

SECTION 23 81 26

SPLIT SYSTEM A/C UNIT (DUCTLESS)

PART 1 GENERAL

1.1 SCOPE

- A. The provisions of Section 23 05 00 apply to all the work in this Section.
- B. Furnish and install split system A/C units as required to provide a complete and satisfactory job.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 23 05 00.
 - 1. Manufacturer's Cuts.
 - 2. Certified Capacity Ratings.
 - 3. Installation Instructions.
 - 4. Operating and Maintenance Instructions.

PART 2 PRODUCTS

2.1 SPLIT SYSTEM A/C UNIT (DUCTLESS)

- A. Furnish and install an air cooled condensing unit/direct expansion fan coil combination. The outdoor section shall be factory assembled, having direct drive fans with horizontal air discharge, reciprocating compressor, refrigerant coil fan motor(s) prewired control panel and a holding charge of refrigerant. The indoor fan coil unit shall have horizontal discharge and will include refrigerant coil, fan and motor, condensate pan with drain, thermal expansion valve, prewired control panel and remote thermostat control.
- B. Refrigerant coils shall be of nonferrous construction with mechanically bonded, smooth plate fins. All tube joints shall be brazed with phosphor copper or silver alloy. Coils shall be pressure tested at the factory.
- C. Unit shall be furnished with direct drive, propeller type fans arranged for horizontal discharge. Condenser fan motors shall have inherent protection, and shall be of the permanently lubricated type resiliently mounted for quiet operation. Each fan shall have a safety guard.
- D. Evaporator fan section shall have forward curved blade, double inlet fans mounted on a solid shaft. Fan shall be statically and dynamically balanced and shall run on permanently lubricated bearings.
- E. Cabinets shall be made of galvanized steel, bonderized and finished with baked enamel.
- F. Compressor shall be serviceable hermetic type. It shall be mounted so as to avoid vibration. It shall be equipped with high and low pressure protection.
- G. System Control. The system shall utilize a microprocessor controller with diagnostic capability, located in the indoor unit. Wall mounted remote control with operation indicator lamps to be used for temperature control, airflow selection rate (including automatic airflow rate change according to room temperature), heating/cooling mode selection, motorized air vane operation, economy operation selection feature, and on/off switching.

- H. Room Air Dampers. Indoor unit shall have motorized air vanes which sweep air from front to back of room by modulating the horizontal air vanes in the vertical plane. Air vanes can be set in a fixed position by a switch on the remote control. Horizontal discharge shall be manually adjusted to desired direction by setting vertical vanes located behind the horizontal motorized air vanes.
- I. Return Air shall be filtered by means of easily removable, washable filters. The filters shall be accessible without tools or exposure to hazardous electrical or moving parts. Provision shall be made to have a filtered outdoor air duct connection to provide fresh air to the unit.
- J. Manufacturer shall have been established in the United States for a period of 5 years and shall have parts and service organizations located not more than 100 miles from the site.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Unit shall be installed in accordance with the manufacturer's recommendations and in coordination with data room equipment layout.
- B. Units shall be installed in fully accessible locations.

END OF SECTION

SECTION 23 82 16

AIR COILS

PART 1 GENERAL

1.1 SCOPE

- A. The provisions of Section 23 05 00 apply to all the work in this Section.
- B. Provide spiral fin type coils for mounting in ductwork or for building up free-standing coil banks as indicated on the drawings.
- C. All coils shall be certified in accordance with ARI Standard 410. All coils shall be tested at 350 PSIG air pressure while submerged in water.
- D. Furnish and install coils as required to provide a complete and satisfactory job.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 23 05 00:
 - 1. Manufacturer's Cuts.
 - 2. Certified Capacity Ratings.
 - 3. Installation Instructions.
 - 4. Operating and Maintenance Instructions.

PART 2 PRODUCTS

2.1 DX COOLING COILS

- A. Encased coil shall operate properly in vertical upflow, downflow or horizontal position. Coil shall be 3 rows deep with a nominal fin spacing of 13 fins per inch. It shall be constructed with aluminum plate fins mechanically bonded to non-ferrous tubing with all joints brazed ultrasonically. Coil shall have factory installed: refrigerant metering devices; refrigerant line fittings which permit mechanical connections; condensate pan with primary and auxiliary drain connections on each.
- B. Casing shall be insulated and constructed to galvanized steel, bonderized and finished with baked enamel.

END OF SECTION

SECTION 26 01 00

ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE

- A. General Conditions of the Contract, Amendments, Supplementary General Conditions, and Special Conditions govern work under this Division.
- B. Work covered by this Division consists of providing all labor, equipment, supplies, and materials; and performing all operations, including trenching, backfilling, cutting, patching, and chasing necessary for the installation of complete electrical systems in strict accordance with these specifications and the applicable drawings.
- C. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.
- D. This Contractor is referred to the General and Special Conditions of the contract which shall form a part and be included in this section of the specification and shall be binding on this Contractor.
- E. Some items of equipment are specified in the singular; however, the Contractor shall provide and install the number of items or equipment as indicated on the drawings, and as required for complete systems.

