (including disconnect). If the device is remote mounted it shall be fed by a circuit breaker and the UL SVR rating shall include the breaker in series with the TVSS.

      SVR Values Wye Module:
      120/208 volt – L-N 400, N-G 400, L-G 400
      277/480 volt – L-N 800, N-G 800, L-G 800

D. Protection and Filtering Elements – The TVSS shall have a maximum surge current rating of:

Service Entrance	100kA per mode
Distribution Panel	100kA per mode
Branch Panel	80kA per mode

E. Devices that derive a maximum surge current rating by adding test results of individual components are not acceptable. Systems using selenium, gas tubes or silicon avalanche diodes in surge current path are not acceptable. The Maximum Continuous Operating Voltage (MCOV) for all voltage configurations shall be 115% of nominal or greater.

F. Standard Monitoring features:
   a) Operational status indicating lights.
   b) Audible alarm and alarm indicating light and test switch.
   c) Dry contacts for remote monitoring purposes.
   d) Transient voltage surge counter.

G. Equipment Mounting
   a) Distribution Panel TVSS – The TVSS device shall include an integral disconnect switch which has been tested to the surge current rating of the TVSS and match or exceed the fault current rating of the board per NEC 285. The Disconnect must switch the phases and neutral. Use of circuit breakers for disconnect mean is not acceptable due to impedance and the requirement for neutral disconnect. The TVSS shall be mounted next to the panel.
   b) Branch panel TVSS – The TVSS device shall be direct bus to bus connected, or wall mounted. Use of a breaker to feed an integral

device shall not be acceptable.

PART 3.00 EXECUTION

3.01 COORDINATION

A. Contractor shall coordinate all service and distribution work with other crafts on the project.

3.02 TEST AND BALANCING

A. At such times as the Architect directs, the Contractor shall conduct in the Architect's presence operating tests to demonstrate the electrical systems are installed and will operate properly and in accordance with the requirements of the specifications. The Contractor shall furnish instruments and personnel required for such tests. Any work that is found to be defective, or material that are found to vary from the requirements of the drawings or specifications shall be replaced by the Contractor without additional cost of the Owner.

3.03 EMERGENCY CIRCUITS

A. All wiring for emergency power and lighting circuits shall be run in conduits independent of all other circuits or conductors. Emergency circuit installations shall be made in accordance with National Electrical Code Article 700.9.

3.04 EQUIPMENT FUSING

A. All equipment shall be furnished complete with fuses as described herein and/or as shown on the Drawings. Contractor shall furnish one set of spare fuses for each size fuse furnished on the project. Fuses shall be delivered to Owner prior to acceptance of project.

B. Fusing for protective equipment shall be of the type specifically designed for the intended application. Fuses for service entrance rated equipment shall be Class L. Fuses for branch circuit protection shall be Class RK5 unless specified otherwise. Provide protective fuses as specifically required by the equipment manufacturer.

3.05 INSTALLATION

A. The Electrical Contractor shall place a sign at the Main Switchboard indicating the type and location of the emergency generator in accordance with National Electrical Code Article 702.8(A) requirements.Disconnecting means shall be provided for each motor and motor controller, and shall be located within site from the controller and motor locations in accordance with National Electrical Code Article 430.102 requirements.

END OF SECTION

SECTION 16450 - EMERGENCY POWER SYSTEMS

PART 1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-16 Basic Electrical Materials and Methods sections apply to work specified in this section.

1.02 SUMMARY

A. Extent of natural gas generator set work is indicated herein, and is hereby defined to include, but not by way of limitation, natural gas engine, electrical generator, engine starting system including batteries, instrument control panel, weather-protective housing, annunciator panel, exhaust silencer and accessories.

B. Type of generator set required for the project includes the following:

1. Natural gas engine-driven generator.

C. Concrete and grout for engine-driven generator pad and foundation, frame and bedplate.

D. Vibration control for engine-driven generator units shall include pads, springs, rails, bases, hangers and connectors as required for vibration control and isolation.

E. Natural gas piping and associated accessories required for installation of engine-driven generator unit is specified in Division-15, section 15488. Electrical contractor, as prime contractor shall be responsible for natural gas piping.

F. Refer to other Division-16 sections for wires/cables, electrical boxes and fittings which are required in conjunction with engine-generator work.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's data on natural gas engine-driven generator set and components. Include manufacturer's standard product warranty, for duration of not less than one-year, for replacement of materials and equipment used in generator system.

B. Shop Drawings: Submit layout drawings of engine-driven generator unit and accessories including, but not limited to, automatic transfer switch, fuel line piping, remote start-stop stations and instrumentation. In

addition, show generator set unit and it's spatial relationship to associated equipment. Allow adequate clearance space for removal of engine generator elements for maintenance purposes.

C. Wiring Diagrams: Submit wiring diagrams for engine-driven generator unit showing connections to electrical power panels, feeders, automatic transfer switch, and ancillary equipment. Differentiate between portions of wiring that are manufacturer-installed and portions that are field-installed.

D. Agreement to Maintain: Prior to time of final acceptance, the Installer shall submit four copies of an agreement for continued service and maintenance of engine-driven generator set, for owner's possible acceptance. Offer terms and conditions for furnishing parts and providing continued testing and servicing, including replacement of materials and equipment, for one-year period with option for renewal of Agreement by Owner.

E. Certifications: Provide engine-driven generator set certified test record of the following final production testing:

1. Single-step load pickup.
2. Transient and steady-state governing.
3. Safety shutdown device testing.
4. Voltage regulation.
5. Rated power.
6. Maximum power.

F. Provide certified test record prior to engine-driven generator set being shipped from factory to project location.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of diesel engine-driven generator units and ancillary equipment, of types, ratings and characteristics required, whose products have been in satisfactory use in similar service for not less than five years.

B. Installer's Qualifications: Firm with at least three years of successful installation experience on projects with engine-driven generator units similar to that required for this project.

C. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 517, 700, 701 and 702 pertaining to construction and installation of emergency and standby systems.

2. NFPA Compliance: Comply with applicable requirements of NFPA 37, "Installation and Use of Stationary Combustion Engines and

Gas Turbines," NFPA 99, and NFPA 101, "Code for Safety to Life from Fire in Buildings and Structures."

3. UL Compliance: Comply with applicable requirements of UL 1008, "Automatic Transfer Switches," and UL 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors".

4. ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA MG 1, "Motors and Generators," and MG 2, "Safety and Use of Electric Motors and Generators."

D. NEMA Compliance: Comply with applicable requirements of NEMA's Stds Pub No. 250, "Enclosures for Electrical Equipment (1000-Volts Maximum)."

E. IEEE Compliance: Comply with applicable portions of IEEE Std 446, "IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications."

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver natural gas engine-driven generator properly packaged and mounted on pallet, or skid to facilitate handling of heavy items. Utilize factory-fabricated type containers or wrappings for engine-generator and components which protect equipment from damage.

B. Store engine-driven generator equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle engine-driven generator equipment carefully to prevent physical damage to equipment and components. Do not install damaged equipment; remove from site and replace damaged equipment with new.

PART 2.00 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide natural gas generator sets of one of the following:

1. Cummins/Onan
2. Katolight

2.02 EQUIPMENT

A. Engine Generator Set:

1. General: Provide manufacturer's standard natural gas engine-driven generator set and auxiliary equipment as indicated by published product information, and as required for a complete installation.

2. Set shall have a Standby Duty rating of 300 KW/375 KVA at .08 p.f., 277Y/480 volt, 3 phase, 60 hz, 1800 rpm. Engine/generator shall be mounted on a heavy duty steel base and shall incorporate vibration isolators of the type and quantity as specified by the set manufacturer, whether mounted internally or externally to the set.

3. Engine: Engine shall be stationary, liquid cooled, with a fuel system that is compatible with pipeline quality natural gas. Design shall be four cycle, minimum of six cylinders, turbocharged and aftercooled, with a minimum displacement of 1150 cubic inches, and nominal gross engine output power of 475bHP. Engine equipment shall include, but not be limited to the following:

   a. Secondary regulator
   b. Solenoid shut off valve
   c. Fuel filter
   d. Flexible fuel connection.

4. Engine protection devices shall have sensing elements located on the engine to initiate the following preliminary alarms and shutdowns:

   a. Low coolant temperature alarm.
   b. Low lube oil pressure alarm.
   c. High coolant temperature alarm.
   d. Low lube oil pressure shutdown.
   e. High coolant temperature shutdown.
   f. Overspeed shutdown.
   g. Overcrank lockout and shutdown.

5. Electronic governing system to control generator system frequency, speed regulation of +/- .25% minimum from no load to full load with automatic overspeed shutdown.

6. Provide low coolant level shutdown, which shall activate high coolant temperature lamp.

7. Lead-acid engine starting batteries.

8. Static duel rate automatic battery charger.

9. Engine mounted thermostatically controlled jacket water heater to maintain jacket water temperature of 70 degrees F. minimum.

10. Positive displacement, mechanical full pressure lube oil pump, full

flow lube oil filter with replaceable element, pressure relief valve, and oil drain valve with hose extension.

11. Generator mounted control panel as manufactured by generator manufacturer. See paragraph 2.04 for control panel specifications.

12. Provisions within the control panel shall be made for a remote annunciator panel.

    a. Extendible features shall be:
    High battery voltage
    Low battery voltage
    Normal battery voltage
    Generator running
    Normal Utility Power
    Emergency power system supplying load
    Pre-low oil pressure
    Low oil pressure shutdown
    Pre-high coolant temperature
    High coolant temperature shutdown
    Low engine temperature
    Overspeed shutdown
    Overcrank shutdown
    Switch not in auto
    Battery charger malfunction

13. A unit mounted radiator sized for operation in a 110 degree F. ambient temperature shall be provided. Also include a 50/50 mix of ethylene glycol.

14. A critical grade exhaust silencer shall be provided along with a stainless steel flexible exhaust connection as recommended by generator set manufacturer.

15. Engine generator set shall be capable of using low pressure gas (4 psi) without the use of external pressure boosters.

16. Alternator: The alternator shall be single bearing, self aligning, four pole, brushless type. Stator shall have 2/3 pitch windings to minimize field heating and voltage harmonics. Temperature rise shall not exceed 80 degrees C. Excitation system shall be permanent magnet type. Voltage regulator shall provide torque-matched underfrequency compensation to optimize motor starting performance and assist the engine during transient load conditions. Regulation from no load to full load shall be within +/- 0.5%.

17. A unit mounted, NEMA 1 enclosed, 450amp, molded-case, main circuit breaker shall be provided.

2.03 ENGINE-GENERATOR SET ACCESSORIES

A. Outdoor Weather-Protective Sound Attenuating Housing: The generator set shall be provided with a factory-installed sound-attenuated housing which allows the generator set to operate at full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 78 dBA at any location 7 meters from the generator set in a free field environment. Housing configuration and materials used may be of any suitable design which meets application needs, except that acoustical materials used shall be oil and water resistant. No foam materials shall be used unless they can be demonstrated to have the same durability and life as fiberglass.

B. The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment. Key-locking and padlockable door latches shall be provided for all doors. Door hinges shall be stainless steel.

C. The enclosure shall be provided with an exhaust silencer that is mounted inside of the enclosure, and allows the generator set package to meet specified sound level requirements. Silencer and exhaust shall include a rain cap and rain shield.

D. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturers standard color using a two step electro coating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating which meets the following requirements:

1. Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.
2. Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.
3. Crosshatch adhesion, per ASTM D3359-93, 4B-5B.
4. Impact resistance, per ASTM D2794-93, 120-160 inch-pounds.
5. Salt Spray, per ASTM B117-90, 1000+ hours.
6. Humidity, per ASTM D2247-92, 1000+ hours.
7. Water Soak, per ASTM D2247-92, 1000+ hours.
8. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

E. Provide anchor bolts of galvanized steel, of types and sizes as recommended by the manufacturer.

F. Provide a unit mounted 120 volt light and a 120 volt general purpose receptacle mounted at the generator control panel. Provide step down

transformer to provide power for light and receptacle. Coordinate location of light with Owner.

G. Remote Annunciation: Provide and install a 20-light LED remote alarm annunciation panel with horn, located as shown on the drawings or in a location that can be conveniently monitored by facility personnel. The remote annunciation panel shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems; and in addition shall provide indications for high battery voltage, low battery voltage, loss of normal power to the charger. Spare lamps shall be provided to allow future addition of other alarm and status functions to the panel. Provisions for labeling of the annunciation panel in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch shall be provided. LED lamps shall be replaceable, and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2.

2.04 ENGINE-GENERATOR SET CONTROLS

A. Engine-Generator Set Control: The generator set shall be provided with a microprocessor-based control system designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification. The control shall be mounted at the location shown on the project drawings for medium voltage applications, and on the generator set for 600 volt and lower applications. When mounted on the generator set the control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered. The control shall be UL508 listed, CSA282-M1989 certified, and meet IEC8528 part 4. All switches, lamps and meters shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts. The controls shall meet or exceed the requirements of Mil-Std 461C part 9, and IEC Std 801.2, 801.3., and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions. The entire control shall be tested and meet the requirements of IEEE587 for voltage surge resistance. The generator set mounted control shall include the following features and functions:

1. Three position control switch labeled RUN/OFF/AUTO. In the RUN position the generator set shall automatically start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
2. Red "mushroom-head" push-button EMERGENCY STOP switch.

Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.

3. Push-button RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
4. Push-button PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

B. Generator Set AC Output Metering: The generator set shall be provided with a metering set with the following features and functions:

1. 2.5-inch, 90 degree scale analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. These meters shall be provided with a phase select switch and an indicating lamp for upper and lower scale on the meters. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.
2. Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.

C. Generator Set Alarm and Status Message Display: The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on a digital display panel:

low oil pressure (alarm)
low oil pressure (shutdown)
oil pressure sender failure (alarm)
low coolant temperature (alarm)
high coolant temperature (alarm)
high coolant temperature (shutdown)
engine temperature sender failure (alarm)
low coolant level (alarm or shutdown--selectable)
fail to crank (shutdown)
overcrank (shutdown)
overspeed (shutdown)
low DC voltage (alarm)
high DC voltage (alarm)

weak battery (alarm)
low fuel-daytank (alarm)
high AC voltage (shutdown)
low AC voltage (shutdown)
under frequency (shutdown)
over current (warning)
over current (shutdown)
short circuit (shutdown)
ground fault (alarm)(optional--when required by code or specified)
over load (alarm)
emergency stop (shutdown)

D. In addition, provisions shall be made for indication of two customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

E. Engine Status Monitoring: The following information shall be available from a digital status panel on the generator set control:

engine oil pressure (psi or kPA)
engine coolant temperature (degrees F or C)
engine oil temperature (degrees F or C)
engine speed (rpm)
number of hours of operation (hours)
number of start attempts
battery voltage (DC volts)

F. Control Functions: The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.

G. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.

H. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.

I. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.

J. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature that is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

K. Alternator Control Functions: The generator set shall include an automatic voltage regulation system that is matched and prototype tested with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alpha-numeric LED readout to indicate setting level.

L. The voltage regulation system shall include provisions for reactive load sharing and electronic voltage matching for paralleling applications. Motorized voltage adjust pot is not acceptable for voltage matching.

M. Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.

N. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition when total load on the generator set exceeds the generator set rating for in excess of 5 seconds.

O. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded .

P. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

Q. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 10VDC or more than 16 VDC. During engine starting, the low voltage limit shall be disabled, and if DC voltage drops to less than 7 volts for more than two seconds a "weak battery" alarm shall be initiated.

2.05 AUTOMATIC TRANSFER SWITCH

A. The Electrical Contractor shall furnish and install an automatic transfer switch as described herein and as shown on the Drawings. The unit shall work together as a system for detecting normal power failure, starting the stand-by power system, and transferring the loads. The unit shall be UL listed and shall have a 24 hour continuous duty rating.

B. SEQUENCE OF OPERATION: When the voltage on any phase of the normal source is reduced to 70% of rated voltage for 3 seconds a pilot contact shall close to initiate starting of the standby plant. When the standby plant is delivering not less than 90% of rated voltage and 95% of rated frequency, the load shall be transferred to the emergency source. When the normal source has been restored to not less than 90% of rated voltage on all phases, the load shall be transferred to the normal source after a time delay of 0 to 30 minutes (adjustable). The standby plant shall run for 10 minutes (adjustable) unloaded and then automatically shut down and be ready to start upon the next failure of the normal source. If the standby plant should fail while carrying the load, retransfer to the normal source shall be made instantaneously upon restoration of the normal source on all phases. Inspection and operational tests shall be conducted in the presence of the Architect, to indicate that the switch satisfies the specifications.

C. The transfer switch shall be furnished with an accessories package containing the following items:

1. Auxiliary contacts operate on normal line failure.
2. Auxiliary contact closed on emergency.
3. Auxiliary contact closed on normal.
4. Pilot light to indicate switch is in emergency position.
5. Pilot light to indicate switch is in normal position.
6. Solid state undervoltage sensing - three phase.
7. Adjustable time delay on retransfer to normal.
8. Adjustable time delay on transfer to emergency.
9. Push-Button retransfer to normal.
10. Push-Button transfer to emergency.

D. CONSTRUCTION AND PERFORMANCE: The automatic transfer switch shall be a double throw switch operated by a reliable electrical mechanism momentarily energized. There shall be a direct mechanical coupling to facilitate transfer in 3 cycles or less. The normal and emergency contacts shall be mechanically interlocked such that failure of any coil or disarrangement of any part shall not permit a neutral position.

E. The automatic transfer switch shall be a three-pole device. The neutral conductor shall not be switched.

F. ATS shall have a delayed neutral position to allow motor voltage

transients to decay before transferring two live sources.

G. The contact structure shall consist of a main current carrying contact, which is a silver alloy with a minimum of 50% silver content. The main current carrying contacts shall be protected by refractory arcing contacts on all sizes. Main and arcing contacts shall be fully visible without major disassembly to facilitate inspection and maintenance. All relays shall be continuous duty industrial type with wiping contacts. All Owner interface contacts shall be rated 10 amperes minimum. All coils, relays, timers and accessories shall be readily front accessible.

H. A manual handle shall be provided for maintenance purposes. A disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation. The switch shall be mounted in a NEMA enclosure suitable for the environment in which it is installed.

I. Switches composed of molded case breakers, motor starters or other components not specifically designed for automatic transfer switch duty will not be approved.

J. The transfer switch shall be Asco 300 series, Onan OT-III series, or approved equal.

PART 3.00 EXECUTION

3.01 INSTALLATION

A. Installation shall comply with applicable codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

B. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

D. Equipment shall be initially started and operated by representatives of the manufacturer.

E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to final testing of the system.

3.02 FACTORY TESTS

A. Equipment supplied shall be fully tested at the factory for function and performance.

B. Factory testing may be witnessed by the owner and consulting engineer. Costs for travel expenses will be the responsibility of the owner and consulting engineer. Supplier is responsible to provide two weeks notice for testing.

C. Generator set factory tests on the equipment shall be performed at rated load and rated PF. Generator sets that have not been factory tested at rated PF will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

D. Transfer equipment factory tests: Each transfer switch supplied shall be factory tested before shipment. Factory tests shall include a complete functional test of the transfer switch controls, including calibration of the voltage sensors.

3.03 ON-SITE ACCEPTANCE TEST

A. The complete installation shall be tested for compliance with the specification following completion of all site work. Representatives of the equipment manufacturer shall conduct on-site testing. The Engineer shall be notified in advance and shall have the option to witness the tests.

B. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two-hour full load test, and a one step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

C. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system. A full load test utilizing a load bank shall be run for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel. Test reports shall be submitted at completion of the project. Any system or equipment deficiencies shall be reported to the engineer and corrected immediately.

3.04 TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

END OF SECTION

SECTION 16500 - LIGHTING

PART 1.00 GENERAL

1.01 LIGHTING SCHEDULE

A. The Contractor shall install lighting fixtures and accessories as shown on the drawings and/or described herein. The Contractor shall also install lamps for all fixtures.

PART 2.00 PRODUCTS

2.01 LAMPS AND BALLASTS

A. Lamps installed in each fixture shall be of the type specifically recommended by the manufacturer of the fixture for use in the fixture, unless specifically noted otherwise.

B. Fluorescent lamps shall be T8, cool white, rapid start, energy saver, 4100°K color temperature, 75 CRI, 2850 initial lumens, unless specified otherwise.

C. Electronic ballasts shall be as described below.

D. Metal halide lamps shall be universal burn, 3,000K color temperature, 70 CRI, diffuse-coated, unless specified otherwise.

E. HID ballasts shall be high power factor type.

2.02 ELECTRONIC BALLASTS

A. Ballasts for operation of four foot (4') F32T8 rapid start fluorescent lamps shall be as follows:
   1. Operate lamps in instant start mode.
   2. Operate multiple lamps as parallel circuit, operating remaining lamp(s) at full light output upon failure of other lamp(s) connected to the same ballast.
   3. Ballast enclosures shall be painted steel. Plastic enclosures are not acceptable.
   4. Individual ballasts specifically designed, and UL Listed, to operate one, two, three or four lamps as scheduled on the drawings.
   5. Operate lamps at rated lumen output and life specified by lamp manufacturers.
   6. Operate lamps at a frequency higher than 20KHZ.
   7. Operate at rated circuit voltage (120 or 277 VAC) at an input frequency of 60 Hz, and tolerate ± 10% sustained voltage variation without damage to the ballast, and maintain light output at ± 10% at ± 10% voltage variation.
   8. Comply with EMI and RFI limits set by the FCC (CRF 47 part 18)

for non-residential applications and not interfere with normal electrical equipment.

9. Power Factor of not less than 0.95.
10. Less than 20% Total Harmonic Distortion.
11. Lamp Crest Factor 1.7 or less.
12. Ballast factor greater than .85.
13. Sound rated "A".
14. Withstand transients per ANSI C.62.41 for location category A.
15. Meet applicable ANSI standards.
16. A five (5) year warranty.

2.03 COMPACT FLUORESCENT BALLASTS

A. Ballasts for operation of compact fluorescent lamp fixtures shall be as follows:

1. Ballast shall operate from a nominal line voltage of (120,277) volts, +/-10%, 50-60 Hz.
2. Ballast shall have a maximum warranty case temperature no less than 70°C.
3. Ballast shall meet ANSI C62.41 Category A transient voltage protection requirements.
4. Ballast shall be Programmed Rapid Start (Advance Soft Start).
5. Ballast Power Factor shall be >98%.
6. Ballast THD shall be <20%.
7. Ballast shall meet FCC Class A (non-consumer) specifications for EMI/RFI.
8. Ballast shall start the lamp at a minimum temperature of 50°F.
9. Ballast shall have a lamp current crest factor <1.7.
10. Ballast shall be sound rated A.
11. Ballast shall be UL listed Class P and CSA Approved.
12. Ballast shall contain potting to secure PC Board, provide lead strain relief, provide a moisture barrier, and ensure proper thermal transmission.
13. Ballast shall contain no PCB's.
14. Ballast must have a lamp end-of-life detection and shut-down circuit that meets proposed ANSI/IEC standards.
15. Ballast shall have permanently connected, internally soldered 18 AWG leads to provide a safe, firm electrical connection.
16. Ballast output frequency to the lamps shall be above 42Khz to minimize interference with infrared control systems.

2.04 FIXTURES

A. Fixtures as described in the Fixture Schedule on the drawings shall be furnished by the Contractor and shall be properly installed.

2.05 OCCUPANCY SENSORS

A. Sensor shall be a self-contained dual voltage ceiling mounted device capable of directly switching loads upon detection of human activity.

Sensor must be circular, and mount to either a single gang enclosure, or surface mount to a round pancake box.

B. Sensor must be rated for 120 through 277 VAC and be capable of switching zero to 600 watts of electronic ballast loads. Sensors must be capable of parallel wiring for multi-sensor applications.

C. Sensor time delay shall be factory set for typical applications, and field adjustable from 30 seconds to 20 minutes. Sensor must provide a green LED motion indicator. Red LED denoting life safety shall not be permitted.

D. PIR sensing must utilize a high density Fresnel domed lens, providing a circular view pattern of at least 360 degrees by 56 degrees.

E. Passive Dual Technology (PDT) sensing must incorporate PIR with Microphonics, which utilizes a passive microphone with automatic gain control (AGC) to sense both occupants moving and sounds. The PIR must be used to initiate an on condition, once on the PIR or Microphonics shall keep the load on. After the time delay expires and the load goes off, the Microphonics shall remain active up to 10 seconds as a back-up grace period.

F. Sensor shall be Sensor Switch Model #CMR-PDT, or equal by Hubbell.

G. Wall box mounted occupancy sensors shall mount in a standard utility box. Sensor shall have self-contained relay (no power pack required), utilize PIR and microphonics detection, and include auto sensitivity adjustment. Wall box sensor shall be intrinsically grounded and include ON/OFF switch and adjustable time delay. Wall box occupancy sensor shall be Sensor Switch #WSD-PDT, or equal by Hubbell.