1.2 DEFINITION

- A. The word "Contractor" as used in this section of the specification refers to the Electrical Contractor unless specifically noted otherwise. The word "provide" means furnish, fabricated, complete, install, erect, including labor and incidental materials necessary to complete in place and ready for operation or use the item referred to or described herein and/or referred to on the Contract Drawings.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. It is assumed that the Contractor has had sufficient general knowledge and experience to anticipate the needs of a construction of this nature. The Contractor shall furnish all items required to complete the construction in accordance with reasonable interpretation of the intent of the Drawings and Specifications. Any minor items required by code, law or regulations shall be provided even if not specified or specifically shown, where it is part of a major system.

1.4 CONTRACT DOCUMENTS

- A. The contract drawings are diagrammatic and are not intended to indicate every detail of construction, or every item of material or equipment required, or exact locations. Indicated locations of outlets, equipment, and connections are approximate and shall be verified by reference to related documents.
- B. The Contractor shall procure complete drawings and specifications on all coincident construction and fit the Electrical work in with it. He shall cooperate with other trades to achieve well coordinated progress and final result; and avoid conflicts with other trades. He shall make minor

moves and changes necessary to accommodate other equipment and/or preserve symmetry without claim for extra payment. Should there be any doubt as to the spacing intent, or location of equipment, the Contractor shall have the point clarified by the Architect/Engineer before proceeding with the installation.

1.5 RECORD DRAWINGS

- A. During construction of this project, the Contractor shall maintain one complete set of electrical contract drawings, on which shall be recorded all significant changes. This set of drawings shall be used for no other purpose. Upon completion of the work, the Contractor shall submit these drawings to the Architect/Engineer for approval and presentation to the Owner.
- B. Upon completion of the project, the Contractor shall prepare an Operation and Maintenance Manual, which shall include catalog data, equipment information, wiring diagrams, and warranty information for the electrical installation. Submit in three copies to the Architect/Engineer for approval and presentation to the Owner.

1.6 REGULATIONS AND COMPLIANCE

- A. The requirements of the North Carolina State Building Code, the National Electrical Code, and all other State and Local codes, ordinances, regulations and interpretations by authorities having jurisdiction are binding upon this Contractor, and nothing contained in, or inferred by, these specifications or the applicable drawings may be construed as waiving those requirements. The latest edition of the National Electrical Code, referred to herein and on the drawings as "N.E.C.", forms a part of these specifications; and under no circumstances may the installation fail to meet the minimum requirements therein.
- B. This Contractor shall secure and pay for all permits, fees, inspections and licenses required. Upon completion of the project and prior to his request for final payment he shall present to the Architect/Engineer a certificate of inspection and approval from the inspection authorities.
- C. Requirements of the Power and Telephone Utilities shall be met. The Contractor shall install and connect all Utility supplied equipment such as current transformers, cabinets, meters, and boxes. Regulations of the Utility shall govern service connections and installation of metering equipment.
- D. The Contractor shall include in his work, without extra cost to the Owner, any labor, materials, service, apparatus, drawings, in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on drawings and/or specified.
- E. All materials furnished and all work installed shall comply with the National Fire Codes of the National Fire Protection Association, and with the requirements of all governmental departments having jurisdiction.
- F. All materials and equipment shall bear the approval label, and shall be listed by the Underwriters' Laboratories, Inc.
- G. It is the responsibility of the contractor to notify the local electrical inspector to schedule the required inspections.

1.7 ELECTRICAL TESTING

- A. Conduct full scale tests with all lights, equipment and appliances in operation and prove the electrical system satisfactory for operation and free from defects. Pay particular attention to the balancing of the single-phase loads on the three-phase system. Promptly remedy all defects.
- B. All current carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500 volt megger. The procedures listed below shall be followed:
 - 1. Minimum readings shall be one million or more ohms for #6 AWG wire and smaller, 250,000 ohms or more for #4 AWG wire or larger, between conductors and between conductor and the grounding conductor.
 - 2. After all fixtures, devices and equipment are installed and all connections completed to each panel, the contractor shall disconnect the neutral feeder conductor from the neutral bar and take a megger reading between the neutral bar and the grounded enclosure. If this reading is less than 250,000 ohms, the contractor shall disconnect the branch circuit neutral wires from this neutral bar. He shall then test each one separately to the panel and until the low reading is found. The contractor shall correct troubles, reconnect and retest until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.
 - 3. At final inspection, the contractor shall furnish a megger and show that the panels comply with the above requirements. He shall also furnish a hook-on type ammeter and voltmeter to take current and voltage readings as directed.
- C. Upon completion of installation of the electrical grounding and bonding systems, the ground resistance shall be tested with a ground resistance tester utilizing the IEEE Fall-of-Potential method of testing. Where tests show resistance-to-ground is over 25 ohms, appropriate action should be taken to reduce the resistance to 25 ohms, or less, by driving additional ground rods. (The compliance should be demonstrated by retesting).
- D. All tests specified shall be completely documented indicating time of day, date, temperature and all pertinent test information.
- E. All required documentation of readings indicated above shall be submitted to the Engineer prior to, and as one of the prerequisites for, final acceptance of the project.