2.06 DIMMING PANEL

A. Dimming Equipment Panel shall be UL tested, and constructed of 14 U.S. gauge steel with a vertically finned extruded aluminum base. The dimmer panel shall be ventilated fully enclosed, dead front enclosure and designed for wall surface mounting. The dead front cover shall allow only the circuit breaker handles to be exposed.

B. Dimming panel shall mount with fins vertical, and with a minimum of 12" clearance above and below for free air circulation. Panels shall be cooled exclusively by means of convection. All heat producing components shall be thermally attached to a heat sink. Conduit knockouts shall be provided on the top, bottom and sides. Nominal panel dimensions shall be 24"W x 60"H x 8"D. The entire panel enclosure shall be stripped, primed and finished with scratch, chip and chemical resistant textured polyurethane.

C. Dimming equipment panel shall be capable of housing incandescent/quartz, low voltage, neon, and fluorescent dimming modules together in one panel. Different lamp loads may not be combined on a

single dimmer module due to different response rate response rate or lamps.

D. Internal wire used within the panel shall have 105 degree C temperature rating clearly labeled on the surface of the wire. All wiring shall be harnessed with cable ties and wired to present a neat, orderly appearance. All field wiring connections shall be clearly labeled to correspond to field wiring diagrams. Pressure lugs shall be provided for service connections and screw terminals for control connections. Load wiring shall connect directly to branch circuit breaker output lugs.

E. A solid neutral assembly shall be provided for connection of all load circuit wires.

F. The entire assembly shall be designed to operate in ambient temperatures up to 40 degrees C (104 degrees F).

G. The system shall be equipped with thermal-magnetic, factory de-rated breakers as scheduled, and additional circuit breakers if required for protection of the low voltage power supply. Primary circuit protection and positive disconnect: one (1) 20 amp circuit breaker for each 2KW module and one (1) 30 amp circuit breaker for each 3KW module. Secondary circuit protection: one (1) 20 amp circuit breaker for each 2KW module and two (2) 20 amp circuit breakers for each 3KW module. A 10 amp circuit breaker is to be wired between the DC power supply and AC service voltage.

H. Fluorescent dimmers shall be equipped with automatic power disconnect relays which will open when the control voltage reaches minimum.

I. All solid state circuit boards shall be made of UL recognized flame retardant material. Circuits shall be plug-in or quick disconnect type; soldered or permanent circuit board connections within the dimming panel, including those on the dimmer modules themselves, will not be acceptable.

J. Dimming module shall be field replaceable of the bolt-on type, completely self-contained. All connections to the module shall utilize color-coding wiring. Incandescent dimmer devices shall be of the silicon controlled rectifier configuration type in back-to-back configuration and shall provide a symmetrical alternating current output. Dimmers for fluorescent, low voltage incandescent, and neon lamp sources shall use triac devices.

K. Each dimmer, regardless of type, shall control from blackout to full bright any load from 100 watts to rated capacity. When a controller is set to the "zero" position, dimmer output shall not exceed two volts. All dimmers shall provide a response to control that conforms to the "Square Law" dimming curve. All dimming modules shall be completely modular in nature and dimensionally interchangeable with each other within the panels.

L. Incandescent modules shall be rated to carry 3000 watts (or 2000 watts) of standard 120-volt tungsten load. The non-dim module shall be capable of controlling up to 2000 VA of tungsten, fluorescent or other lighting load. The non-dim module shall contain electrically held contactors fully rated for 20 amperes and a control circuit capable of responding to a control signal from any of the control devices specified. When used with a preset control system, the modules shall turn off and on positively at a point during the fade determined by the level set on the preset controller.

M. Control voltage shall not exceed 24 volts DC with a maximum current or 2.5 milliamps per control channel. Power supply current is limited to one (1) amp. There shall be no relationship between line voltage phase and the control voltage. Complete isolation shall exist between neutral and DC common. Nominal input voltage for all dimmers is 120/240 60Hz, single phase, three wire. Dimmers shall operate satisfactorily over an input voltage range from 105 volts to 130 volts AC. The inrush current, at rated load, shall not exceed the semi-conductor manufacturer's single cycle surge rating.

N. All dimmers shall be a minimum of 97% efficient at any voltage or up to rated capacity. The voltage drop across the dimmer shall not exceed 5 volts RMS with rated load connected. No load losses shall exceed two watts. Output voltage shall remain stable indefinitely with a given input voltage setting. Output voltage shall be the same for a given control setting regardless of the direction a controller is moved.

O. Dimmers shall not be harmed by "hot patching" a single load up to rated dimmer capacity.

P. Incandescent dimmers shall be provided with an inductive-capacitive (LC) filter for reduction of electromagnetic interference (EMI) and lamp filament buzz. Dimmers shall not cause interference with quality audio or video equipment having properly decoupled power supplies.

Q. The current rise time for SCR dimmers shall not be less than 450 microseconds. Rise time of the output wave form shall be measured from turn on to 95% of the maximum amplitude with the dimmer operating at rated load and the control voltage adjusted to provide power device firing at the 90 degree conduction angle.

R. All dimmers shall have high intensity and low intensity limit trim adjustments.

S. Remote control stations shall be designed for mounting in specifically designed flush wallbox enclosures. Faceplates shall be machine fabricated from a single piece of solid brushed aluminum with a satin clear anodized finish. Standard commercial faceplates shall not be acceptable. All control stations shall be powered from a 24V DC power supply.

T. Faceplates shall attach to the wallbox with flush mounted screws in a

manner that requires some type of tool to remove them. Faceplate graphics shall be silk-screened by the manufacturer and shall be standard or custom graphics. Wiring to remote controls shall be #18 AWG low voltage class II type connected to clearly labeled tabs on the control station

U. Control stations shall be a type that requires no screw terminals and all field connections are to terminate on plainly marked quick-disconnect tabs. Systems using pigtails and wire nuts will not be allowed.

V. Slide potentiometers shall have a minimum 60mm travel for required precise control range. A single control slider may control any number of dimmers. System design allows for multi-station take-control operation.

W. Entrance control station shall be single-gang type with the same type faceplates as specified above, complete with "on" switch with L.E.D. indicator and an "off" switch. This control shall call up a single designated scene upon activation.

X. The dimmer panel shall be furnished with a service rating of 100 amp, three phase.

Y. The dimming panel shall include Hunt Control Systems #PBI series control system, or Lithonia Synergy series control system.

2.07 PRESET CONTROLS

A. The dimming system is to be controlled at the main control station by a four-scene preset dimming panel. Each scene shall incorporate a minimum of nine (9) zones of L.E.D. illuminated slide potentiometers to preset each zone of lighting from 0 to 100%. A rotary adjustable rate potentiometer shall provide a dipless crossfade of three (3) to sixty (60) seconds between scenes. The active scene shall be visible through a translucent cover to indicate the preset levels. Four L.E.D. scene select switches plus an OFF switch shall provide complete control of the preset panel.

B. The main control station shall be a Hunt Control System #PR-4x9 panel, or Lithonia #SQCS-6P12C. Control station shall have stainless steel cover plate.

PART 3.00 EXECUTION

3.01 INSTALLATION

A. Unless otherwise specified, lighting fixtures shall be permanently installed and connected to the wiring system.

B. The Contractor shall support each fixture, independently from the building

structure. Ceiling framing members shall not be used to support fixtures except in specified areas where ceiling supports for this purpose have been specified elsewhere in these specifications. Each fixture shall have at least two fixture supports.

C. Flexible conduit used for fixture whips shall be at least twelve (12) inches, but not more than 48 inches long.

3.02 CEILING COMPATIBILITY

A. Catalog numbers shown on the drawings or descriptions of lighting fixtures contained herein may indicate fixture compatibility with certain types of ceiling construction. Contractor shall determine exact type of ceiling actually to be furnished in each area and shall obtain fixtures to suit, deviation from specified catalogue numbers or descriptions only where necessary and only to the extent necessary to insure fixture/ceiling compatibility.

3.03 LIGHT LEAKS

A. The Contractor shall, at the end of this project, adjust all recessed lighting fixtures so that there will be no light leaks between the fixture trim and the ceiling. Contractor shall also adjust recessed fluorescent fixtures to eliminate any light leaks between fixture trim and ceiling grid member.

3.04 LAMPS

A. The Contractor shall install lamps in all fixtures and shall obtain replacement lamps should any not properly operate or become damaged during construction.

3.05 EXIT FIXTURES

A. Exit fixtures shall be installed according to Life Safety Code requirements, with face(s) plainly visible and directional arrows indicating the proper direction of egress.

END OF SECTION

SECTION 16515 - LIGHTING CONTROL SYSTEM

PART 1.00 GENERAL

1.01 SUMMARY

A. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system. Contractor shall include all labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section.

1.02 DESCRIPTION OF WORK

A. Furnish and install a complete system for the control of lighting and other equipment as indicated on the plans, detailed in the manufacturer submittal and as further defined herein. Contractor is solely responsible to verify quantity, installation locations and wiring requirements for this project. Specific manufacturers catalog numbers, when listed in this section are for reference only. It is the responsibility of the contractor to verify with lighting control manufacturer all catalog information and specific product acceptability.

B. The system shall include but not be limited by the following list: Pre-wired, microprocessor controlled relay panels with electrically held, electronically latched relays panels controlled via a complete list of communication based accessories including digital switches, digital photocells, digital occupancy sensors, digital SmartBreaker panels, Digital Time Clock (DTC) and interface cards to dimming systems, building automation systems, thermostats, and other devices. The type of lighting control equipment and wiring specified in this section is covered by the description: Microprocessor Controlled Digital Relay Lighting Control system with RS 485 Bus communications. Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways and electrical boxes and fittings required for installation of control equipment and wiring.

1.03 SUBMITTALS

A. Shop Drawings: Submit dimensioned drawings of lighting control system and accessories including, but not necessarily limited to, relay panels, switches, digital time clock, photocells, occupancy sensors, and other interfaces. Shop drawings shall indicate exact location of each device or a RFI to confirm location. Plans are diagrammatical. Contractor to verify all lighting control material requirements from approved shop drawings. "Cut Sheet" submittal not acceptable.

B. Product Data: Submit manufacturer's data on the specific lighting control system and components. Submittal shall be in both electronic and hard copy formats. To prevent departures from approved system operation, electronic file submitted shall be able to be directly downloaded to the specified system at manufacturer facility. Submit a complete bill of materials with part numbers, description and voltage specifications.

C. One Line Diagram: Submit a one-line diagram of the system configuration indicating the type, size and number of conductors between each component if it differs from that illustrated in the riser diagram in these specifications. Submittals that show typical riser diagrams are not acceptable.

1.04 QUALITY ASSURANCE

A. Lighting control system products shall be manufactured by Lighting Control & Design, Los Angeles, CA, (tel. 800.345.4448), or approved equal. Such firms shall be regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. Any product other than those listed in this specification must be pre-approved.

B. Control wiring shall be in accordance with the NEC requirements for Class 2 remote control systems, Article 725 and manufacturer specification.

C. A licensed electrician shall functionally test each system component after installation, verify proper operation and confirm that all relay panel and switch wiring conform to the wiring documentation. Comply with NEC and all local and state codes as applicable to electrical wiring work.

D. Lighting control panels (LCPs) shall be UL 916 Listed. LCPs controlling emergency circuits shall be ETL listed to UL 924. Emergency source circuits controlled in normal operation by a relay panel shall fully comply with NEC 700-9(b). Electrical contractor is responsible for verifying compliance.

E. The lighting control system shall be listed, approved and comply as required with all national, state and local energy codes to include but not limited to ASHRAE 90.1-2004.

1.05 MAINTENANCE MATERIALS

A. Provide 10% spare relays per LCP, up to the maximum capacity of the LCP. Provide CD version of manufacturers operating software to include graphical interface software. Provide 2 extra sets of as-built and operating manuals.

1.06 SYSTEM DESCRIPTION

A. The lighting control system is a networked system that communicates via RS485. The system must be able to communicate with fully digital centralized relay panels, micro relay panels, smart breaker panels, digital switches, photocells, various interfaces and shall include all operational software. The intent of the specification is to integrate all lighting control into one system, except for areas controlled by a single motion sensor such as rooms with a single luminaire and emergency fixtures designed to operate 24/7. Distributed lighting control shall be provided using a networked micro relay panel. A centralized relay panel shall control corridors and site lighting. Lighting control system shall include all hardware and software, with software resident within the lighting control system. System shall provide local access to all programming functions at the master LCP and remote access to all programming functions via dial up modem and through any standard computer workstation running an industry standard internet browser. Lighting control system shall have server built into the master LCP that "serves" HTML pages to any authorize workstation. Desktop computers are not part of this section and will be provided by others. Systems that are non-networked, non-digital, or non-server capable will not be acceptable.

B. System software shall provide real time status of each relay, each zone and each group.

C. Lighting control system shall be able to be monitored by and take commands from a remote PC. At any time, should the remote PC go off-line all system programming uploaded to the lighting control system shall continue to operate as intended. Systems requiring an on line PC or server for normal operation are not acceptable

D. All devices shall be pre-addressed at the factory. Field addressing is not acceptable.

E. All programs, schedules, time of day, etc, shall be held in non-volatile memory for a minimum of 10 years at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.

F. System shall be capable of flashing lights Off/On any relay or any zone prior to the lights being turned Off. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled Off sweep using local wall switches within the occupied space. Occupant override time shall be locally and remotely programmable and not exceed 2-hours.

G. The system shall be capable of implementing On commands, Off commands, Raise (dimming) commands, Lower (dimming) commands for any relay, group or zone by means of digital wall switches, specification grade line voltage type wall switches, photocell, web based software or

other devices connected to programmable inputs in a lighting control panel.

H. The lighting control system shall provide the ability to control each relay and each relay group per this specifications requirement. All programming and scheduling shall be able to be done locally at the master LCP and remotely via dial up modem and via the Internet. Remote connection to the lighting control system shall provide real time control and real time feedback.

I. System may consist of centralized relay panels, micro relay panels, smart breaker panels, digital switches, photocells and various digital interfaces. Verify exact components specified. Micro relay panels, smart breaker panels, centralized relay panels and digital switches shall communicate as one network via RS485. Micro relay panels, mounted in each local area, per plans shall control all lighting fixtures in that space, provide power to occupancy sensors and take input from daylight sensor and occupancy sensors. Micro relay panels shall be capable of taking inputs from standard, line voltage type switches and outputting up to 8 independent 0v to 10v dimming signals. All micro relay panels and all devices connected to micro relay panels (switches, photocells and occupancy sensors, etc) shall be wired per lighting control manufacturers instructions.

1.07 MANUFACTURERS

A. Equipment manufacturer and/or manufacturer's model number listed in this Specification is shown to establish general style, type, character, and quality of product desired. Similar items manufactured by other than those listed will be considered, providing submittals are made according to Pre-Bid Approval requirements of Instructions to Bidders.

B. Where no manufacturer or model number are given, any product meeting performance or design criteria, or referenced trade association standard may be used and Pre-Bid Approval is not required.

C. Subject to compliance with the specified requirements, provide products by one of the following manufacturers:
   1. Lighting Control & Design
   2. Hubbell
   3. Wattstopper

D. Part numbers listed in these specifications are based on the Lighting Control & Design system and equipment unless noted otherwise. Product part numbers of approved equal manufacturers shall be equal to the listed products described herein.

PART 2.00 PRODUCTS

2.01 MATERIAL AND COMPONENTS

A. Relay Panels:

1. NEMA rated enclosure with screw cover or hinged door. Other NEMA types optional.
2. 16 AWG steel barrier shall separate the high voltage and low voltage compartments of the panel and separate 120v and 277v.
3. LCP input power shall be capable of accepting 120v or 277v without rewiring.
4. Control electronics in the low voltage section shall be capable of driving 2 to 48, 30a, 18,000 SCCR rated latching relays, control any individual or group of relays, provide individual relay overrides, provide a master override for each panel, store all programming in non-volatile memory, after power is restored return system to current state, provide programmable blink warn timers for each relay and every zone, and be able to control relays that default to Open, Normally Open Latching (NOL) or relays that default to Closed, Normally Closed Latching (NCL).
5. Lighting control system shall be digital and consist of a Master LCP, Slave LCPs, Micro LCPs with up to 8 individual relays, digital switches, digital interface cards and if required, SmartBreaker panelboards. All system components shall connect and be controlled via a single Category 5, 4 twisted pair cable with RJ45 connectors, providing real time two-way communication with each system component. Analog systems are not acceptable.
6. The lighting control system is a networked system that communicates via RS485 and includes centralized relay panels, micro relay panels, digital switches, photocells, various interfaces and operational software. The intent of the specification is to integrate all lighting control into one system. Lighting control system shall include all hardware and software, with software resident within the lighting control system. System shall provide local access to all programming functions at the DTC and remote access to all programming functions via dial up modem and through any standard computer workstation running an industry standard internet browser. Lighting control system shall have server built into the master LCP that "serves" HTML pages to any authorized workstation. Desktop computers are not part of this section and will be provided by others. Systems that are non-networked, non-digital, or non-server capable will not be acceptable.

B. Micro Relay Panels:

1. Micro relay panels shall have up to 8-30a, 18,000 SCCR rated lighting relays and shall control all lighting in the designated area indicated on the plans and be networked to centralized relay panels, micro relay panels, smart breaker panels, digital switches, photocells, various interfaces. Each micro relay panel shall provide

minimum 300ma at 12/24vdc for powering occupancy sensors. Micro relay panels that require a separate occupancy sensor power pack are not acceptable.

2. Micro relay panel shall provide a minimum 4-programmable photocell inputs, a minimum 4-programmable occupancy sensor inputs and matrixed contact closure inputs. This requirement is to insure integration of entire lighting system into one networked, lighting control system.
3. Micro relay panels shall be capable of outputting minimum 4 and up to 8 independent 0v to 10v dimming signals, one independent dimming signal at each of 8 relays. In order to maximize daylight harvesting and minimize disruption to occupants, each dimming output shall provide adjustment for baseline, start point, mid point, end point, trim, fade up rate, fade down rate, time delay and enable/disable masking. All photocell setting must be remotely accessible. Systems providing On, Off with Time Delay only, and system that do not provide remote access are not acceptable.

C. Standard Output Relays:
1. UL Listed 30 Amp, Latching, 18,000 SCCR, 277VAC Ballast and HID and 20 Amp Tungsten at 120 Vac.
2. Relays shall be individually replaceable. Relay terminal blocks shall be capable of accepting two (2) #8AWG wires on both the line and the load side. Systems that do not allow for individual relay replacement or additions are not acceptable.
3. Relays to be rated for 250,000 operations minimum at a full 30a lighting load, default to closed at normal power loss, Normally Closed Latching (NCL). All incandescent circuits shall be energized by use of a Normally Closed SoftStart™ (NCSS) relay rated at 100,000 operations at full 20a load. No exceptions.
4. Optional relay types available shall include: Normally Open Latching (NOL) relay rated for 250,000 operations, a 600v 2-pole NO and NC and a Single Pole, Double Throw (SPDT) relay.

D. Low Voltage Switches:
1. All switches shall be digital and communicate via RS 485. Contact closure style switches, except as specified for connection to the micro relay panel matrixed contact closure inputs, shall not be acceptable. The programming for a digital switch will reside in the switch itself, via double EPROM memory. Any digital switch button function shall be able to be changed locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet.
2. Digital low voltage switch shall be a device that sits on the lighting control system bus. Digital switch shall connect to the system bus using the same cable and connection method required for relay panels. System shall provide capability to locally and remotely program each individual switch button, monitor and change function of each button locally and remotely. Each button shall be capable of being programmed for On only, Off only, On/Off (toggle), Raise (Dim up) and Lower (Dim down). Switches requiring low voltage control

wires to be moved from one input terminal to another to accomplish these functions are not acceptable.

3. Keyed switches shall be programmable and connect to the lighting controls system bus.
4. Digital switches for high abuse areas (common areas, gymnasiums, etc.) shall be vandal resistant, contain no moving parts, and be touch sensitive and available with up to three buttons in a single gang. Multi gang versions shall also be available. Touch pads shall be Stainless Steel and capable of handling both high abuse and wash down locations. High abuse switches shall connect to the lighting control system digital bus. Each high abuse switch touch button shall be able to be control any relay or any group in any panel or panels that is part of the lighting control system. Each touch button shall be able to be programmed for On, Off, Toggle or Maintain operation. All programming shall be done locally or remotely via dial up modem or web interface as described in other paragraphs of this section. High abuse switches shall be able to be enabled or disabled digitally. Each touch pad is to be identified as to function by an engraved label. Switches must be capable of handling electrostatic discharges of at least 30,000 volts (1cmspark) without any interruption or failure in operation.

E. DTC - Digital Electronic Time Clock:

1. A Digital Time Clock (DTC) shall control and program the entire lighting control system and supply all time functions and accept interface inputs.
2. DTC shall be capable of up to 32 schedules. Each schedule shall consist of one set of On and Off times per day for each day of the week and for each of two holiday lists. The schedules shall apply to any individual relay or group of relays.
3. The DTC shall be capable of controlling up to 126 digital devices on a single bus and capable of interfacing digitally with other individual busses using manufacturer supplied interface cards.
4. The DTC shall accept control locally using built in button prompts and use of an 8 line 21-letter display or from a computer or modem via an on-board RS 232 port. All commands shall be in plain English. Help pages shall display on the DTC screen.
5. The DTC shall be run from non-volatile memory so that all system programming and real time clock functions are maintained for a minimum of 15 years with loss of power.
6. Pre-installed Unity™ lighting control software shall provide via local or remote PC a visual representation of each device on the bus, show real time status and the ability to change the status of any individual device, relay or zone. System shall be capable of running optional Unity GX lighting control software, which shall provide for directly importing vector based graphics. No exceptions.
7. Pre-Installed modem that allows for remote programming from any location using a PC. Modem to include all necessary software for local or remote control.

8. DTC shall provide system wide timed overrides. Any relay, group or zone that is overridden On, before or after hours, shall automatically be swept Off by the DTC a maximum of 2 hours later.

F. PHOTOCELL: Photocells shall be mounted in location indicated on the plans. Photocells used for exterior lights shall provide multiple trips point from 1 roof mounted unit. All trips points shall be able to be changed remotely via Internet or dial up modem. Photocells requiring manual trip point adjustment are not acceptable. Photocell used for interior lighting control shall have multiple settings such as start-point, mid-point, off-point, fade-up, fade-down, etc. All settings shall be remotely accessible and adjustable. Systems providing local adjustment only are not acceptable. Photocells to be certified to comply with the current energy code covering this project at time of submittal of plans for building permit.

G. Occupancy Sensors shall have Passive Dual Technology (PDT) sensing and must incorporate Passive Infrared (PIR) with Microphonics, which utilizes a passive microphone with automatic gain control (AGC) to sense both occupants moving and sounds. The PIR must be used to initiate an on condition; once on the PIR or Microphonics shall keep the load on. After the time delay expires and the load goes off, the Microphonics shall remain active up to 10 seconds as a back-up grace period. Sensors shall be Sensor Switch CM-9 and CM-10 series, or equal by Hubbell.

H. Interfaces: For future expansion capability, system shall have available all of the following interfaces. Verify and install only those interfaces indicated on the plans.

1. A dry contact input interface card that provides 14 programmable dry contact closure inputs. Use shielded cable to connect input devices to interface card.
2. Interface card providing digital communication from one system bus to another system bus, allowing up to 12,000 devices to communicate.
3. An interface card that allows the DTC to control up to 32 digital XCI brand thermostats. Programming of thermostats to be able to done locally (at the TC or a PC) or remotely, via modem, Internet or Ethernet.
4. A voice prompted telephone override interface module. Interface module shall accept up to 3 phone lines and allow up to 3 simultaneous phone calls. Voice prompted menu and up to 999 unique pass codes shall be standard with each interface module.
5. Software pre-installed to run Unity GX Graphical Interface Software. Unity GX software shall provide via local or remote PC a visual representation of a specific area or the total area of the project. GX full graphic pages shall be designed to the owner's specifications. Owner to provide to manufacturer all necessary files and criteria.
6. Direct digital interface to SmartBreaker panelboards. Relay panel and SmartBreaker panelboard circuits shall appear on the system

software as similar, yet distinct, items and maintain all functions and features of the system software.

7. Direct digital interface to DMX 512 based systems. DMX interface shall provide 14 global commands, each of which can be modified locally or remotely using lighting controls manufacturer supplied software. DMX interface shall be integral to the system bus and shall connect and be controlled via a single Category 5, 4 twisted pair cable, providing real time response from the lighting control system to DMX commands.
8. Direct digital interface to building automation systems using DDC protocols such as BACnet, Metasys (N2) and ModBus that accept on/off commands, time schedules and report status of all relays in all panels in real time. Interface cards shall "self populate" each individual relay and each group to the BAS. All BAS system programming required shall be the responsibility of the BAS system provider.

PART 3.00 EXECUTION

3.01 INSTALLATION

A. Mount relay control cabinets adjacent to respective lighting panelboard. Cabinet shall be surface or flush mount, per plans. Wiring between relay control cabinet and panelboards to be per local codes and acceptable industry standards. Under no circumstances will any extra be authorized for payment to the EC or GC due to the EC's lack of knowledge or understanding of any and all prevailing codes or specified manufacturer's installation requirements. Neatly lace and rack wiring in cabinets. During construction process, protect all interior components of each relay panel and each digital switch from dust and debris. Any damage done to electronic components due to non-protection shall be the sole responsibility of the installing contractor.

B. Switches: Provide outlet boxes, single or multi-gang, as shown on the plans for the low voltage digital switches. Mount switches as per plans. Supply faceplates per plans and specifications. EC is specifically responsible to supply and install the required low voltage cable, Category 5, 4 twisted pair, with RJ45 connectors and snagless boots (commonly referred to as Cat 5 patch cable) between all switches and panels. Field-test all Cat 5 patch cable with a recognized cable tester. All low voltage wire shall be run in conduit, in accordance with local codes.

C. Wiring:
   1. Do not mix low voltage and high voltage conductors in the same conduit. No exceptions.
   2. Ensure low voltage conduits or control wires do not run parallel to current carrying conduits.
   3. Place manufacturer supplied "terminators" at each end of the system bus per manufacturers instructions.

4. Neatly lace and rack wiring in cabinets.
5. Plug in Category 5 patch cable that has been field-tested with a recognized cable tester, at the indicated RJ45 connector provided at each lighting control device, per manufacturers instructions.
6. Use Category 5 patch cable for all system low voltage connections. Additional conductors may be required to compensate for voltage drop with specific system designs. Contact LC&D or refer to the GR2400 manual for further information. Use shielded cable for dry contact inputs to lighting control system.
7. Do not exceed 4000ft-wire length for the system bus.
8. All items on the bus shall be connected in sequence (daisy chained). Star and spur topologies are not acceptable.
9. The electrical contractor shall install the lighting control system. The EC shall make all necessary wiring connections to external devices and equipment, including photocell and occupancy sensors. EC shall wire the system in accordance with manufacturer's instructions.

3.02 INSTALLATION AND START-UP

A. Verify that conduit for line voltage wires enters panel in line voltage areas and conduit for low-voltage control wires enters panel on low-voltage areas. Refer to manufacturer's plans and approved shop drawings for location of line and low-voltage areas. It is the responsibility of the contractor to verify with lighting control manufacturer all catalog information and specific product acceptability.

B. For approved line voltage type micro relay panel switches connected to matrixed inputs of the micro relay panel, furnish #18 AWG solid conductors. For all other digital switches provide wiring required by system manufacturer.

C. Contractor to test all low voltage cable for integrity and proper operation prior to turn over. Verify with system manufacturer all wiring and testing requirements.

D. Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Start-up and set-up, commissioning of the lighting control system, and Owner instruction includes:
   1. Confirmation of entire system operation and communication to each device.
   2. Confirmation of operation of individual relays, switches, occupancy sensors and daylight sensors.
   3. Confirmation of system programming, photocell settings, override settings, etc.
   4. Provide training to cover installation, maintenance, troubleshooting, programming, and repair and operation of the lighting control system.

E. Panels shall be located so that they are readily accessible and not exposed to physical damage. Panel locations shall be furnished with sufficient working space around panels to comply with the National Electric Electrical Code. Panels shall be securely fastened to the mounting surface by at least 4 points. Unused openings in the cabinet shall be effectively closed. Cabinets shall be grounded as specified in the National Electrical Code.

F. Lugs shall be suitable and listed for installation with the conductor being connected. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs. Maintain the required bending radius of conductors inside cabinets. Cabinets shall be cleaned of foreign material such as cement, plaster and paint. Distribute and arrange conductors neatly in the wiring gutters. Follow the manufacturer's torque values to tighten lugs.

G. Before energizing the panelboard, the following steps shall be taken:
   1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been furnished.
   2. Remove shipping blocks from component devices and the panel interior.
   3. Remove debris from panelboard interior.

H. Follow manufacturers' instructions for installation and all low voltage wiring.

I. Comply with energy code lighting control system "Acceptance Requirements". Acceptance tests are used to verify that lighting controls were installed and calibrated correctly. These tests may require that a responsible party certify that controls are installed and calibrated properly. This is the installing contractors responsibility. Verify requirements with building authority.

3.03 DOCUMENTATION

A. Each relay shall have an identification label indicating the originating branch circuit number and panelboard name as indicated on the drawings. Each line side branch circuit conductor shall have an identification tag indicating the branch circuit number.

B. Provide a point-to-point wiring diagram for the entire lighting control system. Diagram must indicate exact mounting location of each system device. This accurate "as built" shall indicate the loads controlled by each relay and the identification number for that relay, placement of switches and location of photocell. Original to be given to owner, copies placed inside the door of each LCP.

3.04 TRAINING

A. Provide a factory technician for on-site training of the owners' representatives and maintenance personnel. Coordinate timing with General Contractor. Provide a minimum of four hours of factory on-site training.

END OF SECTION

SECTION 16700 - SPECIAL SYSTEMS

PART 1.00 GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install special systems and accessories as shown on the drawings and/or described herein.

B. Shop drawings shall be submitted for approval and shall include complete catalog data and other data shown to describe the equipment proposed.

1.02 COMMUNICATIONS SYSTEMS

A. Special systems specifications listed in Part 2 of this specification may be found in other specification sections as described herein. The individual specification sections shall be referenced for complete product descriptions.

PART 2.00 PRODUCTS

2.01 CCTV SECURITY SYSTEM

A. The Contractor shall furnish and install a conduit system with outlet boxes for a Closed Circuit TV system. Owner shall furnish and install cameras at completion of the project. Contractor shall furnish and install Cat 6E cable for CCTV system as described on the drawings. Termination of cables shall be by Owner or as described on the drawings. Power for CCTV system shall be installed at data closets as shown on drawings.

2.02 FIRE ALARM SYSTEM

A. Refer to specification section 16710 for description of the fire alarm system requirements.

2.03 CLASSROOM AUDIO SYSTEM

A. Refer to specification section 16755 for classroom audio system requirements.

2.04 DATA & TELEPHONE PLANT

A. Refer to specification section 16740 for data and telecommunications system requirements.

2.05 AUDIO / VISUAL & TV DISTRIBUTION

A. Refer to specification section 16745 for description of the audio/visual and TV distribution system.

2.06 INTERCOM SYSTEM

A. Refer to specification section 16750 for description of the intercom system.

2.07 SECURITY SYSTEM

B. The Contractor shall provide, install, and program a functionally complete, integrated Digital Alarm Communicator and Access Control System (DACS) per Manufacturer's guidelines, codes described, and these specifications. The system shall include motion sensors, door contacts, keypads, control panel, and remote annunciation.

C. The DACS system specified herein shall include a Digital Alarm Communicator Transmitter (DACT), built-in telephone line monitor, 500 event (minimum) memory logger, real time clock, calendar, test timer, battery charging / voltage supervision circuitry, battery lead supervision, diagnostics displays, time / event-based scheduling system, lightning / EMI protection circuits, and the associated optional modules and components for a complete DACS system. The system shall be protected from EMI and lightning surges.

D. The control panel equipment, systems, and materials furnished and installed under this section shall be installed in accordance with the applicable standards of National codes (NEC, NFPA, UBC), and shall be UL listed for Access Control. The Contractor upon completion of installation shall furnish training in the complete operation of the systems.

E. The security control system shall be a Radionics model D9412 series, provided, at minimum, with the following components. Additional accessories shall be provided based on the quantities and features required for the application.

- Enclosure(s), with locks and keys.
- Radionics D9412 DACT with removable terminal blocks and mounting bracket.
- Faceplate shield and metal bracket covering rear of D9412 circuit assembly.
- Power transformer, with UL transformer enclosure; 16.5 VAC, 40 VA.
- Manuals.
- Sealed lead-acid battery, 7 AH minimum.
- UL - 12V auxiliary battery charger. Combined with external batteries, increases standby time and provides additional power to auxiliary outputs of D9412B.
- Ceiling Mount PIR Motion Detector, 60 ft. (18 m), with built-in POPIT.
- Point of Protection EXpander module. Each POPEX (up to two per system) shall monitor up to 119 model D9127 Point of Protection Input Transponders "POPIT" or Integrated Fire or Intruder Alarm detectors.
- Dual telephone line module – Seizes telephone line and alternates event transmission to Central Station between primary and secondary phone lines. Transmits over other phone line when first

phone line is determined to be inoperable. Periodically tests phone line for usage and integrity and reports to central station when phone line is faulty. Remembers faulty line and transmits over operational line.

- Wiegand PIN Keypad (stainless steel).
- POPIT module - tampered, UL-listed for fire
- Door contacts; C&K model MPS-8, Sentrol, Inc. 1125 series, or Flair Security Products model RMS 94K.

F. Programming of the system shall include the following tasks:

- Programming system configuration parameters (hardware and software, zone/circuit numbers, communication parameters).
- Programming operational parameters such as opening/closing reports and windows, system response text (custom English) displays of events, activation of relays that drive auxiliary devices, and identifying types of zones/loops.
- Programming passcodes according to the authorities and functions defined by the owner.
- Other system programming tasks required by the owner. These additional programming requirements shall be coordinated between the owner and the contractor.

F. Security system shall be monitored by an off site monitoring service during the one year warranty period. Monitoring service shall be included in bid price.

PART 3.00 EXECUTION

3.01 INSTALLATION

A. Unless otherwise specified, all special systems shall be permanently installed and connected to the wiring system. The systems must be installed according to manufacturer standards and recommendations.

B. The Contractor shall properly support each device, independently from the building structure. Ceiling framing members shall not be used to support devices except for devices specifically intended for such installation.

C. A factory-trained technician shall install the special system equipment. Coordination with the Architect and Owner shall be important for proper positioning of all special systems equipment.

3.02 CONDUIT AND WIRING

A. All wiring for special systems shall be installed in conduit. All wiring shall be new and shall be as specifically recommended by the Special Systems manufacturer, and shall not be smaller than sizes shown on the Drawings.

B. Special systems wiring not installed in conduits shall be supported from j-hooks. Wiring shall be bundled using Velcro straps and neatly tied to

support hooks. Special system wiring shall not be power wiring. Voice and data system wiring shall not be mixed with wiring for other systems. Fire alarm system wiring shall be red and routed independently from other systems.

3.03 MONITORING SERVICE

A. Security system shall be monitored by an off site monitoring service during the one year warranty period. Monitoring service shall be included in bid price.

END OF SECTION

SECTION 16710 - FIRE ALARM AND DETECTION SYSTEM

PART 1.00 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all equipment, accessories, and materials in accordance with the project specifications and drawings, codes and standards, to provide a complete and operating fire alarm system.

B. Equipment specified herein is designed to provide specific functional and operational characteristics. It is the responsibility of the fire alarm contractor to provide all features and functions as outlined in these specifications. It shall be the responsibility of the fire alarm contractor to obtain all required approvals, permits, and certifications from authorities having jurisdiction.

C. It shall be the responsibility of the electrical contractor to provide all conduit systems, standard electrical boxes, and operating power for the fire alarm system as outlined on the project drawings and as required. The fire alarm contractor shall coordinate all requirements with, and provide special back boxes to, the electrical contractor prior to installation of conduit.

D. The electrical contractor shall provide 120-volt power as required to the fire alarm system through separate dedicated branch circuits maximum 20 amperes each. The fire alarm control panel (FACP), digital communicator (DACT), and the signal power expanders (SPX) combine to form the fire alarm control unit. The FACP, DACT, and a SPX, or two or more SPXs, etc. may be fed from one circuit as long the amperage drawn is within the limitations of a 20-ampere circuit. Each such circuit breaker shall be labeled in **red** at the power distribution panel as FIRE ALARM. A breaker panel key shall be stored within the locked cabinet of each fire alarm control unit. The location of all circuit breakers serving the fire alarm control unit shall be posted in the fire alarm control unit cabinets. Each cabinet shall be grounded securely to the building grounding system.

E. Provide all testing, documentation, training, and warranty service contract as outlined in these specifications.

1.02 CODES AND REGULATIONS

- NFPA 70, National Electrical Code, Articles 250, 300, 725, 760, and 800.
- NFPA 72, National Fire Alarm Code.
- NFPA 90A, Installation of Air Conditioning and Ventilation Systems.
- NFPA 101, Code for Safety to Life from Fire in Buildings and Structures.

- ANSI 117.1 American National Standard for Accessible and Useable Buildings and Facilities.
- ASME/ANSI A17.1 Safety Code for Elevators and Escalators
- Americans with Disabilities Act.
- Louisiana Insurance Code Article 5.43-2 Fire Detection and Alarm Devices and the Fire Alarm Rules. International Building Codes (IBC).
- Local and State Building Codes.
- All requirements of the local Authority Having Jurisdiction (AHJ).

1.03 SUBMITTALS

A. Quality Assurance Submittals:
   1. Letter from the fire alarm control panel manufacturer stating that the contractor is a factory trained for the proposed system and Factory Authorized Distributor for the area where the project is located.

   2. Current copy of the contractors Fire Alarm Certificate of Registration for sales, service and installation of fire alarm and fire detection systems issued by the State Fire Marshal.

   3. Copy of the Fire Alarm Technician's License who will supervise this installation.

   4. Calculations for indicating device circuit current drop and battery backup calculations for each unit.

B. Product Data:
   1. Drawing locating all components of the fire alarm system and indicating circuit routing, cable type, and gauge. The licensed Fire Alarm System Planning Superintendent responsible for the design of the system submitted shall sign this drawing.

   2. Print of the Fire Alarm Plan which will be mounted adjacent to panel.

C. Equipment list and data sheets on all fire alarm panel and system devices, riser diagrams, special boxes, cable, modules, and other material as requested by the Architect including:
   1. Manufacturer
   2. Model Number
   3. Indication all options and accessories
   4. Catalog data sheets with photograph

D. Submit complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval.

1.04 QUALIFICATIONS OF A PROPOSED CONTRACTOR

A. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, required current licenses, and meet the other requirements herein described will be disqualified.

B. The contractor shall be licensed by the State of Louisiana Fire Marshal to sell, install, and service commercial fire alarm systems in accordance with Article 5.43-2 of the Louisiana Insurance Code.

C. The proposed contractor, as a business entity, shall be an authorized and designated representative of the fire alarm panel equipment manufacturer, with full warranty privileges, and shall have been actively engaged in the business of selling, installing, and commercial building fire alarm systems for a period of at least 5 years.

D. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the Architect/Engineer.

E. The proposed Contractor shall have an office within 150-miles of the job site, staffed with trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up and perform a 100 percent operational audit of all installed devices, to instruct the Owners representatives and the local Fire Marshal in the proper operation of the system, and to provide service throughout the warranty period. The contractor shall be capable of dispatching technicians to repair a system within six hours of a service request.

F. All work associated with the installation of the fire alarm system shall be under the direct supervision of a state licensed Fire Alarm Technician.

G. The Contractor shall employ factory-trained technicians capable of supporting the maintenance of the system. A certificate of this training shall be provided with the contractors' submittal.

1.05 PRE-APPROVAL

A. Proposed Contractors wishing to propose systems which differ in any features, functions, or operating characteristics from those outlined in these specifications must do so in writing to the specifying authority in accordance with the prior approval requirements.

B. For manufacturers equipment or models other than that specified, the Proposed contractors shall supply proof that such substitute equipment in compatible with all devices to be furnished, and that the equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified.

C. Proposed Contractors that do not obtain prior approval will not be considered an acceptable supplier for this project. Final approval of the alternate system shall be based on the decision of the Owner and Architect. Prior approval to submit a proposal for this project does not automatically insure the system will be an acceptable equivalent.

PART 2.00 PRODUCTS

2.01 GENERAL

A. Type: Complete 24 VDC, closed circuit, electrically supervised, analog addressable, intelligent reporting, micro-processor controlled fire detection system.

B. The system shall meet all requirements for a protected premises and supervising station fire alarm system per NFPA 72.

C. The system and all components shall be tested and found suitable for the specified purpose as part of a protected premises protective signaling (fire alarm) system by a nationally recognized approvals agency acceptable to the AHJ.

D. The control units, power supplies, batteries, subassemblies, software, firmware, all cable types, detection, notification, control devices, and all accessories required to provide a complete operating system shall be listed and labeled by Underwriters Laboratories, Inc. for fire alarm system use under the latest appropriate testing standard including but not limited to the following:

- UL 38 Manually Actuated Signaling Boxes for Use with Fire Protective Signaling Systems.
- UL 50 Enclosures for Electrical Equipment.
- UL 193 Alarm Valves for Fire-Protection Service
- UL 217 Single and Multiple Station Smoke Detectors.
- UL 228 Door Closers-Holders, With or Without Integral Smoke Detectors.
- UL 268 Smoke Detectors for Fire Protective Signaling Systems.
- UL 268A Smoke Detectors for Duct Application.
- UL 346 Waterflow Indicators for Fire Protective Signaling Systems.
- UL 444 Communications Cables.
- UL 464 Audible Signal Appliances.
- UL 497B Protectors for Data Communications and Fire Alarm Circuits.
- UL 521 Heat Detectors for Fire Protective Signaling Systems.
- UL 539 Single and Multiple Station Heat Detectors.
- UL 793 Automatically Operated Roof Vents for Smoke and Heat.
- UL 864 Control Units for Fire Protective Signaling Systems.

- UL 910 Test for Cable Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Ai r.
- UL1424 Cables for Power-Limited Fire Alarm Circuits.
- UL1479 Fire Tests of Through-Penetration Firestops.
- UL1480 Speakers for Fire Protective Signaling Systems.
- UL1481 Power Supplies for Fire Protective Signaling Systems.
- UL1581 Electrical Wires, Cables, and Flexible Cords.
- UL1635 Digital Alarm Communicator System Units.
- UL1638 Visual Signaling Appliances - Private Mode Emergency and General Utility Signaling.
- UL1711 Amplifiers for Fire Protective Signaling Systems.
- UL1971 Signaling Devices for the Hearing Impaired.

E. Only equipment devices have been shown on the contract drawings. Specific wiring between equipment has not been shown.

F. All equipment and components shall be installed in strict compliance with manufacturers' recommendations and the requirements of the components UL listing. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, electrical requirements, cable types, and physical equipment sizes, etc., before beginning system installation. Refer to the manufacturers' riser / connection diagrams for all specific system installation / termination / wiring data.

G. The contractor shall be responsible for sizing, verifying and supplying proper power supply(s) necessary to operate the system and audible/visual signals.

H. All equipment and components shall be new, and the manufacturer's current model. All like devices shall be of the same manufacturer and model number.

I. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.02 ACCEPTABLE MANUFACTURES

A. All references to manufacturer's model numbers and other pertinent information herein are intended to establish minimum standards of performance, function, and quality. Compatible, UL listed equipment may be submitted for approval for the specified equipment as long as all requirements are met.

B. The fire alarm control panel shall be a Fire·Lite Alarm Inc. model MS-9200, Fire Control Instruments 7100 series, or equivalent. This constitutes the quality and performance of the equipment to be furnished, any other proposed suppliers must be pre-approved.

2.03 SIGNAL TYPES (SYSTEM STATUS)

A. General: The Fire Alarm Control Panel shall indicate various conditions or signals depending on system inputs. In all instances a more severe signal shall override all less severe signals. All events are to be recorded with time and date in an electronic event history log maintained by the fire alarm control panel. The following is a short description of conditions that the Fire Alarm Control Panel is required to indicate in order of severity:

B. WATERFLOW FIRE ALARM: A waterflow signal is a special alarm condition that is only applicable when an automatic building sprinkler or similar system is monitored. It indicates that at least one sprinkler head is open, so in addition to a fire, the premises is subject to water damage. This signal is transmitted on a special channel on the digital communicator. This is a fire alarm condition and all actions listed under fire alarm shall take place.

C. FIRE ALARM: This alarm signal is indicative of fire. Such a signal indicates an emergency requiring immediate action. All premises audible and visual notification appliances shall operate and the protected premises evacuated. A local audible alert shall sound, the alarm LED illuminate, and descriptive message appear on the LCD display at the panel and any remote annunciators until the panel is reset. A fire alarm signal is transmitted by the digital communicator.

D. SUPERVISORY ALARM: A supervisory signal indicates the need for action in connection with a monitored fire suppression system, or the maintenance of related systems. The tamper switch on a sprinkler riser is a supervisory condition because the system cannot function with a closed valve. When permitted by the AHJ a signal from a duct mounted smoke detector may also produce a supervisory signal. An audible alert shall sound, the supervisory LED illuminate, and descriptive message appear on the LCD display at the panel and any remote annunciators until silenced. The digital communicator transmits a supervisory signal.

E. TROUBLE: A trouble signal indicates a fault in a monitored circuit or component of the fire alarm system. This could be a short, open, or ground in a supervised circuit. It could also indicate a device or battery failure. A local audible alert shall sound, the trouble LED illuminate, and descriptive message appear on the LCD display at the panel and any remote annunciators until silenced. The digital communicator transmits a trouble signal.

F. MAINTENANCE ALERT: A maintenance alert is an early warning of a condition before a device becomes inoperable. This is usually a smoke detector that needs cleaning or other maintenance item. The maintenance alert shall display on the panel and any remote annunciator LCD display until acknowledged. No audible alert shall sound and no signal transmitted, in order that this condition not be

confused with a supervisory or trouble condition.

G. NORMAL: All systems and supervised circuits functioning normally.

2.04 CIRCUIT TYPES

A. General: All low voltage fire alarm circuits shall be power limited, electrically or electronically supervised, and of the correct cable type and gauge. Low voltage fire alarm cable of various types are to be permitted within the same raceway or conduit. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760. T-taps in any electrically supervised circuit are prohibited by this specification. All junction boxes and conduit ends shall be marked red for all low voltage fire alarm circuits.

B. Signaling Line Circuit (SLC): A signaling line circuit is the backbone loop that interconnects all addressable intelligent devices and over which status, input, and output signals are carried. The operation of these circuits is critical to the operation of the system and they shall by wired in a Class A redundant loop with isolation modules. Class A separation of cable routing shall be observed per NFPA 72.

C. Notification Appliance Circuit (NAC): A notification appliance circuit provides operational power to and is directly connected to the audible and visual signals. These appliances have a relatively large current draw and circuits shall be of an adequate wire gauge to prevent a voltage drop below the rated operating voltage of the appliances. These circuits shall be wired Class B with electrical supervision and end of line devices.

D. Initiating Device Circuits (IDC): Initiating device circuits shall be used only where it is necessary to interface to a contact type or conventional device such as a sprinkler riser waterflow switch, tamper switch, or projected beam detector. Initiating device circuits shall be arranged to serve like categories (beam detectors, heat detectors, tamper switches). Mixed category circuitry shall not be permitted in a single IDC. A two-wire IDC shall contain only devices that require point-contact to operate. A four-wire IDC shall include an additional supervised circuit to supply 24 VDC operating power to devices that require it. These circuits shall be kept as short as possible and shall be wired Class B with electrical supervision and end of line devices, or power supervisory/end of line devices for four-wire circuits.

E. Low voltage, 24 VDC, fire safety control circuits shall be considered as, and meet all requirements of a supervised IDC.

F. Line voltage, 120 VAC, fire safety control circuits shall in all cases be of "fail safe" operation and shall not have backup power. On activation of

the fire alarm, or loss of power, all connected devices shall actuate to their fire safety condition (i.e. HVAC blower control relays shall open, smoke fire dampers shall close, and fire door holders shall release). These circuits shall be controlled by a power relay located within three feet of the breaker panel. Control relays shall be located within three feet of the unit controlled. The power relay shall feature properly rated electrical contacts for a 120 VAC, 20 ampere circuit. These circuits shall be switched by a relay controlled by the fire alarm system and wired by the Electrical Contractor. Line voltage control circuits shall be standard non-supervised line voltage circuits in conduit, with the same type of conductors as specified in Division 16 for light and power circuits.

2.05 CABLING

A. The fire alarm contractor shall provide and install new and unused ASTM bare solid or stranded copper conductor cable per ANSI/NEMA and NFPA codes. Follow the manufacturer's instructions. All cable shall be UL listed for fire protective, power limited applications. All cable exposed in attic spaces shall comply with UL 1424 and UL 1581 vertical tray flame test.

B. Cabling shall be in accordance with local, state, and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 1 4 AWG (1.63 mm) for notification appliance circuits.

C. Cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPL).

D. Signaling Line Circuit (SLC): Use shielded or unshielded cabling as recommended by the FACP manufacturer. When recommended, shielded cable should be utilized to minimize electrical noise interference with data transmission. All wiring for intelligent/addressable data circuits shall be shielded twisted pair, low capacitance, NEC type FPL, West Penn Wire number D975 - 18 AWG, number D991 - 16 AWG, or number D995 - 14 AWG, overall shield 100% aluminum polyester foil, data cable, one twisted pair. Shield drain wire to be grounded at one end only. Equivalent by Atlas, Belden, BSCC, or Remee.