1.8 GUARANTEE

- A. The Contractor shall guarantee that the work done has been done in accordance with the Contract Documents, free of imperfect materials and defective workmanship. For a period of one year after acceptance by the Owner, the Contractor shall repair or replace, at no additional expense to the Owner, any imperfect materials or defective workmanship.

1.9 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. At the completion of the project, submit 3 sets of complete operating and maintenance instructions.
- B. Organize material in the following format:
 - 1. Section I:
 - a. Name of Project
 - b. Address
 - c. Owner's Name
 - d. Electrical Contractor's Name and Address

- e. Warranty Dates
- 2. Section II:
 - a. Description of System
- 3. Section III:
 - a. Major Equipment List (name, manufacturer)
 - b. Routine Maintenance Instructions in Step-by-Step form
- 4. Section IV:
 - a. Operating and Maintenance Instructions by Manufacturer
 - b. Shop Drawings
 - c. Wiring Diagrams
 - d. Warranty Information
 - e. All Contractor Test Reports
 - f. Initial Settings on all Equipment and Devices

PART 2 PRODUCTS

2.1 GENERAL

- A. Except where reuse of existing items are specifically indicated or permitted, all materials and equipment shall be new and shall conform to the standards of the National Electrical Manufacturer's Association and Underwriter's Laboratories, Inc. in every instance where such a standard has been established for the item involved.
- B. Catalog numbers and trade names in these specifications and drawings are intended only to set forth and convey to bidders the general style, type, character and quality of product desired. Similar products of other manufacturers; of equal quality, size, capacity, character, and appearance may be substituted on the written approval of the Architect/Engineer. Requests for approval of substitutions shall be made after the award of the contract in accordance with the bidding requirements of these specifications.
- C. It is the intent of the drawings and specifications that the installation be complete, of finished appearance, and ready for operation. Manufacturers' catalog numbers as used herein and on the drawings are indicative of the type of product to be installed, and do not necessarily identify all parts and accessories required for the proper assembly, installation, and utilization of the product. All required parts and accessories shall be provided.
- D. Materials shall be inspected by the Contractor upon their arrival at the site to be sure they are correct. Material and equipment stored on the site shall be protected against physical damage, dirt and damage caused by precipitation, wind, condensation, excessive humidity, and extremes of temperature. Materials shall be stored in their original cartons within substantial, clean and dry storage facilities provided under this Contract. Conduit, large galvanized boxes, and lighting poles may be stored outdoors on suitable blocks or racks clear of the earth and undergrowth, and pitched to drain. Large electrical equipment intended for ultimate installation outdoors may be stored in the weather on suitable blocks or platforms clear of the earth and undergrowth, and with interior lamps or space heaters continuously energized to prevent condensation. Alternate storage provisions may be submitted to the Architect/Engineer for approval prior to the arrival of the material. Under no circumstances shall equipment be stored in the weather under a cover of polyethylene or tarpaulin. The Architect/Engineer will be the sole judge as to the acceptability of storage facilities, and when directed by the Architect/Engineer, improperly stored or damaged material shall be removed from the site and replaced with new material.