E. Between Building Signaling Line Circuit (SLC) or Network Node Circuits: Cabling between buildings shall be enclosed in conduit, including underground and over canopy installations. Cable used between buildings shall be rated for direct burial. Cable shall be moisture, abrasion, and crush resistant. Use shielded or unshielded cabling as recommended by the FACP manufacturer. When recommended, shielded cable should be utilized to minimize electrical noise interference with data transmission. All between building wiring for

intelligent/addressable data or network node circuits shall be shielded twisted pair, low capacitance, NEC type FPL Direct Burial, West Penn Wire number AQ293 - 18 AWG or number AQ294 - 16 AWG, Aquaseal, overall shield 100% aluminum polyester foil, data cable, one twisted pair. With water blocked construction and overall 1051 C sunlight and moisture resistant PVC jacket. Shield drain wire to be grounded at one end only. Equivalent by Atlas, Belden, BSCC, or Remee.

F. Notification Appliance Circuit (NAC): All audible/visual signaling circuits shall be NEC type FPL, West Penn Wire number 971 - 16 AWG, number 972 - 14 AWG, or number 974 - 12 AWG, two conductor signaling cable. Equivalent by Atlas, Belden, BSCC, or Remee.

G. Initiating Device Circuits (IDC): All conventional contact alarm circuits and low voltage control circuits shall be NEC type FPL, West Penn Wire number 971 - 16 AWG, number 972 - 14 AWG, or number 974 - 12 AWG, two conductor signaling cable. Equivalent by Atlas, Belden, BSCC, or Remee.

2.06 CABLE ROUTING, INSTALLATION, AND SUPPORT

A. System wiring and equipment installation shall be in accordance with good engineering practices as established by the NFPA and the Louisiana Insurance Code. Wiring shall meet all state and local electrical codes.

B. All wiring shall test free from opens, grounds, or shorts. All fire alarm cable shall be supported from the building structure and bundled. Do not attach any supports to joist bridging or other lightweight members. The support system shall provide a protective pathway to eliminate stress that could damage the cabling. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.

C. In all exposed areas such as gymnasiums, shops, field houses, janitors' closets, or mechanical / electrical rooms all fire alarm cable shall be fully enclosed in conduit.

D. Fire alarm cables shall be run in conduit stubs from wall boxes to accessible areas above finished ceilings. Conduit shall be required only within walls and concealed spaces to provide access. Provide a plastic snap in bushing at each end of all open conduit stubs or sleeves - Thomas & Betts Catalog no. 443 - 3/4", 424 - 1", 425 - 1 1/4", 427 - 2", Arlington Industries EMTxxx series insulating bushings, or equivalent.

E. Fire alarm cables shall be run in bundles above accessible ceilings and supported from building structure on j-hooks. Cabling shall be loosely bundled with cable ties randomly spaced at 30 to 48 inches on center; cable ties shall not be tight enough to deform cabling and shall not be used to support the cabling.

F. Fire alarm cable must not be fastened to electrical conduits, mechanical ductwork/piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel for more than four-feet with line voltage electrical conductors. Fire alarm cables shall not be run loose on ceiling grid or ceiling tiles.

G. Fasteners that may be loaded with multiple cables shall be provided. Provided that the weight load is carried by the support rod or wire the support assembly may attach to the ceiling grid for lateral stabilization. The required support wires for the ceiling grid or light fixtures shall not be utilized. Any fastener attached to the ceiling grid shall not interfere with inserting or removing ceiling tiles. The cable pathway of supports must be positioned at least 12 inches above the ceiling grid.

H. All cabling shall be placed with regard to the environment, EMI/RFI interference, and its effect on fire alarm signal transmission.

I. Do not route any fire alarm cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.

J. Fire alarm cable will not be installed in the same conduit, raceway, tray, duct, or track with line voltage electrical cable without a metallic barrier meeting NEC requirements.

K. Maximum cable pulling tension should not exceed 25 lb./ft. or manufactures recommendation, whichever is less.

L. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.

M. No terminations or splices shall be installed in or above ceilings.

N. Cable bends shall not be tighter that the manufacturers' suggested bend radius.

O. Mount all equipment firmly in place such that vibration or jarring will not activate an alarm, supervisory, or trouble signal. Cable shall be routed in a professional, neat and orderly installation.

P. All cable shall have a label on both ends utilizing self-laminating, flexible vinyl film and non-smear nylon marking pens. Utilize Tyton Corporation Part number RO175 Rite-On labels and Part number FTP1 nylon marking pens or equivalent.

Q. Each cable run shall include a three-foot service loop with wire tie located in the ceiling above the control unit panel. This is to allow for future re-

termination or repair.

R. Provide for adequate ventilation to all equipment racks and take precautions to prevent electromagnetic or electrostatic hum.

S. All conduit, ducts, track, and raceways shall be supported from the structure at industry standard intervals for the size specified, utilizing proper anchoring devices. Cable fill may not exceed the manufacturers' instructions for each type of support.

T. Devices mounted on a drop ceiling shall feature a back box fitted with a support hanger (Caddy #512 or equivalent) and an independent drop wire to support the weight of the device.

U. Termination practices

1. Strip back only as much cable jacket as required to terminate.

2. Do not "loop" over wiring terminals, the cable could come loose and the condition not be detected as an open circuit or disconnected device.

3. Preserve wire twists as closely as possible to point of termination (0.5" maximum) to keep signal impairment to a minimum.

4. Avoid twisting cable during installation.

V. J-Hooks

1. Attachments for cabling support shall be spaced at approximately 48 to 60 inches on center. The cable bundle shall not be allowed to sag more that 12 inches mid-span between attachments. Attachments shall be sized as follows: Single cables or bundles up to four cables may be supported directly by the building structure.
   - Bundles up to 1/2" dia. (Ten 1/4" cables)
     2" bridle ring, Caddy #4BRT32 or equivalent
   - Bundles up to 3/4" dia. (Sixteen 1/4" cables)
     3/4" J-Hook, Caddy #CAT12 or equivalent
   - Bundles up to 1-5/16" dia. (Fifty 1/4" cables)
     1-5/16" J-Hook, Caddy #CAT21 or equivalent
   - Bundles up to 2" dia. (Eighty 1/4" cables)
     2" J-Hook, Caddy #CAT32 or equivalent
   - Split bundles greater that 2" dia. or provide cable tray.

2. Do not mix different signal strength cables on the same J-Hook (i.e. fire alarm with telephone/data cable). Multiple J-Hooks can be placed on the same attachment point, up to the rated weight load of the attachment device.

W. Cable Ties: Nylon cable ties shall be furnished and installed to attach wire bundles to supports and for appropriate wire management as required.
Nylon wire tie, 3.9", miniature - Panduit PLT1M-C or equivalent.
Nylon wire tie, 5.6", miniature - Panduit PLT1.5M-C or equivalent.
Nylon wire tie, 11.4", intermediate - Panduit PLT3I-C or equivalent.
Nylon wire tie, 14.6", intermediate - Panduit PLT4I-C or equivalent.

2.07 FIRE STOPPING, PENETRATIONS, AND CORING

A. UL Listed fire stopping methods that match the fire rating of the wall or floor being penetrated are to be used at all fire barrier penetrations. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire-stop caulk or putty, install according to the manufacturers' instructions.

B. All penetrations through fire rated walls or floors shall feature a suitable length of metal conduit. Hole diameter shall not exceed ½" larger than the conduit or sleeve to be installed. The hole shall be neatly cut, not oversize or irregular. Do not share wall/floor penetrations with ductwork, piping, line voltage electrical conduits, etc.

C. All gypsum board or plaster penetrations shall tool cut using an appropriate hole saw / mandrel or manufactured assembly.

D. The Contractor shall make every effort to coordinate with the building Architect, Engineer, Builder and Electrical Contractor to have sleeves placed in new construction so that later coring or drilling of building structural members will not be required. The Contractor must consult with the building Architect, Engineer, and Builder prior to drilling, coring, or sawing of any wall, floor, etc. All penetrations shall be made at approved, appropriate, locations.

E. Upon approval, the contractor shall be required to supply all labor, equipment, tools, and materials to create any additional penetrations, and shall provide the sleeve, temporary and final fire stopping. Special care shall be taken not to stress, overheat, or penetrate any building support member. Coring shall be made with equipment appropriate for the dry penetration of concrete and block materials. Under no circumstances shall penetrations be made utilizing a chisel or percussion type equipment. Concrete, block, or plaster cores shall be made by dry saw/core methods only.

2.08 FACP, DIGITAL COMMUNICATOR, & SIGNAL POWER EXPANDERS SURGE AND AMPERAGE PROTECTION

A. In addition to all the built-in panel surge protection on each incoming 120 VAC power circuit, electrical surge protection shall be provided for each fire alarm control panel, digital communicator, signal power expander and all other 120 VAC power fire alarm control units. Each power circuit

surge protector shall be mounted in a standard grounded metallic electric box. Module shall be hardwired in the incoming power circuit and shall provide power dissipation of at least 1,000,000 VA, clamping voltage of 145 VA, 1 nanosecond response time, 9,000 amps surge current, and 120 joules power dissipation

B. The main fire alarm control panel shall be installed in the location shown on the drawings. Battery cabinets, power supplies and main auxiliary cabinets shall be located in closets, above ceilings or other concealed spaces as approved by the Architect.

C. Fire alarm system equipment shall not be installed in communications closets.

2.09 FIRE ALARM CIRCUIT SURGE AND AMPERAGE PROTECTION

A. Electrical surge protection shall be provided for all entrance connections and on each copper pair that connects one building to another (i.e. any other portion of a building complex not under one continuous roof) at both exit points to prevent damage to equipment.

B. Fire alarm system circuit surge protectors shall be mounted in a standard grounded metallic electric box. Shall be Ditek, 12345-A Starky Road, Largo, Florida 34643 model numbers as follow, multiple pair units are available, or equivalent by Intermatic:

Part number DTK-1LVLP	2 wire protector for 24 Volt circuits.
Part number DTK-1LVLP-D	2 wire protector for 5 Volt circuits.

2.10 ISOLATOR MODULE

A. Provide isolator modules in each SLC loop placed between every 25 or less devices. The isolator modules shall isolate wire-to-wire short circuits on a SLC loop, which shall limit the number of other modules, or detectors that are incapacitated by the short circuit fault. If a wire-to-wire short occurs, the isolators on either side of the short shall automatically open-circuit. When the short is corrected, the isolators shall automatically re-connect the isolated section of the loop.

B. The isolator module shall not require any address-setting, although each isolator may electrically reduce the capacity of the SLC loop by one detector or module address. The isolator module may be built into selected detector bases or mount in a standard 4-inch electrical box. Provide a LED, which shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short has been detected and isolated.

C. Fire·Lite model I300 module, Fire Control Instruments INI-7100 series, or equivalent.

2.11 MONITOR MODULE

A. Addressable Monitor Modules shall be provided where required to interface to contact alarm devices. The monitor module shall be used to connect a SLC to a supervised zone of conventional initiating devices, any normally open dry contact device. The monitor module will mount in a 4-inch square electrical box. Each IDC zone may be wired either class A or class B field selectable. Each monitor module shall be set to a distinct address and internal identification code on the SLC, which the control panel shall use to identify the location, status, and type of device. A status/power LED shall be provided which shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel. The status LED shall illuminate steady upon detection of an alarm condition.

B. Each monitor module shall provide for automatic functional testing of the device from the main control panel and shall reset the IDC monitored when the panel in reset. Results of the test shall then be indicated on the LCD display.

C. Each monitor module shall have an engraved plastic nameplate permanently attached indicating the devices function and control panel device identification number. Labels shall be 1/16" thick two ply black/white acrylic sheet engraving stock with all sides beveled.

D. Fire·Lite modelM300, M301, or M302 modules as required, Fire Control Instruments AMM-2 series, or equivalent.

2.12 CONTROL MODULE

A. Addressable Control/Relay Modules shall be provided where required to provide NAC interface or relay controlled fire alarm functions. The control module will mount in a standard 4-inch electrical box. The control module shall provide a dry contact (form C) relay with SPDT dry contacts rated at 2.0 amps @ 24 VDC and 0.5 Amps @ 120 VAC (pilot duty).

B. Power to operate the relay actuation shall be provided by the SLC. Each control module shall be operated by events as programmed in the control panel (i.e. operate on alarm condition). Control modules shall feature status LEDs to indicate the module is operational and when the relay is energized.

C. Each control module shall be set to a distinct address and internal identification code on the SLC, which the control panel shall use to identify the location, status, and type of device.

D. Each control module shall have an engraved plastic nameplate permanently attached indicating the devices function and control panel

device identification number. Labels shall be 1/16" thick two ply black/white acrylic sheet engraving stock with all sides beveled.

E. Fire·Lite model C304 module, Fire Control Instruments AOM-2R series, or equivalent.

2.13 POWER RELAY

A. Power Relays shall be provided as required to control each fire safety control functions circuit, one or two circuits may be controlled by each relay. Each relay shall be operated by a 120 VAC coil and feature DPDT dry contacts rated 30 Amps @ 120 VAC. Each relay shall mounted in a surface mount metal enclosure with conduit knockouts. Relays shall be UL recognized and rated for ten million mechanical operations.

B. Air Products & Controls model MR-199X-14/C, 120 VAC coil, heavy-duty power relay with metal enclosure, Fire Control Instruments SNAC series, or approved equivalent.

2.14 CONTROL RELAY

A. Control Relays shall be provided where a relay control interface is required to perform fire safety control functions; air handler shut-down, fire door control, etc. Each relay shall be operated by a multi-voltage coil (24 VDC, 24 VAC, or 120 VAC), feature SPDT dry contacts rated 10 Amps @ 120 VAC, and a status LED to indicated the relay is energized. Each relay shall mounted in a surface mount metal enclosure with a status LED viewing hole and conduit knockouts. Relays shall be UL recognized and rated for ten million mechanical operations.

B. Air Products & Controls model MR-101/C, multi-voltage coil, control relay with metal enclosure, Fire Control Instruments ARB series, or approved equivalent.

2.15 FIRE ALARM PLAN

A. Provide a plan view of all building areas covered by the fire alarm system. The plan shall be mounted in a location approved by the Owner. The plan shall meet the following requirements:
- Framed and secured to the wall and plan covered with clear acrylic panel.
- Size to clearly show all required information.
- Orient building to place the entry nearest to control panel at the bottom of plan. - "YOU ARE HERE" indicator with arrow.
- Logical alarm zones.
- Room names and numbers. Verify with Owner.
- Show each initiating device with symbol and identification number as programmed in panel.
- Do not show indicating (audio/visual) devices.
- Symbol legend.

- True north arrow.
- Scale indicator.

2.16 FIRE ALARM CONTROL PANEL (FACP)

A. Type: Microprocessor based modular design, addressable reporting system. The following are required system components and functions.

1. Size panel to allow space for 30% expansion of all devices by the addition of subassemblies contained within the panel housing at a future date. Each signaling line circuit (SLC) shall be limited to 80% of its total device capacity during the initial installation.

2. Provide a UL listed cabinet suitable for semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and the manufacturers' standard finish, red color preferred. The back box and door shall be constructed of 0.060" minimum steel with provisions for electrical conduit connections clearly indicated. The door shall provide a key lock to access system controls/switches, key alike to manual pull station reset. The door shall include a transparent opening for viewing of all alarm, supervisory, and trouble indicators and the LCD display. The door shall be for right or left hand hinging as required. When the door is opened all operator controls shall be accessible and all internal components shall be enclosed (i.e. dead front panel). All components shall be securely mounted and all cable routed and tie wrapped in a neat, professional manner. Conduit shall enter the fire alarm control panel only at conduit entry as specified by the FACP manufacturer.

3. The microprocessor shall provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time of day, day of week, and day of year.

4. The system shall contain an EIA RS-232C serial communication port for transfer and printing of event history data, detector, instructions, and operating sequences as required. The FACP shall be capable of sending packets of up to 40 ASCII characters followed by a carriage return (ODH) and a line feed (OAH) to the serial port. The output shall be formatted to make it possible for an external monitoring computer to recognize certain combinations of characters in certain locations within each 40-character string in order to interpolate the status of the FACP.

5. Fire alarm, supervisory alarm, trouble, and maintenance alert conditions with identifiers shall be displayed on a 40-character

minimum Liquid Crystal Display (LCD). The chronological event history of alarm and trouble conditions may also be displayed.

6. Keypad for functions and programming, two buttons for scrolling data on the LCD, four front panel switches for RESET, ALARM SILENCE, TROUBLE SILENCE, and DRILL/ALL CALL and five LEDs for Normal, Fire Alarm, Supervisory Alarm, Trouble, and Test/Program. When multiple devices are reporting alarm condition there shall be a visual indication that other devices are in alarm.

7. Incoming power shall be supervised. A green "POWER ON" LED shall continuously display while power is present.

8. Power supply/charger and batteries to supply power limited 24 VDC operating and emergency power to the system. The charger shall be capable of maintaining batteries in a fully charged state without damage and of bringing batteries from a fully discharged to a fully charged state within 48 hours of normal operation. Provide audible alarm and diagnostic LEDs to indicate AC power failure, brown out, control unit CPU failure, low battery detection, battery disconnection, and system ground fault detection. Upon AC power failure the power supply shall automatically transfer the system to battery backup. The batteries are to be completely maintenance free. No liquids are permitted; fluid level checks for refilling, spills, and leakage shall not be required. If necessary to meet standby requirements, external battery and/or charger systems may be used. Provide sufficient battery capacity for operation without AC power for twenty-four hours of normal supervision and five minutes alarm operation at the end of this period; include a 20% safety factor in battery calculations to ensure adequate performance for the service life of batteries.

9. Failure of either the primary (AC) or secondary (Battery) power supply shall result in a trouble signal.

10. The CPU and associated equipment are to be protected consistent with UL 864 standards so that voltage surges or line transients will not affect them. All external connections of the FACP shall withstand 6 kilovolt transients to chassis ground.

11. The system shall permit cabling for 24 volt control functions; IDC, NAC, and similar power limited auxiliary functions to be located in the same conduit with the multiplex communication loop (SLC). All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

12. All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of

any internal modules, or any open circuits in the field wiring; a trouble signal will be activated until the system and its associated field wiring are restored to normal condition. The FACP shall check for the presence of ground faults in field wiring and report results on the LCD readout, is it a violation of this specification for any ground fault detection system to be disabled.

13. A single ground or open on any system SLC, IDC, NAC, or fire safety control circuit shall not cause a system malfunction or the loss of ability to report an alarm.

14. Each peripheral device connected to the CPU shall be continuously scanned for proper operation. Data transmissions between the CPU and peripheral devices shall be reliable and error free. The transmission scheme used shall employ dual transmission or other equivalent error checking techniques.

15. The Fire Alarm Control Panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is below or above normal limits, the controller shall differentiate between long term drift above the pre-alarm threshold (maintenance alert, indicative of the need for cleaning) and a fast rise above the pre-alarm threshold (indicative of a smoldering fire).

16. Each addressable device on an SLC loop shall systematically report for type identification. Loss of signal from any addressable device at the control panel shall result in a trouble condition. If the inadvertent installation of another type sensor takes place the system and the installed device shall operate however a "WRONG DEVICE" trouble condition will display until the proper unit is installed or the programmed sensor type is changed.

17. The system shall be capable of on site programming to facilitate changes in operation, sensor sensitivity, or system expansion. The unit shall contain non-volatile EPROM memory; loss of primary and secondary power shall not result in loss of programming information.

18. All system software and firmware shall be UL listed with the control panel and protected from unauthorized changes. The microprocessor shall contain and execute on site programmable logical statements for each control-by-event specific action to be taken when an alarm condition is detected at specific programmed points by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs. Any software or firmware changes made shall require a minimum of a 10% functional test of the system.

19. The system shall store and recall a time and date of incident recorded chronological event history of alarm, supervisory, and trouble conditions. The event history shall store a minimum of four hundred events.

20. Maintenance alerts shall be annunciated as an alert on the LCD only and shall not be confused as a Trouble or an Alarm. This feature shall in no way inhibit the receipt of alarm conditions in the system.

21. The system shall on demand perform and print a detector sensitivity test, meeting requirements of NFPA 72, Chapter 7.

22. Walk test, the Fire Alarm Control Panel shall permit testing by manually placing each initiating device in alarm. The control panel shall pulse the system audible devices on detection of each such alarm and automatically reset the panel, permitting a single serviceman to functionally test the entire system.

23. Manufacturer / Model: Fire·Lite model MS-9200, Fire Control Instruments 7100 Series.

2.17 DIGITAL ALARM COMMUNICATOR TRANSMITTER (DACT)

A. Provide a digital alarm communicator transmitter control unit configured as a slave communicator for the transmission of fire alarm control panel status signals over normal telephone lines.

B. The digital communicator power supply/charger and batteries shall supply power limited 24 VDC operating and emergency power for the unit. The charger shall be capable of maintaining batteries in a fully charged state without damage and of bringing batteries from a fully discharged to a fully charged state within 48 hours of normal operation. Provide sufficient battery capacity for operation without AC power for twenty-four hours of normal supervision and five minutes alarm operation at the end of this period; include a 20% safety factor in battery calculations to ensure adequate performance for the service life of batteries.

C. Conduit shall enter the equipment backbox in conduit entry locations specified by the manufacturer.

D. The communicator shall have the capability to transmit three or four distinct signals to a digital alarm communicator receiver in industry standard formats as follows:
- Waterflow Fire Alarm (When applicable)
- General Fire Alarm
- Supervisory Alarm
- Trouble Condition

E. The communicator shall have the capability to supervise two (2) loop start telephone lines, seize the phone line, and transmit the required signal over either line without additional equipment. The digital communicator shall be capable of transmitting all major digital formats for central station monitoring, coordinate requirements with Owner. The communicator shall monitor the telephone line voltages to detect faults, open (cut line), and short circuit conditions. The communicator shall automatically initiate and complete a verifiable test signal over a telephone line at least every 24 hours to insure correct operation.

F. The Owner shall identify two dedicated loop start telephone lines for connection to the digital communicator. Ground start or party line service telephone lines are not suitable. The fire alarm contractor shall provide RJ31X modules at a point after the telephone company demarcation point and prior to the telephone switch or analog device (i.e. FAX machine). Provide category 3 telephone cable to the digital communicator.

G. The Owner shall select the monitoring service, remote supervision station, or central station service provider and provide connection information to the contractor. The fire alarm system contractor shall provide all activation circuits, program and test the digital communicator. The fire alarm system contractor shall coordinate with and provide all necessary information about the system reporting codes to the representative of the service selected by the Owner. For central station service the installation shall be certificated or placarded by the selected central station. The fire alarm system shall be monitored by an off site monitoring service during the one year warranty period. The Contractor shall include monitoring service shall be included in bid price.

H. Shall be a Silent Knight model 5104 four-channel fire communicator, Fire Control Instruments model 411, or approved equivalent. A digital communicator and backup power supply integrated into the FACP meeting all of the above requirements is acceptable.

2.17 SIGNAL POWER EXPANDER (SPX)

A. Provide as required additional power supplies for notification appliance circuits or as a remote power supply.

B. The signal power expander supply/charger and batteries shall supply power limited 24 VDC operating and emergency power. The charger shall be capable of maintaining batteries in a fully charged state without damage and of bringing batteries from a fully discharged to a fully charged state within 48 hours of normal operation. Provide sufficient battery capacity for operation without AC power for twenty-four hours of normal supervision and five minutes alarm operation at the end of this period; include a 20% safety factor in battery calculations to ensure adequate performance for the service life of batteries.

C. Each signal power expander shall have an engraved plastic nameplate permanently attached indicating the devices device identification number as documented. Labels shall be 1/16" thick two ply black/white acrylic sheet engraving stock with all sides beveled.

D. Each signal power expander shall be connected to the FACP such that the trouble contracts on the power expander generate a trouble signal at the FACP.

E. Conduit shall enter the equipment backbox only at conduit entry as specified by the manufacturer.

F. Provide as required Silent Knight model Firepower 5495 distributed power module(s), Fire Control Instruments SNAC series, or approved equivalent.

2.18 STROBE/HORN SIGNALS (AUDIBLE/VISUAL NOTIFICATION APPLIANCES)

A. Audible/Visual Signals shall conform to ADA standards. Furnish and install where shown on the drawings or as required per NFPA and any local, state, federal codes, or laws. Strobe intensity (candela output) and audible decibel level shall be sized for the room size and area of coverage per ADA and NFPA/ANSI standards. Audible signals shall emit a temporal pattern (Code 3) meeting ANSI S3.41 standards. Housings shall be white in color and imprinted with the international iconographic symbol for fire evacuation devices. Strobe lens shall be clear. All interior strobe flashing shall be synchronized. All interior audible signal tones shall be a synchronized code 3 pattern.

B. Provide synchronization control modules, interconnected such that all circuits are synchronous, for all notification appliance circuits – Edwards Signaling model EG1M Genesis Signal Master sync modules or equivalent. Note that signal appliances that can synchronize on a single circuit, but not across all circuits are not acceptable.