2.2 SUBMITTALS

- A. Within 30 days after the date of award of contract, submit a complete list, in quadruplicate, of materials proposed for installation including requests for approval of substitutions and names of specialty sub-contractors to the Architect/Engineer for approval. Upon approval of the list, the Architect/Engineer will indicate those items for which submittal of shop drawings, cuts, descriptive literature and/or samples are required; and these items will not be considered to be approved until such supplementary data is approved. Any items which fail to comply with specification requirements will be rejected. Intent to use exact material specified does not relieve the Contractor of responsibility for submitting a list. Mention of several manufacturers for any item will not be acceptable.
- B. Prior to delivery of any material to the job site, and sufficiently in advance of requirements to allow the Architect ample time for checking, submit for approval detailed, dimensioned drawings or cuts, showing construction, size, arrangement, operating clearances, performance, characteristics and capacity. Each item of equipment proposed shall be standard catalog product of an established manufacturer and of equal quality, finish, performance, and durability to that specified.
- C. Submittal of shop drawings, cuts, and descriptive literature shall be made in sufficient quantity to permit the retention by the Architect/Engineer of two copies. Submittal data will not be checked prior to the Approval of the Contractor's material list. In addition to the submittal data requested by the Architect/Engineer, the Contractor may, at his option, submit additional shop drawings and/or descriptive data for approval, provided the manufacturer of the additional items has previously been listed on the Contractor's approved Material List.
- D. Submittal data shall be thoroughly reviewed and approved by the Contractor prior to being forwarded to the Architect/Engineer. Submittal data received from the Contractor will be considered to have been reviewed and approved by the Contractor as suitable for the application and for installation in the space allotted.
- E. The submittal of shop drawings shall be with the Contractor stamp affixed. This stamp indicates that the Contractor, by approving and submitting shop drawings, represents that he has determined and verified all field measurements and quantities, field construction criteria, material, catalog material, and similar data that he has reviewed and coordinated information in the shop drawings with the requirements of the work and the Contract Documents. It, also, indicates that any deviation from the Contract Documents has been shown on the submittal and clearly defines the deviations from the specifications.
- F. Approval rendered on shop drawings shall not be considered as a guarantee of quantities, measurements, or building conditions. Where drawings are approved, said approval does not mean that drawings have been checked in detail. Said approval does not in any way relieve the Contractor from his responsibilities or necessity of furnishing material or performing work as required by the contract drawings and specifications.
- G. Failure of the Contractor to submit shop drawings in ample time for checking shall not entitle him to an extension of Contract time, and no claim for extension by reason of default will be allowed.
- H. All shop drawings and submittals are to be in the office of the Architect within 30 days after the Contracts have been awarded. Contractor shall be financially responsible for any price increase of shop drawing items from the time these drawings are issued until they are returned to the Contractor for purchase of items.
- I. Contractor shall keep on the job at all times copies of all approved shop drawings.

2.3 EQUIPMENT DEVIATIONS

- A. Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical, or architectural layout, all such redesign, and all new drawings and detailing required therefore, shall be prepared by the Subcontractor at his own expense and submitted for approval by the Architect.
- B. Where such approved deviation requires a different quantity and arrangement of wiring, conduit, and equipment from that specified or indicated on the drawings, the Contractor shall furnish and install any such structural supports, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the Owner.

PART 3 EXECUTION

3.1 GENERAL

- A. The Contractor shall coordinate the work and equipment of this Division with the work and equipment specified elsewhere in order to assure a complete and satisfactory installation. Work such as excavation, backfill, concrete, flashing, wiring, etc., which is required by the work of this section shall be performed in accordance with the requirements of the applicable section of the specifications.
- B. It is the intention of these specifications and drawings to call for finished work, tested and ready for operation. Whenever the work "provide" is used, it shall mean "furnish and install complete and ready for use".

3.2 DUTIES OF CONTRACTOR

- A. Contractor shall furnish and install all materials called for in these Specifications and accompanying drawings, and must furnish the apparatus complete in every respect. Anything called for in the specifications and not shown on the drawings or shown on the drawings and not called for in the specifications must be furnished by the Contractor.
- B. Contractor is responsible for familiarizing himself with the details of the construction of the building. Work under these specifications installed improperly or which requires changing due to improper reading or interpretation of building plans shall be corrected and changed as directed by the Architect without additional cost to the Owner.
- C. The Contractor shall follow drawings in laying out work and check drawings or other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, Architect/Engineer shall be notified before proceeding with installation.
- D. While every effort has been made to accommodate the equipment necessary for the work of this contract, it is the responsibility of the Contractor to ensure that equipment supplied as a part of this contract will fit in the spaces provided for by the drawings. Any concern by the contractor regarding the adequacy of a space for the equipment supplied, shall be brought to the attention of the Architect/Engineer in a written form prior to the approval of the related equipment submittals and prior to any rough-in associated with this equipment.
- E. The plans are diagrammatic and are not intended to show each and every fitting or a complete detail of all the work to be done; but are for the purpose of illustrating the type of system, etc., and special

conditions considered necessary for the experienced mechanic to take off his materials and lay out his work. This Contractor shall be responsible for taking such measurements as may be necessary at the job and adapting his work to local conditions.

- F. Conditions sometimes occur which require certain changes in drawings and specifications. In the event that such changes in drawing and specifications are necessary, the same are to be made by the Contractor without expense to the Owner, providing such changes do not require furnishing more materials, or performing more labor than the true intent of the drawings and specifications demands. It is understood that while the drawings are to be followed as closely as circumstances will permit, the Contractor is held responsible for the installation of the system according to the true intent and meaning of the drawings. Anything not entirely clear in the drawings and specification will be fully explained if application is made to the Architect. Should, however, conditions arise where in the judgement of the Contractor certain changes will be advisable, the Contractor will communicate with the Architect and secure his approval of these changes before going ahead with the work.
- G. The right to make any responsible change in location of apparatus, equipment, routing of conduit up to the time of roughing in, is reserved by the Architect without involving any additional expense to the Owner.
- H. It shall be the duty of prospective Contractors to visit the job site and familiarize themselves with job conditions. No extras will be allowed because of additional work necessitated by, or changes in plans required because of evident job conditions, that re not indicated on the drawings.
- I. Contractor shall leave the premises in a clean and orderly manner upon completion of the work, and shall remove from the premises all debris that has accumulated during the progress of the work.

3.3 COORDINATION

- A. This Contractor shall coordinate the work of all subs and shall furnish any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- B. Where the work will be installed in close proximity to, or may interfere with the work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than $3/8" = 1'-0"$, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordination, or so as to cause any interference with work of any subs, he shall make the necessary changes in his work to correct the condition without extra charge.
- C. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

3.4 EXCAVATION

- A. Required excavation for installation of all electrical work shall be provided by the Electrical Contractor. Particular care shall be taken not to disturb or damage work of other trades.
- C. In backfilling pipe trenches, approved fill shall first be compacted firmly and evenly on both sides of pipe in 6" layers to a depth of 12" over the top of the pipe. Remainder of trench shall be backfilled to established grade in 6" layers. The Contractor shall compact between each layer with a high-frequency vibrator tamper such as Dart Soil Compactor (as manufactured by Dart

Manufacturing Company, Denver, Colorado). Fill shall be compacted to density specified in Earthwork Section for the area through which trench is cut. Where compaction requirements are not established for an area, the Contractor shall compact fill to 95% maximum density at optimum moisture content.

- D. Excess earth shall be deposited on the site as directed by the Architect/Engineer.
- E. Where ditches occur outside of building, the surface shall be finished to match existing surfaces. Any existing work, or work of other trades, which is damaged or disturbed shall be repaired or replaced, and left in good order.

3.5 SLEEVES, CUTTING, AND PATCHING

- A. Contractor shall place his own sleeves and advise other trades of required chases and openings so they can be properly built in. Sleeves provided under this division shall be formed out of no less than schedule 40 galvanized rigid steel conduits. Where any raceway supports installed under this Contract pierce the roof, suitable pitch pockets shall be provided and coordinated with the roofing contractor as necessary to be acceptable to the Architect/Engineer. Provide suitable fittings where any raceways or equipment cross expansion joints.
- B. Permitted cutting or patching necessary shall be done by Contractor. Structural members shall not be cut except by written permission of Architect/Engineer.

3.6 PROTECTION AND CLEAN-UP

- A. Protect all material and work from damage during construction. Equipment installed in the building prior to its being closed in and dried out shall be protected from the elements in the same manner as previously specified for stored materials. Protect finished surfaces from splattering of mortar, paint, dirt, plaster, etc. Do not install device plates, face plates, canopies, flush cabinet trims, or fixtures on walls or ceilings until after painting or cleaning of the surface has been completed, and arrange for such items that are required to be field painted to be painted before being mounted. Repair, clean and touch-up or replace all damaged material. At the completion of the project, remove all dust from finished surfaces, including lighting fixtures, lenses and lamps.
- B. The Contractor shall keep premises free of debris resulting from his work.

3.7 PAINTING AND FINISHING

- A. Suitable finishes shall be provided on all items of electrical equipment and materials which are exposed. This shall consist of either an acceptable finish as manufactured and supplied to the job or application of suitable finishes after installation.
- B. Where installed in finished areas, exposed equipment and materials shall be supplied with prime coat, and shall be professionally painted or enameled as directed to match or blend with adjacent surfaces.
- C. In unfinished areas such as equipment rooms, exposed equipment shall be furnished with suitable factory applied finishes (e.g. standard gray enamel finish for panelboards, etc.).
- D. Equipment furnished in finishes such as stainless steel and brushed aluminum shall not be painted.
- E. All finishing shall be as directed by, and shall be satisfactory to, the Architect/Engineer.

G. Paint material shall be selected from the products listed below and, insofar as practical, products of only one manufacturer shall be used. Contractor shall submit to the Architect/Engineer the listed manufacturer he proposes to use in the work. Should the Contractor desire to use products of a manufacturer not listed below, or products made by a listed manufacturer but not scheduled herein, Contractor shall submit complete technical information on the proposed products to the Architect/Engineer for approval. Only products approved by the Architect/Engineer shall be used.