C. Small rooms as indicated provide 15 cd strobe only - Edwards Signaling model EG1-V15 or equivalent. Corridors up to 20' wide provide 15 cd strobe/horn - Edwards Signaling model EG1-HV15, Fire Control Instruments Spectralert series, or equivalent.

D. Medium size rooms (typical classrooms) as indicated provide 30 cd to75 cd strobe/horn – Edwards Signaling model EG1-HVxx, Fire Control Instruments Spectralert series, or equivalent.

E. Large rooms (over 40' longest wall) as indicated provide 110 cd strobe/horn – Edwards Signaling model EG1-HV110, Fire Control Instruments Spectralert series, or equivalent.

F. Exterior strobe/horns provide 75 cd Wheelock model ASWP-2475W-FW with WPBB-W backbox, or equivalent, weatherproof for outdoor installation per UL 1638 Surface mounted.

G. Provide where indicated on plans or required protective polycarbonate or wire guards. Minimum of 1/8" thick clear polycarbonate or 10 gauge welded steel wire constriction with a white epoxy powder coat finish. To be Wheelock model EWR slotted horn/strobe enclosure, Space Age Electronics, Inc. Marlboro, MA, model number SSU 03505 universal signal guard, or equivalent.

2.19 MANUAL PULL STATIONS

A. Manual Fire Alarm Pull Stations shall be provided at all exits and where indicated on the drawings. Each addressable manual pull station shall incorporate a transmitter and receiver having a unique identification and status reporting capability to the control panel.

B. Each manual station shall be attached to a SLC and be set to a distinct address and internal identification code, which the control panel shall use to identify the location, status, and type of device.

C. Manual Stations shall be designed for semi-flush mounting on a standard electrical box. The station shall be constructed of hi-impact red molded Lexan or aluminum with instructions for station operation in raised white letters. The word "FIRE" shall appear on the manual station in letters one half inch in size or larger. Manual stations shall meet accessibility requirements and be operable by one hand with a five pound or less pull force.

D. Stations shall provide a visible indication they have been operated. Stations shall require a key to be returned to normal condition, key alike to FACP. It is the responsibility of the Fire Alarm Contractor to insure that the pull stations provided allow key reset with the station protector frame/spacer in place.

E. Provide a tamper proof clear Lexan shield with horn station protector over each pull station. When the shield is lifted a continuous audible warning horn shall be activated. Lowering and realigning the shield shall silence the horn. The horn shall provide 85 dB at 10 feet and be powered by a standard 9-volt replaceable battery. Shall be a Stopper II Manual Station Protector with horn as manufactured by Safety Technology International, Inc. Waterford, Michigan part number STI 1100. Provide with spacer, part number STI 3100, for pull stations on surface mount backboxes as required.

F. Fire·Lite model BG-10LX station, Fire Control Instruments MS series, or equivalent.

2.20 HEAT (THERMAL) DETECTORS

A. Combination rate of rise and fixed thermal detectors shall be provided where indicated on the drawings. The intelligent thermal detectors shall connect via two wires to one of the intelligent control panel loops and be re-settable from the FACP. The detectors shall use dual electronic thermostats to measure temperature levels in its chamber and provide fast response to rapid rate of rise in temperature.

B. The fixed temperature element shall be rated at 135° Fahrenheit for areas where ambient temperatures do not exceed 100° Fahrenheit, and 200° Fahrenheit for areas where the temperature does not exceed 150° Fahrenheit.

C. The rate of rise element shall operate when the rate of temperature rise exceeds 15° Fahrenheit per minute.

D. The detectors shall provide a calibrated test method whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself, by activating a magnetic switch, or may be activated remotely on command from the control panel.

E. Each thermal detector attached to a SLC and shall be set to a distinct address and internal identification code, which the control panel shall use to identify the location, status, and type of device.

F. The detectors shall provide dual alarm and power/status LEDs. Status LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LEDs may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected.

G. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base. Detectors shall be provided in smooth attractive white finish. Detectors shall be UL listed with respective control panel.

H. Fire·Lite model HD-600 devices on an M302 module, Fire Control Instruments 600 series, or equivalent.

2.21 SMOKE DETECTORS

A. Photoelectric Smoke Detectors shall be provided where indicated on the drawings. The photoelectric detectors shall be re-settable from the FACP. The detectors shall operate by the photoelectric light-scattering principal using an LED light source to detect smoke density. The detector shall provide automatic sensitivity drift compensation to provide longer term stability and reliability. The detector shall also provide a maintenance alert feature whereby the detector shall initiate a trouble condition should

the unit's sensitivity approach the outside limits of the normal sensitivity window. In addition, the detector shall also be provided with extensive RF and EMF noise immunity. Detectors shall withstand wind gusts to 4,000 feet per minute without false alarming or initiating a trouble indication.

B. The detector shall provide a calibrated test method whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself, by activating a magnetic test switch, or may be activated remotely on command from the control panel.

C. Each smoke detector shall be attached to a SLC and set to a distinct address and internal identification code, which the control panel shall use to identify the location, status, and type of device.

D. The detectors shall provide dual alarm and power/status LEDs. Status LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LEDs may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected and verified.

E. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base. Detectors shall be provided in smooth attractive white finish, and be sealed against dirt, vermin, and backpressure. Detectors shall be provided with fine mesh insect/contaminate screen. Detectors shall be UL listed with respective control panel.

F. Except for temporary testing, smoke detectors shall not be installed until the building is ready for occupancy and cleaned as dust free as possible.

G. Fire·Lite model SD-300 devices, Fire Control Instruments ASL-PL series, or equivalent.

2.22 DUCT MOUNTED SMOKE DETECTORS

A. Duct mounted detector housings with intelligent photoelectric detector heads shall be provided where shown on the drawings, or as required. Detectors shall operate by the photoelectric light-scattering principal using an LED light source to detect smoke density. The detector shall operate in air velocities of 300 to 4,000 ft./min. without a shift in sensitivity. Each detector shall be re-settable form the FACP.

B. The unit shall consist of a 16-gauge steel or Noryl molded plastic enclosure with molded integral conduit knockouts. The unit shall be provided with gasket seals to provide proper sealing of housing to mechanical ductwork and to insure proper airflow into the detector sampling chamber. Duct housing shall be designed to easily mount to rectangular or round ducts.

C. The Duct Detector Unit shall be U.L. listed to the most current UL 268A standard and be cross-listed for use with the fire alarm control panel. Each duct unit shall be equipped with sampling tubes protruding into the associated ductwork. For ducts up to 3' wide the supply tube shall be 1" shorter than the duct width. For ducts 3' to 8' wide the sampling tube to be 1" longer than the duct width and protrude through the opposite side of the duct for support. Duct widths greater than 8' will require internal bracing. Sampling tubes shall be configured to provide adequate airflow through the detector housing and fitted with an integral porosity filter system to aid in reducing detector contamination. Detectors shall be installed per NFPA 90A and the manufacturer's instructions.

D. When smoke is detected by a duct mounted smoke detector, it shall activate either a supervisory fire alarm condition at the fire alarm control panel as directed by the AHJ. Duct mounted smoke detectors shall indicate a supervisory alarm unless otherwise directed, duct mounted smoke detectors are not a substitute for area detection. In either case the activation of any duct mounted smoke detector shall actuate all related air handler shut down relays, smoke fire dam per motors, fire door release devices, etc.

E. Each smoke detector shall be attached to a SLC and set to a distinct address and internal identification code, which the control panel shall use to identify the location, status, and type of device.

F. Each detector shall be provided with a remote test and reset switch with power/status LED indicator. The remote test switch shall be located in the nearest corridor ceiling unless otherwise directed. The status LED shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. The LED shall be placed into steady illumination when a supervisory condition has been detected.

G. Each remote test switch/LED indicator faceplate shall have an engraved plastic nameplate permanently attached indicating the HVAC unit number, type, and device identification number as programmed in panel. Labels shall be 1/16" thick two ply black/white acrylic sheet engraving stock with all sides beveled.

H. Duct mounted smoke detector housings and sample tubes shall be furnished by the Fire Alarm Contractor and mounted by the Mechanical Contractor. Coordinate with the mechanical contractor.

I. Fire·Lite model DHX-502 housing with ST-x series sampling tube, SD-300 photoelectric detector head, and RTS451 remote test switch/LED indicator, Fire Control Instruments ADS series, or equivalent.

2.23 HVAC UNIT BLOWER SHUT-DOWN AND SMOKE FIRE DAMPER OPERATION

A. Provide a power relay for each fire safety control circuit as required to operate smoke fire dampers, control relays for shut-down of each air handler, etc. as indicated on plans.

2.24 AUTOMATIC FIRE SUPPRESSION SYSTEMS

A. All automatic fire suppression systems shall be monitored by the fire alarm system. The activation of any automatic fire suppression system shall produce an alarm condition. The kitchen ventilation hood suppression system shall provide contacts to monitor activation of system. Provide monitor modules as required for alarm functions.

2.25 ELECTROMAGNETIC DOOR HOLD BACK AND RELEASE

A. Provide electromagnetic door hold back and release devices as shown on the drawings or as required.

B. Provide required devices and connections for holdbacks integrated into door systems when supplied. The fire alarm contractor shall verify voltages, exact style, and quantity required with architectural plans. Operating power to be provided by the Electrical Contractor.

C. Provide Control Module and Power Relay for 120 VAC holdbacks.

D. Provide Control Module and a UL listed Class 2 transformer, 120 VAC primary/24 VAC secondary, 20 VA output, for 24 VAC holders. Shall be Edwards model number 592 transformer with number 593 mounting plate or equivalent.

E. Unless otherwise provided supply Fire·Lite DH-150xA series, Fire Control Instruments FM series, or equivalent, 24 VAC, mounting style as required.

2.26 SPRINKLER RISER WATERFLOW AND TAMPER SWITCHES

A. Waterflow switches shall be provided and installed by the sprinkler system contractor and should meet the following requirements:

1. Integral, mechanical, non-coded, non-accumulative retard type device with a normally open dry contact for supervision by the fire alarm system.

2. Flow switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30 - 45 seconds.

3. Flow switches shall be located a minimum of one (1) foot from a fitting that changes the direction of the flow and a minimum of three (3) feet from a valve.

B. Sprinkler and standpipe valve supervisory switches shall be provided and installed by the sprinkler system contractor and should meet the following requirements:

1. Each sprinkler system water supply control valve riser or zone control valve, and each standpipe system riser control valve shall be equipped with a supervisory switch device with a normally open dry contact for supervision by the fire alarm system. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.

2. Each Post Indicator Valve (PIV) or main gate valve shall be equipped with a supervisory switch.

3. Mount switch so as not to interfere with the normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.

4. The mechanism shall be contained in a weatherproof aluminum housing that shall provide a 3/4-inch tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.

5. Switch housing to be finished in red baked enamel.

6. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.

7. When applicable — air or water pressure, tank level, temperature switches, or pump supervision devices shall each be provided with a normally open dry contact for supervision by the fire alarm system.

C. All wiring, monitor modules, end of line devices, and connection to the fire alarm system shall be by the fire alarm contractor.

D. Each waterflow switch shall actuate an individually annunciated, by sprinkler riser zone, alarm condition at the fire alarm control panel. Waterflow alarm shall be transmitted to the designated channel on the digital communicator.

E. Valve tamper switches and other supervisory devices as required shall initiate a supervisory alarm condition and may be grouped up to twenty devices per IDC when acceptable to the AHJ. Grouping shall be limited to risers within the same room by this specification.

2.27 AUXILIARY CONTROL AND MONITORING FUNCTIONS

A. Where noted, shown on plans or required provide monitor and control modules as required for fire alarm, supervisory alarm, trouble, and control functions. When present the following systems shall be controlled and/or monitored by the fire alarm system:
- Fire pump systems.
- Emergency power and generator systems.
- Smoke vents.
- Smoke control related fan systems.
- Remote manual and automatic control of elevators.
- Building security controlled access system override.

2.28 Voice Evacuation System shall be as follows:

A. Voice Evacuation System - The system shall contain a U.L. Listed stand-alone single channel voice evacuation system U.L. Listed for fire alarm use to be installed per the plans. The system shall contain a power supply, amplifier and all voice control assemblies housed in a single lockable enclosure. The system will use pre-recorded voice commands locally for the purpose of evacuation notification. The system must support a minimum of two pre-recorded messages and have the capability of adding application specific messages through the use of a PC. The system shall contain a supervised hand-held coiled cord microphone to provide manual audible instructions. The system shall include an amplifier capable of producing a minimum of 50 watts of power. An optional 4-speaker circuit splitter shall be available for the system. Speaker outputs shall be either 25 or 70.7v RMS and shall terminals for Class A style connections. All speaker circuits shall be supervised for opens, shorts and grounds. The built-in power supply shall be capable of operating the system and charging the system's backup batteries. The panel shall have individual visual indicators for the following: speaker trouble, alarm, mic trouble, earth fault, low battery and power. The system shall be triggered and fully supervised from the main FACP. Manufacturer shall be Gamewell-FCI FireVac IV Series or Silent Knight SKE450.

B. Audio Visual Speaker Strobes - Where shown on the plans, provide an audiovisual speaker/strobe combination unit. The speaker shall be capable of operating at 25.0 or 70.7 nominal Vrms. Speakers shall be have selectable output taps of .25, .50, 1 and 2 watts. The strobe unit shall be ADA approved and have multi-select settings of 15, 30, 75 and 110 candela. The assembly finish shall be available in red or white. Manufacturer shall be System Sensor Spectralert Series or approved equal. The assembly shall be installed on standard electrical back boxes.

PART 3.00 EXECUTION

3.01 OPERATION

A. When a fire alarm condition is indicated by any manual pull station, heat detector, area smoke detector, sprinkler system waterflow indicating device, any automatic fire suppression system monitor, or by any duct-mounted smoke detector (when applicable) shall cause the following actions or effects to take place:

1. At the panel and any remote annunciators a system alarm LED shall flash and a local sounding device shall activate.

2. The 40-character LCD display shall indicate all pertinent information associated with the alarm condition and its location.

3. The digital communicator shall actuate and transmit an alarm signal.

4. All audible and visual signal devices shall operate until silenced manually, or until automatically silenced, by the control panel. A subsequent alarm from another device shall automatically reactivate all audible and visual signal devices. Once a waterflow alarm, when applicable, has been activated in shall not be possible to manually silence the audible and visual signal devices until the flow indication from the waterflow switch has ceased.

5. All automatic programs assigned to the alarm point shall be executed and associated indicating devices and relays shall be activated. Instantaneous activation on general alarm of all fire safety control functions including; air handler shut down relays, smoke fire damper motors, fire door release devices, etc.

6. The FACP event history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.

B. The detection of any system internal or external trouble condition or the actuation of any supervisory alarm condition; sprinkler system valve tamper switch, sprinkler system low pressure switch, etc., or a duct mounted smoke detector (when applicable) will automatically cause the following actions to take place:

1. At the panel and any remote annunciators a system supervisory alarm LED or trouble LED shall flash as appropriate and a local sounding device shall activate. Audible supervisory or trouble alerts that have been silenced shall automatically re-sound every twenty-four hours or less until repairs is made.

2. The 40-character LCD display shall indicate all pertinent information associated with the trouble or supervisory condition and its location; however, unacknowledged alarm messages shall have priority over trouble messages.

3. The digital communicator shall actuate and transmit the supervisory or trouble signal.

4. Any automatic programs assigned to the supervisory alarm point shall be executed and associated indicating devices and relays shall be activated. When duct mounted smoke detectors indicate a supervisory alarm provide instantaneous activation of all related fire safety control functions including; air handler shut down relays, smoke fire damper motors, fire door release devices, etc.

3.02 TESTING, WARRANTY, SERVICE

A. A factory-trained representative of the manufacturer shall supervise the final connections and testing of the system and it shall be subject to the final acceptance of the Architect, Engineer, and local authorities. Testing shall include, but not be limited to, the following:

1. Before energizing the system check all cables for correct connections and test for short circuits, ground faults, continuity, and insulation.

2. Close each sprinkler system valve with a tamper switch, when applicable, and verify proper supervisory alarm at the FACP.

3. Verify alarm activation of waterflow switches by operation of the test port valve on each riser (when applicable). Open each initiating device circuit and verify that the trouble signal actuates.

4. Open and short each signaling line circuit and verify that the trouble signal actuates.

5. Open and short each notification appliance circuit and verify that trouble signal actuates.

6. Individually ground each circuit and verify response of trouble signals.

7. Check for presence of strobe signal and audibility of tone at all alarm notification devices.

8. Check installation, supervision, and operation of all area detectors using the walk test.

9. Check installation, configuration, and operation of all duct mounted smoke detectors. Verify that there is adequate airflow through the sample tubes and housing to activate the detector when smoke is present in the duct.

10. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

11. Verify proper operation of all auxiliary control functions including door release, shut down of controlled air handlers, and smoke fire damper closing. Check operation of elevator recall and shutdown when applicable.

B. The Fire Alarm Contractor shall be ultimately responsible for safe and complete operation of the system. Any issues affecting proper operation of the system relating to the Electrical, Mechanical, Fire Protection, Fire Suppression or other contractors shall be resolved by the Fire Alarm Contractor, at no additional cost to, and without requesting intervention by the Owner.

C. The Fire Alarm Contractor shall provide a complete, dated, installation certificate meeting state requirements for each installation. A Fire Alarm Installation Record sticker listing the; installation firm's name, address, and telephone number; signature of Licensee and license number; Fire Alarm Planning Superintendents name and license number; and the installation date, meeting state requirements shall be attached to the main fire alarm control panel. The Fire Alarm Contractor shall submit a copy of the installation certificate to the Architect/Engineer at the time of substantial completion.

D. The contractor shall provide a warranty of the installed system against defects in material or workmanship for a period of one (1) year from the date of substantial completion. Any equipment or cabling shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner. All equipment will carry a one-year warranty or manufacturer's warranty whichever is greater.

E. Immediately prior to the end of the warranty period the system shall be inspected and certified for the following year at no additional cost to the Owner.

3.03 DRAWINGS, MANUALS, AND TRAINING

A. Upon completion of the installation, and prior to final inspection, the fire alarm Contractor shall furnish as-built drawings. Drawings shall be prepare in Auto Cadd format and the Cadd file delivered to the Architect with as-built documents. Provide one reproducible vellum and four prints. In addition, this the fire alarm contractor shall furnish four (4) copies of a complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide the Owner a copy of the panel control software including the program, site specific data file, and passwords that the Owner may require to maintain the system. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for

commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system.

B. The fire alarm contractor shall conduct formal on-site training sessions. It shall be the responsibility of the Contractor to coordinate time and location of training sessions with the Owner. Provide documented general instruction as follows:

1. Provide instruction to the maintenance personnel to include the location, inspection, maintenance, testing, and operation of all system components. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.

2. Provide instruction to designated personnel on the functions and operation of the fire alarm and detection system including capabilities, limitations, monitoring, and the meaning of status messages. State the proper procedure for fire drills, routine maintenance, and request for service. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.

3.04 MONITORING SERVICE

A. Fire alarm system shall be monitored by an off site monitoring service during the one year warranty period. Monitoring service shall be included in bid price.

END OF SECTION

SECTION 16740 - DATA SYSTEMS

PART 1.00 GENERAL

1.01 SCOPE OF WORK FOR COMMUNICATIONS SYSTEM

A. The Contractor shall furnish labor, materials, and equipment required for the installation of a communication system infrastructure to provide the maximum performance for the system components and subsystems as shown on the Drawings.

1.02 STRUCTURED SYSTEM

A. The infrastructure requires a structured cabling system from ADC, Belden CDT, Commscope/Uniprise, or Systimax forming a channel solution. A channel solution is defined as: The end-to-end transmission path, using a single vendor solution, connecting any two pieces of application-specific equipment. Equipment cables and work area cables are included in the channel. Fiber jumpers and/or data patch cords of appropriate length will be provided for all data drops, switches, and patch panels.

B. The Certified Structured Connectivity Solutions should have as a minimum:
   a. Category 6E for Data and 5E for voice wire shall be one of the following - as it applies to the environment and the Certified Structured Solution selected:
      1. ADC TrueNet
      2. Belden/CDT
      3. Commscope/Uniprise
      4. Systimax Solutions
   b. A twenty-year written warranty on material and workmanship.
   c. Work shall be inspected and approved at least two times by the wiring manufacturer' representative - (at rough-in and at final inspection).
   d. All telephone and data wiring work is to be performed by a qualified telecommunications contractor regularly employed in this field. The contracting company performing the telecommunications and data work must have been continuously in the telecommunications business for at least the past five consecutive years.

1.03 QUALITY ASSURANCE

A. All work and equipment shall conform to the appropriate portions of the following specifications, codes and regulations:
   a. Building Industry Consulting Services International (BICSI)
   b. Telecommunications Distribution Methods Manual
   c. ANSI/TIA/EIA Standards:
      1. ANSI/TIA/EIA- 568-B.1- Commercial Building Telecommunications Cabling Standard, Part 1: General

Requirements.

2. ANSI/TIA/EIA -568-B.2 - Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components.
3. ANSI/TIA/EIA - 568-B.3 - Optical Fiber Cabling Components Standards
4. ANSI/TIA/EIA - 569A- Commercial Building Standard for Telecommunications Pathways and Spaces
5. ANSI/TIA/EIA - 606 (A) - The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
6. ANSI/TIA/EIA - 607 (A) - Commercial Building Grounding and Bonding Requirements for Telecommunications
7. ANSI/TIA/EIA - 526-7 -- Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.
8. ANSI/TIA/EIA-526-14A -- Measurement of Optical Power Loss of Installed Multimode Fiber Cable Plant.
9. ANSI/TIA/EIA-758(A) -- Customer-Owned Outside Plant Telecommunications Cabling Standard.

e. National Electric Safety Code (NESC)
f. National Fire Protection Agency (NFPA)
g. National Electrical Code (NEC)
h. Any Applicable State and Local Codes.

B. If conflict exists between applicable documents, then the more stringent requirement shall apply.

C. Maintenance Considerations - The cable and wire system shall be installed to maximize the safety, maintainability, and performance effectiveness of maintenance personnel and minimize the demands upon skills, training, and manpower. Splices/terminations shall be placed and supported with convenient accessibility so as to maximize the efficiency and ease with which it can be maintained. No cables shall be spliced unless as shown on plans or approved by Engineer.

1.04 SHOP DRAWINGS

A. Shop drawings shall be submitted for approval and shall include complete catalog and other information shown to describe the cables, wire, and equipment proposed.

PART 2.00 PRODUCTS

2.01 OUTSIDE PLANT TELEPHONE CABLE

A. Outside telephone feeder cable shall be a multi twisted pair cable, gel filled, with coated aluminum shield and outer plastic jacket suitable for underground service. The cable shall have the following characteristics:
1. Cable shall meet Rural Utilities Services (RUS) Specification PE-

89.

2. Conductors shall be solid, 24 gauge, annealed copper. Strands shall be individually insulated, polyethylene insulated cable (PIC), and twisted into pairs.
3. Number of pairs in cable shall be as noted on the drawings.
4. Individual conductors shall be color coded per telephone industry practice.
5. A petroleum gel shall be used to fill all voids and indices to prevent the intrusion of moisture.
6. A coated aluminum shield shall encase the cable and be flooded with the petroleum gel. The shield shall be continuous throughout the length of the cable.
7. The cable shall have an overall PVC jacket/sheath. The jacket/sheath shall be abrasion resistant, impervious to light or water.

B. Cable shall be Lucent product designation ANMW (Available in a 25pair cable to a 1800pair cable), Superior Essex part number 09-xxx-04 (where xxx = the pair code), or approved equal.

2.02 INSIDE PLANT CABLE

A. Inside telephone feeder cable shall be multi-pair telephone cable designed for inside wiring. The cable shall have the following characteristics:
1. Conductors shall be solid, 24 gauge, annealed copper. Strands shall be individually insulated, polyethylene insulated cable (PIC), and twisted into pairs.
2. Number of pairs in cable shall be as noted on the drawings.
3. Individual conductors shall be color coded per telephone industry practice.
4. The cable shall have an overall jacket/sheath rated, per NEC code, for the environment in which it will pass through, i.e. "CMP" if the cable passes through any plenum space.
5. Cable shall be Lucent part designation 2010 (25 pair to 100 pair), Superior Essex part number 18-xxx-36 (where xxx is the pair code) or approved equal.

2.03 DATA STATION CABLES

A. Data station wiring shall be Category 6 enhanced (Cat 6e) communications wire and cable. Station Cable shall be four-pair, unshielded, twisted pair, inside-station cable, and shall be constructed of solid 24 gauge annealed copper. Each conductor shall be insulated with a continuous layer of fluorinated ethylene propylene (FEP). The sheath shall be all weather, flame resistant, polyvinyl chloride. Station wire shall be constructed of 4 twisted pair sharing one sheath. Cable shall have Category 6e transmission characteristics as specified by ANSI/EIA/TIA-568-B2.1.