1. Rust Inhibitive Primer:
 - a. Devoe: Bar-Ox Quick Dry Metal Primer, Red.
 - b. Duron: Deluxe Red Primer.
 - c. Glidden: Rustmaster Tank and Structure Primer.
 - d. Pittsburgh: Inhibitive Red Primer.
2. Galvanized Metal Primer:
 - a. Devoe: Mirrolac Galvanized Metal Primer.
 - b. Duron: Duron Deluxe Galvanized Metal Primer.
 - c. Glidden: Rustmaster Galvanized Iron Metal Primer.
 - d. Pittsburgh: Speedhigh Galvanized Steel Primer.

3.8 OBSERVATION

- A. The project will be observed periodically as construction progresses. The Contractor will be responsible for notifying the Architect/Engineer at least 72 hours in advance when any work to be covered up is ready for inspection. No work shall be covered up until after observation has been completed.

END OF SECTION

SECTION 26 03 00

EQUIPMENT CONNECTIONS AND COORDINATION

PART 1 GENERAL

1.1 SCOPE

- A. The connection of all equipment provided under any Division of these specifications or by the owner requiring electrical connection shall be provided as part of this Division, unless otherwise indicated or specified. Special outlets, where indicated, are considered to be electrical connection to the equipment.
- B. Drawings indicate approximate equipment capacity (including motor horsepower) and approximate location of connection. It is the responsibility of this Contractor to determine the exact characteristics of equipment actually being supplied; and to provide proper branch circuit connections, conductor protection, and grounding.

PART 2 EXECUTION

2.1 GENERAL

- A. Heating, Ventilating, Air Conditioning and Plumbing Equipment: Unless otherwise indicated, provide all power wiring, including feeders and branch circuits, to the terminals of the equipment, including mounting of motor starters; feeder and branch circuit over-current protection; disconnecting means within sight of each motor and each starter, whether or not specifically indicated on drawings.
- B. Unless otherwise indicated, individually mounted motor starters will be furnished as part of the Division furnishing the driven equipment. Unless otherwise indicated, remote control wiring for Heating, Ventilating, Air Conditioning and Plumbing equipment will be provided as part of those respective Divisions.

END OF SECTION

SECTION 26 10 00

BASIC MATERIALS AND METHODS

PART 1 GENERAL

1.1 WIRING METHODS

- A. Unless otherwise indicated or specified, the Wiring Method for this project shall consist of copper conductors with 600 volt insulation installed in metal raceways.
- B. The word "Raceway" and the word "Conduit" (or abbreviation "C") used herein or on the drawings indicate Rigid Metal Conduit, and where permitted, Intermediate Metal Conduit, Electrical Metallic Tubing, Rigid Nonmetallic Conduit, Flexible Metal Conduit, or Liquidtight Flexible Metal Conduit.
- C. Reference to "Rigid Conduit" or "RMC" indicates heavy-wall Rigid Metal Conduit only.
- D. Reference to "IMC" indicates Intermediate Metal Conduit.
- E. Reference to "PVC" indicates Rigid Nonmetallic Conduit.
- F. Reference to "EMT" or "Tubing" indicates Electrical Metallic Tubing.
- G. Reference to "Flex" or "Flexible Conduit" indicates Flexible Metal Conduit, or, where required, Liquidtight Flexible Metal Conduit.
- H. Other wiring methods, such as Metal-Clad Cable shall be provided to the extent indicated on the drawings and/or hereinafter specified.

1.2 FASTENING METHODS

- A. Acceptable fastening methods include wood screws and nails on wood construction, toggle bolts on hollow masonry, expansion bolts and lead anchors on brick and concrete, and machine screws on metal surfaces.
- B. Explosive fasteners may be used in steel and concrete in accordance with the manufacturer's recommendations.
- C. Wire, perforated metal strap, and wooden plugs are not acceptable as fastening material.
- D. Materials used shall be good quality, made of zinc or cadmium coated steel or other non-corroding material.
- E. Materials, whether exposed or concealed, shall be firmly and adequately held in place. Fastening and support shall afford safety factor of three or higher, and shall be in full compliance with the seismic protection requirements of the North Carolina State Building Code.
- F. Fixtures, raceways, and equipment shall be supported from the structure. Nothing may be supported on suspended ceiling unless definitely noted so on the Drawings or specifically permitted by the Architect/Engineer.

- G. Equipment and raceways attached to outside walls, or interior walls subject to permanent moisture, shall be shimmed out with non-corrodible material so as to provide 1/4" air space between wall and equipment or raceway.