B. Cables routed in air plenum shall have a sheath and conductor insulation

constructed of material so as to be classified as type CMP as defined by the NEC 800-3(b)(3).

C. Data cable shall be BLUE.

D. Data cabling shall be:

1. ADC – TrueNet AirES C6T Cables, Plenum TN 6SP / Non-Plenum TN 6SR

2. Belden/CDT - DataTwist 600e UTP cables, Plenum 7852A / Non-Plenum 7851A

3. Commscope/Uniprise UltraPipe cables, Plenum 6ECMP / Non-Plenum 6ECMR

4. Systimax - GigaSPEED XL7 Solution, Plenum 2071 E / Non Plenum 1071 E

E. Data cables installed in floor and routed in conduit underground or under slab shall be Outside Plant rated. Cable shall be minimum Cat. 6 rated, and include PE insulation, black PE jacket with floodant.

2.04 VOICE STATION CABLES

A. Voice and Data station wiring shall be Category 5e (Cat 5e) communications wire and cable. Station Cable shall be four-pair, unshielded, twisted pair, inside-station cable, and shall be constructed of solid 24 gauge annealed copper. Each conductor shall be insulated with a continuous layer of fluorinated ethylene propylene (FEP). The sheath shall be all weather, flame resistant, polyvinyl chloride. Station wire shall be constructed of 4 twisted pair sharing one sheath. Cable shall have Category 5e transmission characteristics as specified by ANSI/EIA/TIA-568-B2.1. Cable shall support network transmission applications such as Fast Ethernet, TP-PMD (100 Mbps), high speed Token Ring and ATM (155 Mbps).

B. Cables routed in air plenum shall have a sheath and conductor insulation constructed of material so as to be classified as type CMP as defined by the NEC 800-3(b)(3).

C. Voice station cables shall be white.

D. Voice cabling shall be:
1. ADC – TrueNet AirES C5eT Cables, Plenum TN5ESP / Non-Plenum TN5ESR
2. Belden/CDT - DataTwist 350 cables, Plenum 1701A / Non-Plenum 1700A
3. Commscope/Uniprise Ultra II cables, Plenum 5504M / Non-Plenum 55N4R

4. Systimax - PowerSUM Solution Plenum 2061 / Non Plenum 1061

2.05 COMMUNICATIONS OUTLETS

A. Voice and data outlets shall be a modular data communication unit. Wall mounted outlets shall be flush mounted in a double gang utility box and covered with a single gang data device plates. Complete outlet shall consist of utility box, communication assembly devices, cover plate, and jack inserts. All data outlet inserts shall be eight (8) position/eight (8) conductor, insulation displacement, open system to multi-vendor, EIA/TIA 568-B2.1, Category 6E.

B. Outlet shall be furnished with 8-position, Category 6E compliant, RJ-45 modular, gig jacks. Each outlet shall consist of voice or data jack as shown on the Drawings. Voice outlet jack shall be white. Data outlet jack shall be BLUE.

C. Cover plates shall be brushed stainless steel, and shall be jumbo size.

D. Outlets shall consist of the following items:
1. Double gang outlet box.
2. High-impact, flame retardant. thermoplastic cover plate.
3. Voice and data jack inserts, category 6e compliant: ADC KM8 Information outlets; Belden/CDT GigaFlex PS+ UTP Modules; Commscope/Uniprise Uniprise 600 series; or Systimax GigaSPEED XL MGS400 jacks.

2.06 PATCH PANELS

A. The patch panels shall support giga-speed transmission for UTP cabling systems utilizing Category 6e performance rated cable. Terminations shall use 110-IDC (Insulating Displacement Connector) field made continuous to the 8-pin modular jack on front of panel via Printed Circuit interconnections. The panel shall mount on nineteen (19") inch rack and be fully EIA/TIA 568-B2.1 compliant. Panels will be T568B wiring. Panels shall be Systimax GigaSPEED XL PATCHMAX GS series, ADC C6T Patch Panel series, Belden/CDT Giga Flex PS6+ Patch Panel series, or Commscope Uniprise 600 series.

2.07 WIRING BLOCKS

A. Voice feeder cables shall be terminated on Category 5e compliant, type 110 blocks. The 110 block shall be fire-retardant, molded plastic base. Block will be equipped with legs that create space behind the block for routing cables terminated on the block, and space at the sides that may be used as a vertical jumper trough.

B. The blocks shall have circuit identification holders and labels. The labels shall be used to identify lines, circuits, and cable pairs, and identify building locations defined by room numbers, columns, or other building

coordinates.

C. Type 110 wiring blocks shall be Ortronics #110ABC5E300, Siemon #S110AW2-300, Panduit #P110B300, or approved equal

2.08 RELAY RACK CABINET

A. Relay rack shall be closed cabinet design enclosure, and 29" wide x 84" high x 42" deep for 19" rack mounting equipment. Panel mounting holes are to be #12-24 tapped on EIA universal spacing on both front and rear of rack, and shall include 44U rack space. Rack shall be self-supporting with base suitable to floor mount. Rack shall be suitable for front and rear mounting of patch panels and/or Owner furnished active electronics. Rack shall be furnished with 3.5" high wire management frames and supports as shown on the Drawings, or as required for installation.

B. Relay rack cabinet shall be furnished with adjustable levelers, mesh steel doors, lift-off side panels, and removable, perforated top panel. Side panels shall include lock and finger release latches. Cabinet shall include vertical cable management, and horizontal cable management front and rear. Include two (2) horizontal mount 10 position power strips, APC model AP9563, or equal.

C. Relay rack cabinet shall be Great Lakes GL840ES-2942 series.

2.09 UPS SYSTEM

A. Rack mounted UPS shall require in the main wiring closet and each secondary closet. UPS shall be two (2) rack unit or three (3) rack unit mounting spaces in a 19" wide rack. UPS for secondary closets shall have 2000VA/1400 watt maximum rating with 5-minute runtime at full load during power outages. UPS for main closet shall have 3000VA/2100 watt maximum rating with 14-minute runtime at full load during power outage. Runtime can be expandable with the addition of external battery packs.

B. UPS shall provide regulated 120 volt output power with 120 volt line voltage, 30 amp for 3000VA unit and 20 amp for 2000VA unit. UPS shall include interface DB-9 RS232 ports.

C. UPS shall be APC #SURTA2000RMXL (2000VA rated) or #SURTA3000MXL (3000VA rated), or approved equal.

2.10 CROSS-CONNECT WIRE

A. Cross-connect wire, patch cables, and fiber jumpers shall be furnished and installed by Contractor. Cross-connect and patch cables must be factory certified Category 6e for voice and data wiring. The fiber jumper shall be a duplex, buffered, graded-index fiber, 62.5/125/900 micron, kevlar yarn over each fiber cladding, and a flame-retardant PVC jacket.

2.11 PATCH CORDS

A. Patch cords shall be provided for each data run indicated on plans. Furnish additional patch cords equal to five percent of the quantity shown. Provide cords of appropriate lengths. For wiring closets provide one (1) one-meter patch cords for each wired patch panel port. For work station locations patch cords shall be half 10 foot and half 15 foot, appropriate for the wiring solution provided. Patch cords to be installed and dressed from wiring closet to switch. Patch cord color Blue.

B. Contractor shall verify lengths of patch cords required prior to purchase.

2.12 INSIDE PLANT FIBER CABLES

A. Fiber optic cable installed inside the building shall be a multi-mode, six (6) fiber as shown on the Drawings, 62.5/125/900 micron, breakout style, riser rated for indoor applications (CMR). Each individually jacketed fiber shall contain kevlar strength member to allow direct termination of cable. Cable shall be UL listed and constructed in accordance with EIA/TIA 568 requirements.

B. Fiber optic cables shall meet the following requirements:
   a. Max. attenuation dB/Km @ 850/1300nm: 3.5/1.5
   b. Bandwidth MHz-Km @ 850/1300: 160/500

C. Fiber cables shall be furnished with ST connectors.

2.13 FIBER CONNECTORS

A. Fiber cable connectors shall be 62.5/125/900 micron, multi-mode, ST style connectors, or as selected by Owner.

2.14 FIBER BREAK-OUT KIT

A. Fiber break-out kits shall be used to terminate fiber into protective buffer tubes. Kit permits separation and protection of individual fiber elements. Kits shall be Corning #FAN-BT47-06, Systimax D181755 series, or approved equal.

2.15 FIBER SHELF

A. Fiber cables shall be routed to the fiber shelf located in each communications closet rack. Shelf shall be rack mounted with total capacity of twelve (12) or twenty-four (24) bulkheads and/or splices. Twenty-four fiber capacity unit shall be a Corning #CCH-02U series, or approved equal. Twelve fiber capacity shall be Corning #CCH-01U series, or approved equal.

B. The MAIN FIBER SHELF shall allow termination of buffered cables or direct termination of outside plant cables. The shelf is to be used as a

termination shelf only (direct connector termination). The shelf will be equipped with seventy-two (72) fiber capacity (72 ST connectors or 144 SC connectors), hinged front and rear doors, knockout for optional lock mechanism, universal shelf mounting brackets, cable clamp brackets for termination for cables, blank labels for identifying fiber splices and terminations, splice tray housing, splice tray housing that slides out for easy access, and other associated hardware. These shelves will be rack mounted. The shelf shall be Corning CCH-04U (72 fiber combination), or approved equal.

2.16 FIBER JUMPERS

A. Fiber optic jumper cable shall be a multi-mode, 62.5/125/900 micron. Fiber connection end will be decided prior to ordering jumpers. One (1), three-meter fiber jumper shall be provided for each cable fiber, using ST to MTRJ connector configuration. Fiber jumpers at main data distribution frame shall require ST to ST connector configurations. All other fiber patch cables shall be ST to FC connector configurations.

B. Contractor shall review fiber connector configurations with St. Tammany Parish School Board Information Technology Department prior to ordering fiber jumpers.

C. Contractor shall verify lengths of fiber jumpers required prior to purchase.

2.17 DATA ROOM CABLE TRAY

A. Cable tray used in data room shall be a tubular steel ladder with cross slats welded to top of stringers. Ladder shall be 12" wide, with 6" slat spacing, and 24" wide, with 9" slat spacing. Stringers shall be nominal 3/8" x 1-1/2" high tensile tubular steel. Cross slats shall be nominal 1" x 1/2" tubular steel. Tray shall be finished in black or gray enamel. Tray shall be furnished with appropriate runway clamp assemblies and support assemblies, and shall be UL 1863 listed for Communication Circuitry Accessory.

B. Tubular steel ladder shall be Homaco, Inc. TR6-12 series, CPI 10250-712 series, or approved equal.

2.18 INNERDUCT

A. Innerduct shall be a nonmetallic pliable raceway for use in riser and general purpose applications per NEC Articles 725, 770, 800 and 802. Innerduct shall be suitable for use in vertical runs in a shaft or between floors, as well as areas other than the plenum. Innerduct shall comply with UL 2024 Standard. Innerduct shall be orange, and shall include sequentially marked footage. Duct outside diameter shall meet IPS dimensions. Innerduct shall be Carlon Riser-Gard series or Plenum-Gard series.

PART 3.00 EXECUTION

3.01 INSTALLATION

A. Unless otherwise specified, all communications systems shall be permanently installed and connected to the wiring system. The systems must be installed according to manufacturer standards and recommendations.

B. The Contractor shall meet with the Engineer, wiring system subcontractor, wiring solution representative and the School Board Technology Services representative to review wiring paths. This meeting shall also be used to coordinate the voice/data system installation with the Owner's ordering of electronic equipment required for the facility. This meeting shall also be used to prevent problems with the data wiring during installation.

C. Test results and as-built documents will be provided to the School Board Department of Technical Services in both hard copy and electronic copy, furnished on a CD.

D. Wiring map/as built documents showing voice and data outlets, device numbers, room locations, and termination locations will be displayed in each wiring closet.

E. Wireless drop wiring shall be punched down on a separate punch down block at the end of the data punch down blocks. The wireless punch down block shall be a different color.

F. All fiber runs must be home run with no splices. Fiber cables must be installed in conduit or innerduct when routed above ceilings, or in conduits when installed outside or under walkways. Fiber cable must include pull cord with each fiber installation.

G. Voice and data wiring routed above accessible ceilings shall be supported on J-hooks, and shall be loose bundled using Velcro wraps.

H. Voice and data wire bundles shall not include power wiring or wiring for other low voltage systems (fire alarm, intercom, security, CCTV, etc.).

I. Cabling installed in underground or under slab conduits shall be suitable for the environment installed and shall be compliant with the structured connectivity solution.

3.02 DATA SYSTEM GENERAL REQUIREMENTS

A. All cables, wires, and equipment shall be securely and neatly installed. Inside routing shall be installed parallel and perpendicular to existing structural lines and members.

B. Each station wire shall be plainly marked at its backboard end with the room number to which it is connected, and terminated on the termination blocks or patch panel.

C. Data cables shall be routed above ceilings, with cables neatly bundled. Cables must not be tie-wrapped. No more than 30 cables shall be bundled.

D. Contractor shall maintain recommended Category 5e bending radius, pulling tension, and cable support requirements. Cables ties may be finger tight, however, not so tight so they distort the outer jacket of the cable.

E. Cable suspended above an open ceiling shall not rest on ceiling tiles or lighting fixtures, and shall be supported from roof structure at 4' to 6' intervals.

F. Data system wiring shall be installed in accordance with NEC Article 800-5 and 6 requirements, and wiring solution requirements.

3.03 FIBER CABLE INSTALLATION

A. Fiber cables shall be terminated using ST type connectors. Connectors shall be attached using hot melt, ultraviolet, epoxy, heat curable, or crimp methods.

B. All multi-mode fiber cables shall be terminated at both ends and Contractor shall coordinate termination of fibers at source end.

C. All fiber runs must be home run with no splices. Fiber cables must be installed in conduit or innerduct when routed above ceilings, or in conduits when installed outside or under walkways. Fiber cable must include pull cord with each fire installation.

D. Fiber cable shall be tested in one direction at 850nm or 1300nm.

3.04 COMMUNICATIONS SYSTEM QUALIFICATIONS

A. The communications system installer shall be experienced in the design, fabrication and installation of communications premise distribution systems of similar size and scope to this project. Installation technicians shall be a structured cabling system certified installed by the structured cabling system manufacturer.

3.05 CABLE/WIRE IDENTIFICATION

A. Each cable shall be clearly labeled and identified in accordance with the following:

1. Each cable pair shall be plainly marked at the backboard end on terminal blocks with printed labels. Handwrite labels shall not be

permitted.

2. All outlets shall be permanently marked or labeled with printed type labels on the jack faceplate -- ID number, voice, data.
3. All cables shall be legibly and permanently numbered at each end using wrap-around/stick-on label systems or approved equal.
4. In rooms where more than one jack exists, the jacks shall be numbered sequentially using alpha-numeric numbers.
   Labeling in Room/Classroom shall contain:
   a. The room number of wiring closet that drop is terminated.
   b. The drop number. This number should be consecutive numbers by room, by wiring closet. Example: Room 203 with data drops 73 through 75, and voice 2 and 3 all terminated in wiring closet 117. The label in Room 203 would look like:
      R17 – D73-75 (data)
      R17 – V2 & 3 (voice)
      Labeling in wiring closet shall contain:
      i. The room number of the room the drop is in.
      ii. The drop number. This number should be the numbers by room and by wiring closet. Example: Room 203 would have data drops 73 through 75 and voice 2 and 3 all terminated in wiring closet 17. The label in wiring closet 17 would look like:
      R203 – D73-75 (data)
      R203 – V2 & 3 (voice)
      iii. Drop numbering shall start with 1 and continue through 999 by wiring closet.
      iv. Layout or wire on punch down block shall be by room number. Drop numbering shall start with 1 and continue through 999 by wiring closet.

5. All conduits, except those used for individual station jacks, shall be clearly and permanently marked or labeled at both ends, indicating the location of the other end of the conduit.

B. All cable and wiring identification shall be in compliance with ANSI/TIA/EIA 606 Structured Cabling Systems standards.

3.06 DOCUMENTATION AND TESTING

A. Upon completion of construction, the Contractor shall provide "as installed" drawings showing the exact placement of all outlets, cables, conduits and connecting hardware called for in this section. This shall be given in CD form and hard copy form to the owner.

B. Data wiring shall be tested upon completion of installation. Data cables shall contain no defective pairs nor near fails and shall be tested in accordance with Channel Solution standard per TIA/EIA 568-B.

C. The test procedures shall demonstrate, at a minimum:

1. Continuity of each conductor from end-to-end -- open test.
2. Shorted conductors with other conductors -- short test.
3. Proper polarity of paired conductors from end-to-end -- reverse test (for correct tip & ring and data terminations).
4. Proper termination of wire pairs from end-to-end -- cross test (for splits and other wrong terminations).
5. Proper ground and shield bonding (for shielded cables only) -- effective ground test (for zero potential difference bonding).
6. Grounded conductors (for all cables) -- ground fault test.
7. Detection of AC or DC power on any conductor -- power fault test.
8. All data cables shall be tested per EIA/TIA 568-B2.1 Level III requirements.

D. Prior to testing of any communications cable/wire and hardware, the Contractor shall notify the Architect and Engineer, in writing, at least two (2) weeks in advance of testing. Contractor shall furnish hard copy of all test reports to the Architect for approval prior to completion and final acceptance of project.

E. The data system shall be warranted and category 6e compliance certified from the data outlet to the patch panel, and shall be channel certified.

3.07 BONDING AND GROUNDING

A. Grounding and bonding of the communications system shall be in strict accordance with TIA 607, National Electrical Code, and NFPA requirements. Grounding and bonding shown on the drawings represent a minimum requirement.

END OF SECTION

SECTION 16745 - CABLE TV SYSTEM

PART 1.00 GENERAL

1.01 SCOPE OF WORK FOR CABLE TV SYSTEM

A. This section specifies extending the Owner furnished and installed Master Antenna TV (MATV) system, and includes the furnishing, installing and testing of the MATV infrastructure. The infrastructure system shall include but not be limited to: interface cabinet; necessary combiners and filters; distribution amplifiers; cable and connectors; and necessary passive devices such as splitters, directional couplers, TV outlets and taps.

B. The Cable TV system shall distribute a uniform signal throughout the school. EBRP School Board Technology Services office shall install head-end signal equipment and shall contract with the local cable company for cable services into the facility.

C. The MATV Extension system shall receive the VHF and UHF TV channel signals from the CATV System and shall process and distribute them to the designated TV outlets indicated on the drawings. The MATV Extension system shall provide adjacent channel operation of the 125 television channels.

D. The MAN Extension system shall provide for connection of standard CATV capable TV receivers to the designated TV outlets in all day rooms, class rooms, recreation rooms, and other areas as shown on the drawings.

1.02 SYSTEM PERFORMANCE

A. The signal level of each channel at each TV outlet shall be ± 10 dBmV, plus or minus 5 dB across 75 Ohms.

B. The MATV system shall meet the following minimum parameters at each TV outlet. The signal quality at the interface point shall not be less than the stated minimum parameters:

Signal-To-Noise Ratio:	44 dB
Cross Modulation:	-46 dB
Hum Modulation:	-55 dB
Return Loss:	14 dB
Isolation (outlet-outlet):	24 dB
Visual to Aural Carrier Ratio:	13 dB to 17 dB below visual Impedance: 75 ohm

C. Test Equipment List: The Contractor is responsible for furnishing all test equipment required to test the system in accordance with the parameters specified. Unless otherwise stated, the test equipment shall not be considered part of the system. The Contractor shall furnish test equipment of any accuracy better than the parameters to be tested. The test

equipment furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. The test equipment list shall be furnished as a part of the proposal, to include the make, model number of the following type of equipment as a minimum:

a. Spectrum Analyzer
b. Signal Level Meter
c. Volt-ohm Meter
d. Color TV Receiver

1.03 ACCEPTABLE MANUFACTURES

A. All reference to manufacturers or suppliers model numbers and other pertinent information herein are supplied to establish minimum standards of performance, function, and quality. The model numbers used are those of Blonder-Tongue Laboratories, Inc., Old Bridge, New Jersey. The intent is to establish a standard of quality, function, and features. It is the responsibility of the bidder to insure that the proposed product meets or exceeds every standard of these products and requirements as set forth in these specifications.

B. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.

C. The following are acceptable manufactures any other proposed suppliers must be pre-approved:

Blonder-Tongue
General Instrument / Jerrold Electronics
Pico Macom / Tru◊Spec
Scientific Atlanta

1.04 SHOP DRAWINGS

A. Shop drawings shall be submitted for approval and shall include complete catalog and other information shown to describe the cables, outlets, and equipment proposed.

PART 2.00 PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. General: All equipment to be supplied under this specification shall be new and the current model of a standard product of a Manufacturer of record. A Manufacturer of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment, and which:

1. Maintains a factory production line for the item submitted.

2. Maintains a stock of replacement parts for the item submitted.
3. Maintains engineering drawings, specifications, operating manuals and for the items submitted.
4. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid (IFB).

B. Specifications of equipment as set forth in this specification are MINIMUM requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity or performance characteristics of items furnished in the MATV system. When the Contractor furnishes an item of equipment for which there is a specification contained herein, the item of equipment shall meet or exceed the specification for that item of equipment.

C. The total MATV Extension system shall be designed and installed so that the combination of equipment actually employed does not produce any undesirable visual or aural effects such as signal distortions, noise pulses, glitches, hum bars, transients, ghosting, etc.

D. Active component equipment shall consist of solid-state components, be rated for continuous duty service, comply with the requirements of FCC Docket No. 21006 and be provided with "F" connectors unless otherwise specified.

E. All passive distribution equipment shall meet or exceed 80 dB radiation shielding specifications and be provided with "F" connectors unless otherwise specified.

F. All trunk, branch and interconnecting coaxial cables and unused ports/taps shall be terminated with a 75 ohm terminating resistor designed for MATV cable systems without adapters.

G. Equipment Functional Characteristics:

Input Voltage:	105 to 130 Volts AC
Power Line Frequency:	60 Hz $\pm$ 2.0 Hz
Operating Temperature:	0 to 50 degrees C Humidity: 80% minimum rating

2.02 EQUIPMENT CABINET

A. The equipment cabinet shall be lockable, heavy gauge steel with baked on paint finish. It shall be floor or wall mounted with knock-out holes for cable entrance and provided with ventilation ports for equipment. Two (2) keys shall be provided for each lock to the Resident Engineer when the system is accepted. Refer to specification section 16740 for description of equipment cabinets.

2.03 DISTRIBUTION EQUIPMENT

A. Amplifier, Broadband: The broadband amplifier shall provide 35 adjacent

TV channel operation with separate adjustable gain and slope controls. It shall be UL approved with integral lightning/surge protection, and shall meet the following characteristics:

Frequency Response:	± 1.5 dB, 54-860 MHz
Noise Figure:	10 dB Max.
Output Capability:	42 dBmV Min., 125 channels
Cross Modulation:	-46 dB
Gain Control Range:	10 dB
Slope Control:	0-8 dB @ 860 MHz
Connectors: Impedance:	75 Ohm

B. Splitter/Mixer: The splitter/mixer shall be a rugged construction in a radiation proof metal housing. It shall provide multiple isolated outputs from a single input, or conversely, a single output from multiple isolated inputs. Splitter/mixer shall meet the following characteristics:

Bandpass:	5-1000 MHz	
Tap-Tap Isolation:	17 dB	
Splitting Loss:	2-Way	4 dB Max.
	4-Way	7.5 dB Max.
	8-Way	12 dB Max.
Connectors:	"F"	
Impedance:	75 Ohm	

C. Directional Coupler: The directional coupler shall be encased in a rugged radiation proof metal housing. Coupler shall meet the following characteristics:

Outputs	1 each
Insertion Loss:	1.3 dB Max.
Tap Loss:	8 dB Min.
Isolation Tap-Output:	25 dB Min.
Bandpass:	5-1000 MHz
Connectors:	"F"
Impedance:	75 Ohm

D. Directional Multi-Tap: The multi-tap shall be a directional coupler type and encased in a rugged radiation-proof metal housing. It shall come in multiple tap values. Directional multi-tap shall meet the following characteristics:

Tap Loss:	10 dB Min.
Bandpass:	5-1000 MHz
Insertion Loss:	3.7 dB Max.
Isolation:	
Tap-Output:	28 dB
Tap-Tap:	23 dB
Outputs:	Two, Four & Eight
Match:	14 dB
Connectors:	"F"
Impedance:	75 Ohm

E. TV Receiver Wall Outlet: The TV receiver wall outlet shall consist of an

RF jack. All RF cable connections to wall outlets shall be screw on "F" cable connectors. The wall outlet shall be fed from a directional coupler or be a directional coupler. The wall outlet shall be provided with stainless steel cover plate to fit the RF Jack.

F. TV Receiver Connection Cable: Coaxial Cable – The Contractor shall provide a connection cable for each TV outlet in the MATV system, plus an additional 10% as spares. The cable shall connect the TV receiver to the RF jack. Connection cable shall meet the following characteristics:
Length: 1800 mm (6 feet)
Cable Type: RG-6
Connector: CATV grade type F

G. Coaxial Cable: The coaxial cable shall be an RG-6 type with vinyl jacket, and certified 100% sweep tested by the Manufacturer by tags on each reel. The tags and a two foot sample shall be delivered to the Resident Engineer prior to installation. The cable shall be able to pass the frequency spectrum from 5 to 1000 MHz. Coaxial cable shall meet the following characteristics:

Center Conductor:	18 AWG
Dielectric:	Foam
Temperature Rating:	80 degrees C
Impedance:	75 Ohm
ATTENUATION:	
Frequency	
7 MHz	Max. dB/100'
54 MHz	0.6
216 MHz	1.8
470 MHz	3.5
890 MHz	7.0

H. RF Connectors:

1. "F" Type: The "F" connector shall have a screw type coupling for quick connect/disconnect of coaxial cable terminations. It shall be a crimp on integral ferrule connector designed to fit the coaxial cable furnished. The connector shall be installed using the connector manufacturer's approved crimping tool. "F" type connectors shall meet the following characteristics:
   Working Voltage: 500 V
   Frequency Range: 0 to 1000 MHz
   Impedance: 75 Ohms

2. "F" type connectors shall be tightened with the approved torque wrench recommended by the connector manufacture to that manufactures specifications.

I. Coaxial Cable Terminators: Coaxial cable terminator units shall be a metal housed precision types in the frequency ranges selected. Terminators shall meet the following characteristics:
Frequency: 5-890 MHz

	200-1,500 MHz
	3,000-5,000 MHz
Power Blocking:	As required, 1.5:1 Max
Return Loss:	25 dB
Connectors:	"F", "N", "UHF", "CATV", "BNC"
Impedance:	50 or 75 Ohms

PART 3.00 EXECUTION

3.01 INSTALLATION

A. System Installation:

1. After award of contract, and within the time period specified in the contract, the Contractor shall deliver the total system in a manner that fully complies with the requirements of this specification. The Contractor shall make no substitutions or changes in the system without written approval from the Resident Engineer.

2. The Contractor shall install all equipment and systems in a manner that complies with accepted industry standards of good practice, the requirements of this specification and in a manner that does not constitute a safety hazard. The Contractor shall insure that all installation personnel understand and comply with all the requirements of this specification.

3. The Contractor shall install suitable filters, traps and pads for minimizing interference and for balancing the amplifiers and distribution systems(s). All filters, splitters, couplers, tap-offs, matching transformers and TV wall outlets shall be able to pass color TV channels in the frequency bands selected, in the directions specified, with low loss, and high isolation and with minimum delay of the color sub carrier frequency. The Contractor shall install all equipment necessary to meet the requirements of paragraph 2.01.C and the system performance standards.

4. All passive equipment shall be connected according to the manufacturer's specifications to insure correct termination, isolation, impedance match and signal level balance at each TV outlet.

5. Where TV receivers are installed adjacent to each other in classrooms, install MATV outlets for each receiver.

6. All lines shall be terminated in a suitable manner to facilitate future expansion of the MATV system. There shall be a minimum of one (I) spare output at each distribution point at each distribution room.

7. All vertical and horizontal coaxial lines shall be terminated so that subsequent expansion for additional channels or conversion to CATV (cable) shall require modifications of the system head-end

equipment only.

8. Terminating resistors (75 Ohm) shall be used to terminate all unused branches, outlets and all unused equipment ports of the system and shall be devices designed for the purpose of terminating coaxial cable carrying TV signals in MATV systems.

9. Equipment installed outdoors shall be weatherproof or installed in weatherproof enclosures with hinged doors and locks with 2 keys.

10. Equipment installed indoors shall be installed in metal cabinets with hinged doors and locks with 2 keys.

B. Conduit, Cables and Wiring:
1. The Contractor shall employ the latest installation practices and materials.
2. All cables shall be installed in conduit unless otherwise specified.
3. Conduit fill shall not exceed 40 percent.
4. Cable runs shall be splice free.
5. All cable junctions and taps shall be accessible.
6. Cables shall be installed and fastened without causing sharp bends or rubbing of the cables against sharp edges. Cables shall be fastened with hardware that will not damage or distort them.
7. Cables shall be labeled with permanent markers at the terminals of the electronic and passive equipment. The lettering on the cables shall correspond with the lettering on the as-installed diagrams.
8. Cable shall be grouped and shall not change position throughout the cable run.
9. Completely test all of the cables after installation and replace any defective cables.

C. AC Power:
1. The Contractor shall connect all of the branch AC circuits thath supply power to the MATV system to a single panel board and shall clearly indicate on the directory in the panel board that the circuits supply power to the system.
2. The contractor shall furnish and install a 120 volt AC branch circuit, wired to a separate breaker, from the power panel to each equipment cabinet, in accordance with the National Electrical Code.
3. An AC power outlet shall be provided convenient to each item of equipment in the equipment cabinet and to each TV receiver wall outlet.
4. 4. AC power wiring shall be run separately from signal cable.

D. Grounding:
1. The Contractor shall ground all Contractor installed equipment to eliminate all shock hazard and to minimize, to the maximum extent possible, all ground loops, common mode returns, noise pickup, cross talk, etc.
2. The Contractor shall install lightning arrestors and grounding in

accordance with the National Electrical Code and Lighting Protection Code.

3. Ground wires for antenna masts shall be at least No. 6 AWG stranded copper wire.
4. Ground wires for equipment shall be at least No. 14 AWG stranded copper wire.
5. Ground wires for equipment cabinets or racks shall be at least No. 10 AWG stranded copper wire.

E. Equipment Assembly:

1. Equipment installed indoors shall be installed in metal cabinets with hinged doors and locks so as to be accessible for maintenance without interference to other nearby equipment. Two keys shall be furnished for each cabinet lock.
2. Equipment shall be installed with sufficient vertical separation to insure adequate air circulation. Any cabinet, in which the ambient temperature shall exceed 45 degrees C at the top, shall be equipped with a quiet thermostatically controlled fan. The cabinet shall be designed to provide airflow around equipment.
3. Cables shall enter the equipment cabinets in such a manner that all doors shall open and close without disturbing or damaging the cables.

3.02 TESTS

A. Pretesting:

1. Upon completing installation of the MATV system extension, the Contractor shall align, balance and completely pretest the entire MATV system.
2. During the system pretest, the Contractor shall verify (utilizing the approved spectrum analyzer and signal level meter) that the system is fully operational and meets all system performance requirements of this specification.
3. The Contractor shall measure and record the visual and aural carrier levels of each channel at each of the following points:
   a. Head-End signal level and signal-to-noise for each TV channel specified.
   b. Distribution Amp inputs and outputs.
   c. Last outlet of each leg.
   d. A random sampling of 25% of TV outlets.
4. After pretest measurements are made, the system shall be left to "cook in" until the final inspection is completed.
5. A copy of the recorded system pretest measurements and the written certification that the system is ready for the formal acceptance test shall be submitted to the Resident Engineer.

B. Acceptance Test:

1. After the system has been pre-tested and the Contractor has submitted the pre-test results and the certification to the Resident

Engineer, the Contractor shall schedule an acceptance test date and give the Resident Engineer written notice 30 days prior to the date the acceptance test is expected to begin. The MATV system shall be tested utilizing the approved test equipment to certify proof-of-performance. The system test shall verify that the total system meets all the requirements of this specification.

2. The notification of the acceptance test shall include the expected length of the test in days.

3. The acceptance test shall be performed on a "go/no-go" basis. Only those operator adjustments required to show proof-of-performance shall be allowed. The test shall demonstrate and verify that the installed MATV system does comply with the operational and technical requirements of this specification under operating conditions. The MATV system shall be rated as either acceptable or unacceptable at the conclusion of the rest. Failure of any part of the system that precludes completion of system testing, which cannot be repaired in four (4) hours, shall be cause for terminating the test of the MATV system. Repeated failures that result in a cumulative time of eight (8) hours to effect repairs shall cause the entire MATV system to be declared unacceptable. Retesting of the entire MATV system shall be rescheduled at the convenience of the Owner.

C. Acceptance Test Procedure:

1. Inspection: The Owner representative will tour all major areas to insure that all MATV systems are completely and properly installed in place, and are operationally ready for proof-of-performance testing. Failure of the MATV system to meet the installation requirements of this specification shall be grounds for terminating all testing. The MATV system diagrams and pretest measurements shall be reviewed.
2. Interface Point Test:
   a. After the inspection, the MATV signals at the interface point shall be tested to verify that it meets all performance requirements utilizing the spectrum analyzer or signal level meter.
   b. Following the Signal Level Test, a standard television color receiver shall be connected to the interface point test tap output with suitable pad(s). All TV channels shall be viewed to verify that there are not visible signal distortions such as intermodulation (windshield wiper effect), ghosting, beats, etc. on any channel.
3. Distribution System Testing:
   a. The MATV distribution system shall be checked at the first and last outlet in each leg to verify that the MATV distribution system meets all performance requirements utilizing the spectrum analyzer or signal level meter and TV receiver.
   b. A random sampling of a minimum of 25% of the TV outlets

shall be checked, unless incorrect levels indicate that a wide sample should be taken.

3.03 DOCUMENTATION AND TESTING

A. Upon completion of construction, the Contractor shall provide "as installed" drawings showing the exact placement of all outlets, cables, and conduits and connecting hardware called for in this section.

END OF SECTION

SECTION 16750 - INTERCOM-CLOCK COMMUNICATION SYSTEM

PART 1.00 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all equipment, accessories, cabling, devices, and materials in accordance with the project specifications and drawings to ensure a fully operational intercom, master clock, secondary clock, and class change time tone communication system of the highest quality.

B. It shall be the responsibility of the Electrical Contractor to provide all conduit systems, standard electrical boxes, and operating power for the communication system as outlined on the project drawings. The Intercom Communication System Contractor shall coordinate all system requirements with and provide special back boxes to the Electrical Contractor prior to installation of conduit.

C. Equipment specified herein is designed to provide specific functional and operational characteristics. It is the responsibility of the Intercom System Contractor to provide all features and functions as outlined in these specifications.

D. The Telephone System Contractor shall provide one (1) central office trunk "CO" line or station connection (analog port) on the telephone system, telephone cable to the intercom rack, and a designated button or station number to allow each telephone to access this port. This will provide transparent access from the telephone system to the intercom. The intercom system shall feature a distinctive dial tone and DTMF touch tone recognition to provide this transparent interface.

E. Testing for all requirements shall be performed with all cable runs and wiring devices in place. Provide all documentation and training as outlined in these specifications.

1.02 CODES AND REGULATIONS

NFPA 70, National Electrical Code.
NFPA 101, Code for Safety to Life from Fire in Buildings and Structures.
All applicable parts will be FCC Class B approved.
Americans with Disabilities Act.
Uniform Building Codes (UBC).
Local and State Building Codes.
All requirements of the local Authority Having Jurisdiction (AHJ).

1.03 SUBMITTALS

A. Quality Assurance Submittals: Letter from manufacturer stating that the Contractor is an Authorized Factory Distributor for the area where the project is located.

B. Product Data: Drawing location all components of the system and indicating circuit routing, cable type, and gauge.

C. Equipment list and data sheets on all system devices, racks, special boxes, wire, and other material as requested by the Architect including:
   1. Manufacturer
   2. Model Number
   3. Indication all options and accessories
   4. Catalog data sheets with photograph

.D. Submit complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval.

1.04 QUALIFICATIONS OF A PROPOSED CONTRACTOR

A. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified.

B. The proposed contractor, as a business entity, shall be an authorized distributor and designated representative of the equipment manufacturer, with full warranty privileges. The proposed contractor shall have been actively engaged in the business of selling, installing, and commercial building commercial communication systems for a period of at least 5 years.

C. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the Architect/Engineer, based on experience of key personnel, current and completed projects, and all licensing requirements are met 10 working days prior to the contract proposal date.

D. The proposed Contractor shall have an office within 150-miles of the job site, staffed with trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up and perform a 100 percent operational audit of all installed devices, to instruct the Owners representatives in the proper operation of the system, and to provide service throughout the warranty period. The contractor shall be capable of dispatching technicians to repair a system within six hours of a service request.

E. The proposed contractor shall be fully experienced in the design and installation of the type of system herein specified.

F. The Contractor shall employ factory-trained technicians capable of supporting the maintenance of the system. No contract employees are allowed unless they have been to the factory service school within the

last 18 months. A certificate of this training shall be provided with the contractors' submittal.

G. The Proposed Contractor shall not have any grievances or complaints of record regarding workmanship, code compliance, or service response. A Proposed Contractor that has any prior finding(s) of a code violation or has any litigation in process concerning the installation of a communication sys tem is unacceptable.

H. The ability of a proposed Contractor to obtain plans and provide a performance bond shall not be regarded as the sole qualification of the Contractors' competency and responsibility to meet the requirements and obligations of the contract.

I. The General Contractor shall be satisfied that a proposed Contractor meets all the requirements expressed herein before including the Contractor's proposal in the project.

J. The Owner may investigate, as they deem necessary to determine the ability of the proposed Contractor to perform the work. The proposed Contractor shall furnish to the Owner with any information or data requested for this purpose.

K. The Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.

L. The Owner reserves the right to reject the proposal of any Contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

1.05 PRE-APPROVAL

A. Proposed Contractors wishing to propose systems, which differ in manufacturer, features, functions, or operating characteristics other than those outlined in these specifications must do so in writing to the specifying authority in accordance with the prior approval requirements.

B. For manufacturer's equipment or models other than that specified, the Proposed Contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified.

C. Proposed Contractors that do not obtain prior approval will not be considered an acceptable supplier for this project. Final approval of the alternate system shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically insure the system will be an acceptable equivalent.

PART 2.00 PRODUCTS

2.01 GENERAL

A. All basic equipment shall be listed by Underwriters' Laboratories and be so labeled.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations and the requirements of the components UL listing. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, electrical requirements, cable types, and physical equipment sizes, etc., before beginning system installation.

C. All date keeping hardware, firmware, and software provided shall be fully compliant with dates including the year 2000 and beyond. Any time equations must function normally; leap year, and daylight savings time must be supported.

D. All basic equipment shall be new and shall be the latest product of a manufacturer of established reputation and experience of quality electronic equipment. Model numbers indicate current equipment types; if later models exist, the Contractor shall provide those. The manufacturer shall have supplied similar apparatus to comparable installations rendering satisfactory service for at least three (3) years.

E. All like devices shall be of the same manufacturer and model number.

F. Only equipment devices have been shown on the contract drawings. Specific wiring between equipment has not been shown.

G. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., speakers shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

H. Installation subject to approval, inspection, and test of the Architect/Engineer.

2.02 ACCEPTABLE MANUFACTURES

A. All references to manufacturer's model numbers and other pertinent information herein are intended to establish minimum standards of performance, function, and quality. With prior written approval from the Owner equivalent UL listed equipment from other listed manufacturers may be substituted for the specified equipment as long as the minimum standards are met.

B. It is the responsibility of the Intercom Communication System Contractor to provide all features and functions as outlined in these specifications.

The intercom shall accept standard DTMF signals from the administrative telephone system through a CO trunk line or station connection (analog port).

C. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.

D. Where no manufacturer or model number are given, any product meeting performance or design criteria, or referenced trade association standard may be used and Pre-Bid Approval is not required.

E. Subject to compliance with the specified requirements, provide products by one of the following manufacturers:
   1. Rauland
   2. Dukane
   3. Bogan

2.03 OPERATION

A. Operation of the system and description of system components shall be described in the following sections.

2.04 INTERCOM AND PUBLIC ADDRESS

A. Each classroom shall be equipped with an intercom ceiling speaker with a station call number.

B. Intercom speakers shall serve all corridors and common areas.

C. All speakers: classroom, office, corridor, exterior, cafeteria, and other common areas shall broadcast announcements and class schedule time tone signals as zoned. Speakers shall be produce clear human voice reproduction at 10 dBA over ambient noise levels minimum (i.e. corridors at class change) but never less than 65 dBA or more than 110 dBA throughout all normally occupiable areas.

D. Provide Intercom Phone Consoles with Digital Readout at the Receptionist station and as indicated on plans to provide the following functions:
   1. The digital readout displays shall identify incoming calls by their designated numbers. The display shall show visually, in the order received, three (3) calls at a time. Emergency calls shall override normal calls and shall annunciate with the letters "EMER" and the calling station number. There shall be an audible indication of incoming intercom calls. Emergency calls shall initiate a distinctive audible alert and be indicated on the display.

2. Provide facilities for answering calls registered in the display by pressing a single "response" button on an authorized administrative telephone.

3. The Digital Readout shall be an independent device suitable for attachment to the receptionist telephone.

E. Provide the capability to broadcast all-call or zoned intercom announcements and class change time tones over all interior, exterior, and corridor speakers. Zone exterior speakers separately.

F. The system shall provide facilities for calling a staff (classroom) station or making page announcements from either intercom phone console.

G. The system shall provide facilities for calling a staff (classroom) station by dialing the station number. User programmable room station numbers for any combination of 2 to 4 numeric digits.

H. The central microprocessor control equipment shall be of modular design, expandable to 250 stations. All programming shall be alphanumerical menu driven. The system shall be equipped with self diagnostics.

I. The system shall provide the capability of assigning speaker locations to any one or more of the eight (8) software programmable zones for zone paging or time signal reception.

J. Systems amplifiers shall be capable of providing sufficient power for emergency paging of all speakers with a 30 percent reserved capacity for future expansion.

K. System central control equipment shall be Underwriters Laboratory listed under Commercial Audio Systems and Accessories U.L. 813 and installed in a 19" rack cabinets and located where shown on the drawings or as directed by the Architect.

L. Provide an Uninterruptible Power Supply (UPS) with sufficient standby battery capacity to operate the intercom-clock system without AC power for two hours of normal operation (no announcements) and thirty minutes of all-call announcement operation (full load) at the end of this period.

2.05 AUDIO PROGRAM DISTRIBUTION

A. Type: A rack mounted AM/FM tuner, cassette, compact disc player, and preamplifier unit.

B. Intercom Control Panel and Pre amplifier:
1. Monitor speaker.
2. Up to 5 signal input channels.

3. Master gain control.
4. Output level graphic indicator.
5. Volume control for selecting, cueing, and level adjustment of inputs.

C. Output program channel that will allow simultaneous distribution of a program source to selected or all room stations without interrupting intercom channels.

D. The staff member shall follow the posted instructions to select room(s) or zoned areas to send the program. Provide eight (8) separate user-programmable paging zones programmed as directed by the Owner.

1. AM/FM Tuner:

AM:

- Frequency range: 535 to 1605 kHz Usable sensitivity: 20 UV at S/N 20 dB

FM:

- Frequency range: 88 to 108 M Hz
- Usable sensitivity: 3 UV at S/N 30 d B Frequency response: +/-2 dB, 50 to 10 kHz
- Distortion: Less than 1.5%
- Antenna: Standard RG-59U connector

Controls:

- AM/FM band selection
- Tuning
- Off/On
- Tone

2. Cassette Tape Player:

- Tape speed: 1-7/8" IPS
- Response: 50 to 8000 Hz
- Wow and Flutter: Less than 0.3% (WRMS)
- Signal to noise ratio: 45 dB or better
- Controls:
- Eject
- Rewind
- Fast forward

3. Compact Disc Player:

- Rack mounted 5-disc rotary, audio CD changer player.
- Features:
- Front loading 5 disc capacity.
- Full random play.
- One disc random play.
- Delete programming.

2.06 TELEPHONE SYSTEM INTERFACE FUNCTIONS (Requires interface to telephone equipment.)

A The functions described below are accomplished through the connection of the intercom system to a C.O. port or station port (analog port) of the telephone system and a dedicated button, or other means (dial a code, etc.), to access this line.

B. In order for these functions to operate the Owner must provide a telephone system with an accessible analog DTMF port for connection to the intercom. If the Owner elects not to provide a telephone system with these capabilities, then provide a labeled intercom service jack at the main telephone backboard for future connection.

C. Any administrative system telephone shall be able to page on an all-call, and zone basis to any of the 8 paging zones.

D. Any administrative system telephone shall be able to initiate an emergency announcement to all locations. Emergency announcements override all other programs.

2.07 EMERGENCY SIGNAL TONE OPERATION

A. Provide facility through both rack mounted switches and dial-up operation through the telephone system interface the ability to distribute various emergency signal tones through all intercom speakers. Verify exact requirements with Owner. Provide the following functions each with a distinctive signal:

B. Take Cover (Hazardous Weather Conditions) European siren or similar. Evacuate (Hazardous Condition Within Building) stutter tone or similar.

C. Security Alert (Suspicious Person on Campus, keep students in class and lock doors) chime or similar.

D. The tone for all outdoor speakers shall be a pleasant sounding tone due to the location of the school near residences. Final tone selection will be accomplished at the time of shop drawing review.

2.08 MASTER CLOCK SYSTEM

A. The system shall include a built-in Master Clock capable of performing the following functions:
   1. Provide a minimum of 255 discrete time event entries including the following:
      - The time of day in hours and minutes
      - The day or any combination of (7) days of the week the event is to occur Selection of any one or any combination of (8) zones or outputs to be activated.
      - Selection of any one or any combination of (8) schedules to allow maximum flexibility due to special circumstances or seasonal changes.

B. The Master Clock shall be able to simultaneously correct intercom system displays, digital, synchronous analog secondary clocks, and electronic video display clocks.

C. In the event of a power failure, all programmed data shall be retained in non-volatile memory. Time keeping shall be held by an internal lithium battery providing a 5-year back-up so that there is no need to re-enter the time or date after the power has been restored. The clock shall have an internal quartz crystal control to provide an accurate, dependable time base. Upon restoration of power, the system will automatically correct secondary clocks.

D. Output points, activated by the Master Clock, shall be provided in the system for controlling external sounds and other devices.

E. Direct, Select, Editing, and Review routines shall be provided to permit the user to change and edit time, events, zones, and schedules without having to reprogram the entire sequence.

F. The system shall be configured to allow mechanical bells and loudspeaker class change tones to operate simultaneously within the same system.

2.09 INTERCOM SYSTEM HEADEND EQUIPMENT

A. Mount all equipment, except portable equipment, firmly in place. Permanently mark all cables and install in a professional, neat and orderly installation. All wiring and cables will be securely fastened and routed using wire ties. Provide for adequate ventilation in all equipment racks and take precautions to prevent electromagnetic or electrostatic hum. Insert test results in the owner's manual.

B. Provide the components necessary to form a complete intercom with single-line telephone system interface performing to the above specifications. The intercom system equipment housing shall be sized to support the existing facility plus 30% expansion capability. The housing (i.e. card cage) shall be sized for this expansion, the driver cards, etc. would be added in the future. Equipment list, quantities as required, shall consist of but not limited to:

a. Basic system intercom package
b. Card cage unit
c. Central processor unit
d. Audio buffer unit
e. Console port
f. Audio termination panel
g. Power supply unit
h. 125 watt power amplifier(s)
i. Intercom station cards
j. Telephone station cards
k. Receiver/Decoder unit

l. PABX input unit
m. Telephone line amplifier
n. RS232 interface card
o. Remote digital clock driver
p. Technics CD player
q. AM/FM/cassette/player
r. Telecor power supply for TCIPD
s. FM dipole element antennae
t. Tripp Lite, BC1050, Uninterruptible power supply
u. Hayes, model 2400, Modem for remote diagnostic

C. Headend Equipment Racks:

1. Provide as required TIA/EIA standard 19" floor cabinets, 77" high rack space, with rear door and lift-off side panels and filler panels in front as required. The cabinet shall be constructed of 16 gauge CRS throughout. Hinges shall be bolted and not welded for strength. Rear section shall be of one piece construction with electric welding at all seams. Panel mounting rails shall be tapped for 10-32 screws. Each cabinet shall be provided with all necessary blank and vent rack panels to fill unused space. The overall dimensions shall be: 81.25 inches high, 22.313 inches wide, and 25.5 inches deep. The equipment rack shall be an Atlas/Soundolier model no. 502-77B with 542-77B side panels or equivalent. Provide an Atlas/Soundolier Model AS120 wall shelf for UPS. Provide a Middle Atlantic Products Part No. RS H-4S custom rack mount for the CD Changer. Finish to be Atlas/Soundolier Color # 962 textured black.

2.10 CLASSROOM / OFFICE / CORRIDOR DEVICES

A. Provide as indicated on plans intercom phone desksets with digital readout to perform communication, paging and signaling functions. A minimum of four (4) sets shall be furnished.