1.3 EQUIPMENT IDENTIFICATION

- A. Suitable nameplates shall be provided for the identification of electrical equipment including Panelboards, Motor Starters, Safety Switches, and Circuit Breakers.
- B. Nameplates for equipment shall be black color and shall be of engraved white core plastic laminate, not less than 1/16" thick. Nameplate identification shall include equipment name, source of power supply and voltage.
- C. Engraving shall be of professional quality, with block style letters, minimum 1/4" high.
- D. Nameplates shall be attached with sheet metal screws. They shall be sized to allow for installation of screws without obscuring text.
- E. Nameplates for special system equipment shall be color-coded as follows:
 - 1. Bright red surface with white core for all equipment related to fire alarm system.
- F. All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate. Identification shall be by tags with string or wire attached to conduit or outlet.
- G. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match the surface color scheme outlined above. This includes covers on boxes above lift-out and other type accessible ceilings.

1.4 SLEEVES AND PENETRATIONS

- A. The Electrical Contractor shall provide sleeves and openings for his penetrations through exterior walls, interior walls and partitions, floors, and roofs. Provisions for all such penetrations shall be as approved by the Architect/Engineer.
- B. For any raceway passing through an exterior wall, above or below grade, provide appropriate sleeve and water proofing. Center the conduit in the sleeve and fill the space between conduit and sleeve with appropriate compound such as lead and oakum, and then apply caulking compound - Thiocaulk or approved equal - flush with the wall surfaces.
- C. For raceways penetrating floor slabs, smoke partitions, and fire-rated walls, provide steel pipe sleeves and seal with high-temperature non-shrink grout or other material as approved by the Architect/Engineer. Materials and installation methods shall be UL listed as a Through-Penetration Firestop System suitable for use with the UL Fire Resistance Design encountered. Refer to the UL fire protection details shown on the drawings.
- D. Conduits penetrating roof surfaces for purpose of connecting to roof-top mechanical equipment shall utilize openings and curbs provided for the equipment where possible.
- E. For other raceway penetrations through the roof the Contractor shall provide appropriate prefabricated roof curb assemblies - "Pipe Portal System" as manufactured by Roof Products and

System Corp., Addison, Illinois or equal method as approved by Architect/Engineer and Roofing Subcontractor.

1.5 SUBMITTALS

- A. Submit for approval manufacturer's data sheets for all basic materials.

END OF SECTION

SECTION 26 11 00

RACEWAYS AND FITTINGS

PART 1 GENERAL

1.1 SCOPE

- A. Provide complete raceway systems as indicated on the drawings, as herein specified, and as required by applicable codes. Comply with Section 26 10 00 Basic Materials and Methods.
- B. All wiring shall be installed in raceways unless specifically noted otherwise.

1.2 SUBMITTALS

- A. Submit for approval manufacturer's data sheets for all raceway system components.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Metal raceway and components shall be as manufactured by Allied, Triangle, Wheatland, Thomas & Betts, or other approved manufacturers.
- B. Non-metallic raceway system components shall be as manufactured by Carlon, Queen City Plastics, Ipex, or other approved manufacturers.

2.2 MATERIALS AND APPLICATIONS

- A. Rigid Metal Conduit shall be zinc coated Schedule 40 steel or alloy 6063-T42 aluminum with threaded couplings and fittings. Termination at sheet metal enclosures shall consist of double locknuts and insulating bushings. Rigid Steel conduit shall be used for all exposed and concealed work except where other raceways are indicated or permitted. Aluminum conduit complete with aluminum fittings may be used in lieu of steel conduit except in wet locations, underground, or in poured concrete. Steel and aluminum shall not be mixed in the same run of conduit.
- B. Intermediate Metal Conduit (IMC) with threaded couplings and fittings may be used for exposed and concealed work in lieu of rigid metal conduit except underground outside the building foundation, or where supporting lighting fixtures, or in hazardous locations, or where exposed to severe impact or injury. Termination at sheet metal enclosures shall consist of double locknuts and insulated bushings.
- C. Electrical Metallic Tubing (EMT) of 2" maximum size may be used for concealed work in lieu of Rigid Metal Conduit except underground or in poured concrete. EMT of 2" maximum size may be used for exposed work in lieu of Rigid Metal Conduit except outdoors, or above a roof, or where supporting lighting fixtures, or where exposed to severe impact or injury, or in hazardous locations, or less than 10 feet above a floor or platform in other than in electrical, mechanical, or communications closets or equipment rooms.
- D. Rigid PVC Conduit shall be Schedule 40, UL listed for use with 90°C conductors above or below ground. Conduit run underground or run in or under a poured concrete slab shall be rigid PVC. Vertical elbows and vertical extensions from underground or concrete embedded PVC conduits smaller than 3" trade size may also be of PVC provided that they remain concealed or

otherwise protected, but shall be of Rigid Steel Conduit (or IMC where permitted) where they stub up into exposed locations or trade size is 3" or larger. An insulating bushing or end bell shall be provided at each termination. Conduit run underground and not under a poured concrete slab shall have installed continuously above it a warning tape. Tape shall be 12 inches wide, centered on conduit and located 12 inches below finished grade.