B. Provide a priority paging microphone at the Receptionist station – Shure model no. 550L or equivalent.

C. Ceiling intercom speaker assemblies shall consist of an 8 inch dual cone speaker with 25/70 volt line matching multiple tap transformer, frequency response of 65-17,000 Hz minimum, 8 watt normal RMS, 5.0 ounce ceramic magnet, .75 inch voice coil, and steel, baked enamel baffle. Speakers as indicated on plans shall be connected with a wall mount volume control. Speaker back-box shall be 22-gauge welded steel with support rails. Ceiling mount speaker assemblies shall be Atlas/soundolier model no. FD25W speaker with baffle, backbox, and tile support bridge or equivalent. Speakers utilizing 45-ohm impedance or speakers requiring special amplifiers powered by central power supplies shall not be considered under this specification. Provide quantities as indicated on the drawings. The speaker/enclosure assembly shall be supported by wire from the building structure; in no

case shall these assemblies be supported by the ceiling grid. Quam-Nichols Company model no. C5 speaker, BU ceiling tile style baffle, TR speaker support assemblies, with ERD8TR backbox, meeting the above requirements are acceptable for drop ceiling installation.

D. Digital Secondary Clocks: Provide 24 VAC operation digital secondary clocks connected to the master clock system, minimum character height 4" LEDs. Clocks shall be located as shown on the drawings. Single face surface mount wall clocks double face clocks in corridors shall include dual mounting kits for digital clocks.

E. CALL-IN SWITCH – Call-in station shall be momentary pushbutton mounted on stainless steel plate. An additional call-in station shall be equipped with an EMERGENCY CALL pushbutton that overrides calls at the Administrative Control Consoles to receive the emergency call. Emergency call button shall be clearly marked.

2.11 INTERCOM HORN SPEAKERS

A. Provide paging-talkback 15 watt continuous rated horn speakers in gymnasiums and indoor play areas where indicated on plans. Atlas/Soundolier model no. AP-15TU or equivalent. Outdoor speakers shall include volume control to allow adjusting speaker volume in the field.

2.12 FLUSH WALL MOUNT EXTERIOR INTERCOM SPEAKERS

A. Outside wall mount speakers shall be flush-mounted using vandal-proof grills. Transducer shall be horn type projector mounted flush with a 15 watt rating by Atlas/Soundolier or equivalent. Constructed of treated, heavy gauge aluminum, all exposed parts shall be plated and sealed. Shall be a weatherproof unit, mount driver unit within waterproof housing. Double re-entrant type, horn dispersion angle: 160 degrees. Audio power rating: 15 watts at full range and 20 watts at frequencies above horn cutoff. Frequency response: 475-14,000 Hz. Sound pressure level: 111 dB at rated power. Provide a vandal proof grill constructed of self-aging aluminum alloy with a minimum tensile strength of 44,000 P.S.I. Size 10-3/4" sq. x 3/4" projection. Square front with textured white enamel finish. Mount with tamper-proof hardware. Loudspeaker Assembly: Atlas/Soundolier model no. APF-15T with model L20-211 protective enclosure and model VP161-APF grill. Provide volume control on outside speakers.

2.13 CABLE ROUTING, INSTALLATION, AND SUPPORT

A. System wiring and equipment installation shall be in accordance with good engineering practices as established by the NEC and the TIA/EIA. Wiring shall meet all state and local electrical codes.

B. All wiring shall test free from opens, grounds, or shorts. All communication cable shall be supported from the building structure and bundled. Do not attach any supports to joist bridging or other lightweight members.

C. The support system shall provide a protective pathway to eliminate stress that could damage the cabling. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.

D. In all exposed areas such as gymnasiums, shops, field houses, janitors' closets, or mechanical / electrical rooms al l communication cable shall be fully enclosed in conduit.

E. Communication cables shall be run in conduit stubs from wall boxes to accessible areas above finished ceilings. Conduit shall be required only within walls and concealed spaces to provide access. Provide a plastic snap in bushing at each end of all open conduit stubs or sleeves - Thomas & Betts Catalog no. 443 - 3/4", 424 - 1", 425 - 1 1/4", 427 - 2", Arlington Industries EMTxxx series insulating bushings, or equivalent.

F. Communication cables shall be run in bundles above accessible ceilings and supported from building structure. Cabling shall be loosely bundled with cable ties randomly spaced at 30 to 48 inches on center, cable ties shall not be tight enough to deform cabling and shall not be used to support the cabling.

G. Communication cable must not be fastened to electrical conduits, mechanical ductwork/piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel for more than four-feet with line voltage electrical conductors. Communication cables shall not be run loose on ceiling grid or ceiling tiles.

H. Support shall be provided by mounting appropriate fasteners that may be loaded with multiple cables. Provided that the weight load is carried by the support rod or wire the support assembly may attach to the ceiling grid for lateral stabilization. The required support wires for the ceiling grid or light fixtures shall not be utilized. Any fastener attached to the ceiling grid shall not interfere with inserting or removing ceiling tiles. The cable pathway of supports must be positioned at least 12 inches above the ceiling grid.

I. All cabling shall be placed with regard to the environment, EMI/RFI interference, and its effect on communication signal transmission.

J. Do not route any data communication cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.

K. Communication cable will not be installed in the same conduit, raceway, tray, duct, or track with line voltage electrical cable without a metallic barrier meeting NEC requirements.

L. Maximum cable pulling tension should not exceed 25 lb./ft. or manufactures recommendation, whichever is less.

M. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.

N. No terminations or splices shall be installed in or above ceilings.

O. Cable bends shall not be tighter that the manufacturers' suggested bend radius.

P. Mount all equipment firmly in place such that vibration or jarring will not activate an alarm, supervisory, or trouble signal. Cable shall be routed in a professional, neat and orderly installation.

Q. All cable shall have a label on both ends utilizing self-laminating, flexible vinyl film and non-smear nylon marking pens. Utilize Tyton Corporation Part number RO175 Rite-On labels and Part number FTP1 nylon marking pens or equivalent.

R. Each cable run shall include a three-foot service loop with wire tie located in the ceiling above the control unit panel. This is to allow for future re-termination or repair.

S. Provide for adequate ventilation to all equipment racks and take precautions to prevent electromagnetic or electrostatic hum.

T. All conduit, ducts, track, and raceways shall be supported from the structure at industry standard intervals for the size specified, utilizing proper anchoring devices. Cable fill may not exceed the manufacturers' instructions for each type of support.

U. Devices mounted on a drop ceiling shall feature a back box fitted with a support hanger (Caddy #512 or equivalent) and an independent drop wire to support the weight of the device.

V. Termination practices:
1. Strip back only as much cable jacket as required to terminate.
2. Preserve wire twists as closely as possible to point of termination (0.5" maximum) to keep signal impairment to a minimum.
3. Avoid twisting cable during installation.

W. J-Hooks:
1. Attachments for cabling support shall be spaced at approximately 48 to 60 inches on center. The cable bundle shall not be allowed

to sag more that 12 inches mid-span between attachments. Attachments shall be sized as follows: Single cables or bundles up to four cables may be supported directly by the building structure.

- Bundles up to 1/2" dia. (Ten 1/4" cables)
  2" bridle ring, Caddy #4BRT32 or equivalent
- Bundles up to 3/4" dia. (Sixteen 1/4" cables)
  3/4" J-Hook, Caddy #CAT12 or equivalent
- Bundles up to 1-5/16" dia. (Fifty 1/4" cables)
  1-5/16" J-Hook, Caddy #CAT21 or equivalent
- Bundles up to 2" dia. (Eighty 1/4" cables)
  2" J-Hook, Caddy #CAT32 or equivalent
- Split bundles greater that 2" dia. or provide cable tray.

2. Do not mix different signal strength cables on the same J-Hook (i.e. fire alarm with telephone/data cable). Multiple J-Hooks can be placed on the same attachment point, up to the rated weight load of the attachment device.

X. Cable Ties:

1. Nylon cable ties shall be furnished and installed to attach wire bundles to supports and for appropriate wire management as required.

   Nylon wire tie, 3.9", miniature - Panduit PLT1M-C or equivalent.
   Nylon wire tie, 5.6", miniature - Panduit PLT1.5M-C or equivalent.
   Nylon wire tie, 11.4", intermediate - Panduit PLT3I-C or equivalent.
   Nylon wire tie, 14.6", intermediate - Panduit PLT4I-C or equivalent.

2.14 FIRE STOPPING, PENETRATIONS, AND CORING

A. UL Listed fire stopping methods that match the fire rating of the wall or floor being penetrated are to be used at all fire barrier penetrations. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire-stop caulk or putty, install according to the manufacturers' instructions.

B. All penetrations through fire rated walls or floors shall feature a suitable length of metal conduit. Hole diameter shall not exceed ½" larger than the conduit or sleeve to be installed. The hole shall be neatly cut, not oversize or irregular. Do not share wall/floor penetrations with ductwork, piping, line voltage electrical conduits, etc.

C. All gypsum board or plaster penetrations shall tool cut using an appropriate hole saw / mandrel or manufactured assembly.

D. The Contractor shall make every effort to coordinate with the building Architect, Engineer, Builder and Electrical Contractor to have sleeves placed in new construction so that later coring or drilling of building

structural members will not be required. The Contractor must consult with the building Architect, Engineer, and Builder prior to drilling, coring, or sawing of any wall, floor, etc. All penetrations shall be made at approved, appropriate, locations.

E. Upon approval, the contractor shall be required to supply all labor, equipment, tools, and materials to create any additional penetrations, and shall provide the sleeve, temporary and final fire stopping. Special care shall be taken not to stress, overheat, or penetrate any building support member. Coring shall be made with equipment appropriate for the dry penetration of concrete and block materials. Under no circumstances shall penetrations be made utilizing a chisel or percussion type equipment. Concrete, block, or plaster cores shall be made by dry saw/core methods only.

2.15 CABLE

A. The Contractor shall provide and install new and unused ASTM bare solid copper conductor wire per ANSI/NEMA codes. Follow the manufacturer's instructions. All wire shall be UL listed for communication and control circuits.

B. All cable shall have labels on both ends utilizing self-laminating, flexible vinyl film and non-smear nylon marking pens. Utilize Tyton Corporation Part No. RO175 Rite-On labels and Part No. FTP1 nylon marking pens or equivalent.

C. Each call button shall be wired with telephone type Category 3 cable and punched down on 110 type blocks to allow flexibility for future equipment. Cable shall be NEC type CM or MP, West Penn Wire No. WP52995, 24 AWG, unshielded twisted pair, 4-pair - (8) conductor. Equivalent by Belden, Carol or Comtran.

D. Each speaker cable shall be NEC type CMR, West Penn Wire No. 291, 22 AWG, overall shielded, two (2) conductor, plus one (1) drain wire. Equivalent by Belden, Carol or Comtran.

E. Secondary clock wire shall be NEC type CMR, West Penn Wire No. 222, 20 AWG, two conductor unshielded, or equivalent by Belden, Carol, or Comtran.

F. Microphone cable runs shall be West Penn Wire No. 77291, NEC type CM, 22 AWG, 2 conductor twisted pair with 1 00% coverage foil shield and 24 AWG stranded drain wire.

G. Furnish an insulated #6 copper ground wire run from the amplifier to an earth ground, attached securely to the amplifier case, and terminated at each end to bare metal.

2.16 SURGE AND AMPERAGE PROTECTION

A. Electrical surge protection shall be provided for all service entrance connections and on each copper pair that connects one building to another (i.e. any other portion of a building complex not under one continuous roof) at both exit points to prevent damage to equipment.

B. Intercom circuit surge protectors shall be mounted in a standard grounded metallic electric box. Shall be Ditek, 12345-A Starky Road, Largo, Florida 34643 model numbers as follow, multiple pair units are available, or equivalent:

Part No. DTK-1LVLP-SPK 2 wire protector for 70 Volt circuits.
Part No. DTK-1LVLP-OPX 2 wire protector for 48 Volt circuits.
Part No. DTK-1LVLP 2 wire protector for 24 Volt circuits.
Part No. DTK-1LVLP-X 2 wire protector for 12 Volt circuits.
Part No. DTK-1LVLP-D 2 wire protector for 5 Volt circuits.

PART 3.00 EXECUTION

3.01 TESTING, CERTIFICATION, WARRANTY, SERVICE

A. All equipment will carry a one-year warranty or manufacturer's warranty whichever is greater.

B. A factory trained service technician shall supervise the final connections and testing of the system and it shall be subject to the final acceptance of the Architect, Engineer, and local authorities. Testing shall insure the following:

C. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

D. Complete and functional system.

E. Installed in accordance with manufacturer's instructions.

F. Upon completion of the testing, the manufacturer or his representative shall issue to the Owner a letter of certification attesting to the fact that he has tested and adjusted the system, that all components are properly installed and free of defects, and that the system is in compliance with this specification.

G. The contractor shall provide a warranty and service contract for the installed system. The warranty shall be against defects in material or workmanship for a period of one (1) year from the date of substantial completion. Any equipment or wiring shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner. All equipment will carry a one-year warranty or manufacturer's warranty whichever is greater.

H. The service contract shall provide a minimum of the following:
   1. Diagnostics of the system should a problem occur.

   2. Reprogramming. Desired changes to class of service of any device or to the master clock schedule. The Intercom Communications Sys tem Contractor will provide this service with an unlimited number or frequency of the changes.

   3. The Communication Systems Contractor will provide service software upgrades to the system that become effective during the period of the service contract.

I. The contractor shall make available a service contract offering continuing factory authorized service of this system after the initial warranty period. This contract shall automatically renew each year at the owner's discretion. Contractor will provide the cost of renewal to the owner thirty (30) days prior to the expiration of the contract after the first year.

J. The system manufacturer shall maintain engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.

3.02 DRAWINGS, MANUALS, AND TRAINING

A. Upon completion of the installation and prior to final inspection, this Contractor shall furnish as-built drawings. As-built drawings shall be prepared in AutoCAD format. Provide reproducible vellum and four prints, in addition to an AutoCAD file. In addition, this Contractor shall furnish four (4) copies of a complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Include complete instructions for the inspection, testing, and maintenance of the system.

B. This contractor shall conduct formal on-site training sessions. Provide documented general instruction as follows: Provide instruction to the maintenance personnel to include the location, inspection, maintenance, testing, and operation of all system components. Provide a minimum of four (4) hours--two 2-hour sessions separated by a minimum of two weeks.

C. Provide instruction to designated personnel on the functions and operation of the intercom and master clock system including emergency and service request procedures. Provide a minimum of four (4) hours--two 2-hour sessions separated by a minimum of two weeks.

END OF SECTION

SECTION 16755 - CLASSROOM AUDIO SYSTEM

PART 1.00 GENERAL

1.01 SUMMARY

A. Classroom Audio Systems shall include all components required to amplify voice and other audio sources; an audio amplifier/mixer/built-in charger for microphone/transmitter(s), wall or ceiling speakers with mounting brackets and plenum speaker wire, REDMIKE™ or LightMic™ classroom microphone, infrared sensor with plenum cable, NiMH rechargeable AA batteries, and power cords.

1.02 DESCRIPTION

A. The Classroom Audio System shall include but not limited to the following components:
   1. Infrared receiver/amplifier/mixer with built-in transmitter charging jacks, 8-band graphic equalizer, and 2 stereo audio inputs (L820)
   2. UL Listed 24V / 2.5A Power Supply (PS-24V-2.5)
   3. REDMIKE microphone/transmitter with rechargeable sensing battery (RMT)
   4. Optional second REDMIKE for student pass-around use or team-teaching (RMT)
   5. Optional LightMic with rechargeable NiMH batteries for student pass-around use or team-teaching (LT71)
   6. Optional IR Handheld microphone/transmitter with rechargeable NiMH batteries for student pass-around use. (HM70)
   7. Infrared sensor with plenum-rated coax cable (SR70F)
   8. Multiple Speaker(s) available to match specific room characteristics with mounting hardware and plenum-rated wire (see specifications)

1.03 REGULATORY REQUIREMENTS

A. Conform to applicable building code for requirements applicable to work specified herein.

1.04 QUALITY ASSURANCE

A. Qualifications:
   1. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project. When requested, submit certificate indicating qualification.
   2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction, approving acceptable installer and approving application method.

B. Acceptable Manufacturers:
   1. Basis of Design: Lightspeed Technologies, 11509 SW Herman Road,

Tualatin, OR 97062, PH 800-732-8999, FAX 503-684-3197

2. Substitutions must be in full compliance to specifications as written

C. Manufacturer Testing: Manufacturer to provide quality assurance certification for each system and all of its components. A report for each system will be available upon request. Report will include serial numbers and pertinent testing data for all of the system functions.

D. Successful third party installation (when needed) will be supplied with necessary training to allow for product installation certification by Manufacturer and will be installed according to Lightspeed recommendations.

1.05 SUBMITTALS

A. Manufacturer's data on all products including but not limited to:
   1. Catalog cut sheets
   2. Installation instructions
   3. Typical wiring diagrams
   4. Drawings showing speaker locations
   5. Operation and maintenance manuals
   6. Manufacturer's warranty documents
   7. Manufacturer's parts lists
   8. Product serial numbers

1.06 WARRANTY

A. Manufacturer's Warranty: All the major system components (transmitters, receiveramplifier, sensor, and speakers) must be warranted for five years against defects occurring while used in normal classroom instruction. The warranty shall be equivalent to a Lightspeed Technologies' Five-Year Warranty.
   1. Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.
   2. Warranty Period: Five years commencing on Date of Substantial Completion.

1.07 OWNER INSTRUCTION

A. Owner's Instruction: user-training will be performed by the manufacturer's local representative. The training will include a video on the research and benefits of classroom audio, system operation, simple troubleshooting guidelines, and incorporating the classroom audio into teaching styles. The manufacturer will also provide additional training in trouble-shooting techniques and product return procedures.

B. Instruction materials and detailed Owner's manual shall be provided to cover operational and basic maintenance procedures.

PART 2.00 PRODUCTS

2.01 OVERALL SYSTEM DESCRIPTION

A. The system must have specifications and features that are equivalent to the Lightspeed 820iR Series Infrared Classroom Audio System including integrated Infrared receiveramplifier with the following:
   1. Two IR channels with independent volume controls
   2. Two stereo audio inputs with independent volume controls
   3. One audio output on front panel with level control
   4. Two speaker outputs, capability to power a total of four or eight speakers
   5. 8-band graphic equalizer
   6. One infrared sensor inputs with sensor short indicator, capability to power up to three IR sensors

B. The system shall be available with an alternative group of 2 frequencies to allow for a total of 4 compatible channels in a single room or common area.

C. The system shall carry a "No Audio Dropout Guarantee" for enclosed classrooms up to 1600 square feet with ceiling heights of 12 feet or less. Should any audio dropout occur, the manufacturer will correct it at no additional charge.

2.02 RECEIVER /AMPLIFIER SPECIFICATIONS

A. The receiver/amplifier shall meet or exceed the following specifications:
   1. Power output: 24 Watts Total (12 W / Channel)
   2. Frequency response: 40 Hz to 20 kHz
   3. Power supply (UL Listed): 24V/2.5A
   4. Signal-to-noise: >73 dB
   5. Image and Spurious Rejection: >70 dB
   6. Total Harmonic Distortion: <1 % @ 40 Watts (10W / Channel)
   7. Speaker load impedance: 40 / Output
   8. Standard sub-carrier frequencies: 2.06/2.54 MHz; Alternative sub-carrier frequencies: 3.2/3.7 MHz
   9. Receiver Sensitivity: 6 microV for 60 dB S/N
   10. Reception Selectivity: ±40 kHz
   11. Nominal Dimensions (W x D x H): 9.5" x 8.5" x 1.75"
   12. Controls:
      a. (1) Power switch with LED
      b. (2) IR microphone volume controls
      c. (2) Auxiliary audio input volume controls
      d. (1) Mixed audio output level controls
      e. 8-band graphic equalizer
   13. Connections:
      a. (2) Speaker outputs (binding post connectors)
      b. (1) Mixed audio outputs (3.5mm), allows for connection of two ALD devices
      c. (1) DC Power input

d. (2) Audio inputs (Dual RCA x2)
e. (1) IR sensor inputs (F-type) with short indicator LED

2.03 REDMIKE PENDANT-STYLE IR MICROPHONE/ TRANSMITTER

A. Description: the pendant-style REDMIKE transmitter shall be capable of being worn around a teacher's neck as a hands-free microphone via the lavaliere cord or to be used as a handheld student pass-around microphone. The REDMIKE must be rechargeable via cradle charger and must have alkaline charge protection.

B. Microphone/transmitter shall meet or exceed the following specifications and standards:
1. Standard sub-carrier frequencies: 2.06/2.54 MHz
2. Audio distortion: <1%
3. Integrated microphone type: uni-directional electret
4. Input jack for audio source or optional external microphone: 3.5mm
5. Microphone input impedance: 2.2k ohm
6. Alkaline Charge Protection: Yes
7. Battery Charger: cradle charger (charges two REDMIKE transmitters)
8. Cradle Charger input: mini DC jack
9. Cradle Charger Output Jack: 3.5mm DC output jack for LT-71 or HM-70 transmitters
10. Battery Power: One (1) AA NiMH Lightspeed rechargeable battery (Part# BA-NH2A27)
11. Nimonal Dimensions: 3.5" (h) x 0.9" (w) x 1.0" (d)
12. Nominal Weight (with battery): 2.1 oz.

2.04 OPTIONAL LIGHTMIC TRANSMITTER (HANDHELD OR PENDANT-STYLE)

A. The LightMic Transmitter shall be available as an optional item for Owner's future use.

B. Description: the pendant-style LightMic transmitter shall be capable of being worn around a teacher's neck as a hands-free microphone via the lavaliere cord or to be used as a handheld student pass-around microphone. The LightMic must be rechargeable via charging cradle or cable.

C. The LightMic Transmitter shall meet or exceed the following specifications or standards:
1. Standard sub-carrier frequencies: 2.06/2.54 MHz; Alternative sub-carrier frequencies: 3.2/3.7 MHz
2. Audio distortion: <1%
3. Integrated microphone type: uni-directional electret
4. Input jack for optional external microphone: 3.5mm
5. Microphone input impedance: 2.2k ohm
6. Battery Charger input: 3.5mm DC jack
7. Battery Power: 2 AA NiMH Rechargeable Batteries
8. Nominal Dimensions: 1.375" (w) x 4.625" (l) x 1" (d)
9. Nominal Weight (with batteries): 3.7 oz.

2.05 OPTIONAL HANDHELD IR MICROPHONE / TRANSMITTER

A. The Handheld IR Microphone/Transmitter shall be available as an optional item for Owner's future use.

B. The Handheld IR Microphone/Transmitter shall meet or exceed the following specifications or standards:
   1. Standard sub-carrier frequencies: 2.06/2.54 MHz; Alternative sub-carrier frequencies: 3.2/3.7 MHz
   2. Audio distortion: <1%
   3. Integrated microphone type: uni-directional electret
   4. Battery Charger input: 3.5mm DC jack
   5. Battery Power: 2 AA NiMH Rechargeable Batteries

2.06 EXTERNAL SENSOR

A. The External Sensor shall meet or exceed the following specifications or standards:
   1. Power: from receiver/amplifier
   2. Reception coverage: 360 degrees
   3. Cable: 50 ohm plenum-rated Coax (50 feet) with F-type connectors
   4. Mounting: ceiling or wall mount (bracket included)
   5. Diodes: 32

2.07 LOUDSPEAKER

A. The speaker packages available shall be a ceiling mounted system described as follows:

   1. CNXQ Flat-panel Ceiling Speaker (one speaker for rooms of 1200 sq. ft. or less)
      a. Description: NXT™ distributed mode panel
      b. Panel Size: 22.25" x 22.25"
      c. Frequency Response: 60 Hz - 15 kHz ± 6dB
      d. Impedance: 4 Ω
      e. Power Handling: 15 W
      f. Enclosure: white aluminum frame

2.08 CONNECT THE 8201R TO OTHER AUDIO SOURCES

A. The 820iR amplifier must have two audio inputs to allow other audio sources to be played through the system. Computers, DVD/VCR's, TV's, CD's, MP3's etc. may be connected into the 820iR amplifier using appropriate patch cords.

PART 3.00 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's installation instructions.

B. Final adjustment: Upon completion, the system shall be clean, adjusted and left in perfect operating condition. Transmitters shall be plugged in and charging and user manual should be left in a conspicuous place.

C. Provisions: There shall be no audible components of hum, noise, or distortion.

3.02 ADDITIONAL AS-BUILT DATA REQUIRED

A. Provide as-built documents indicating conditions with final locations of ceiling-mounted speakers, remote infrared sensor and audio amplifier; to include serial number for the equipment in each location. As-built document shall include AutoCAD drawing.

3.03 INSTALLATION HARDWARE

A. Receiver/Amplifier: The 820iR receiver/amplifier shall be placed in locations within the classroom as shown on the drawings.

B. The IR Sensor: The IR sensor shall be designed to snap into the ceiling grid. Plenum-rated sensor cable shall be routed back and connected at the receiver/amplifier. Sensor shall be mounted on a wall above seven feet with included mounting clip.

C. Speakers: See specification sheet and installation instructions for specific speakers. Mounting brackets shall be installed square and plumb, at the height and location recommended by the Manufacturer and in accordance with local building and electrical codes.

3.04 CLEAN-UP

A. Remove unused materials and debris from the work and storage areas. Leave areas in an undamaged and acceptable condition.

B. Save the shipping boxes for the school to return product for service.

END OF SECTION