- E. Flexible Metal Conduit shall be of zinc coated steel of minimum length, and shall be used in lieu of Rigid Metal Conduit for connections to moving or vibrating apparatus, recessed lighting fixtures, dry-type transformers, and motors. Flexible Metal Conduit may be used where rigid connections are impractical due to obstructions or space limitations. Flexible Metal Conduit used in wet, damp, or corrosive location shall be PVC jacketed liquid-tight complete with liquid-tight connectors.
- F. Fittings for steel conduit and tubing shall be of zinc coated steel or malleable iron. Insulating bushings of plastic provided for Rigid and Intermediate Metal Conduits shall be rated for 150°C. Bonding bushings shall be steel or malleable iron with non-removable plastic throats rated 150°C. EMT fittings shall be of the compression type. Set-screw, indenter, pressure cast, and die cast fittings are not acceptable. Connectors for EMT, Flexible Metal Conduit and Liquid-tight Flexible Metal Conduit shall be the insulated throat type. Connectors for Flexible Metal Conduits shall be of the "Tite-Bite" design.
- G. Conduit expansion fittings shall be of zinc coated cast or malleable iron and steel conduit, complete with flexible bonding straps. Expansion fittings shall allow longitudinal conduit movement of 4 inches.
- H. Minimum raceway size shall be 1/2", except Flexible Metal Conduit connections to individual lighting fixtures may be 3/8". Other raceway sizes, unless indicated on the drawings, shall be determined by the Contractor in accordance with NEC requirements for type THW insulated conductors, or the actual insulation used if it is thicker than type THW.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Rigid and Intermediate Metal Conduits shall be made up with full threads, to which a conductive pipe compound (T & B Kopr-Shield or equal) has been applied, and butted in coupling. Terminations at sheet metal enclosures in indoor dry locations shall be made with double locknuts and an insulating bushing. Terminations at sheet metal enclosures in outdoor, damp, and wet locations shall be made with threaded conduit hubs of zinc coated malleable iron.
- B. Except where run under a concrete slab on grade, underground conduits shall be installed a minimum of 24" below grade. Trenching and backfilling shall comply with Section 26 01 00 Electrical General Requirements.
- C. All underground conduits shall have metalized warning tape installed above the conduit that identifies the specific system buried below. The warning tape shall consist of a minimum 3.5 mil solid foil core encased in a protective plastic jacket (total thickness 5.5 mils). Tape shall be 6 inches wide with black lettering imprinted on a color coded background that conforms to APWA color code specifications. Tape shall be installed 18 inches above the conduit and in no case less than 6 inches below grade.
- D. Installation of PVC conduit shall be in accordance with the manufacturer's recommendations using solvent welded couplings and fittings. Field bends shall be made with approved heating equipment.

Open flames are not permitted. An insulating bushing or end-bell shall be provided at each termination.

- E. Conduits shall be rigidly supported not more than 8 feet on center and shall be concealed within walls, ceilings, and floors, except as indicated or specifically approved by the Architect/Engineer; kept at least 6" from flues and steam or hot water pipes; and protected against the entry of dirt, plaster, or trash. Raceways shall be supported independently of suspended ceiling members and suspension wires. PVC conduits that turn up inside walls shall transition to EMT no greater than 60 inches above slab or at the first box encountered, whichever comes first.
- F. Suspended EMT shall be provided with additional hangers at elbows and bends, and where necessary to avoid strain at couplings and connectors.
- G. Exposed conduits, where permitted, shall be run parallel or perpendicular to walls, structural members and ceilings; with right-angle turns consisting of symmetrical bends or cast metal fittings with threaded hubs. Offsets may be used where necessary provided that they are of minimum length.
- H. Conduits crossing expansion and contraction joints shall cross perpendicular to the joint and shall be provided with expansion fittings. Conduits shall not be embedded in the concrete slabs at the expansion and contraction joints.
- I. Conduit may not be installed laterally in any concrete slab where the outside diameter of the conduit, measured at a coupling, exceeds one-third the thickness of the concrete. Conduits shall occupy the middle third of the slab when practical and leave at least 3/4 inch concrete cover. Where reinforcing bars occur at the 3/4 inch level the conduit shall be run inside them toward the center of the slab. Conduits may cross each other within the slab provided the 3/4 inch concrete cover is maintained. Conduits shall be tied to the reinforcing rods or otherwise supported when necessary to prevent sagging when concrete is poured. They shall be laterally spaced not closer than three diameters on centers to allow complete coverage.
- J. Immediately after installation, conduit openings shall be covered to prevent entrance of foreign matters. Covers shall remain in place throughout the rough-in stage.

END OF SECTION

SECTION 26 12 00

CONDUCTORS

PART 1 GENERAL

1.1 SCOPE

- A. Furnish and install a complete system of wire and cable in compliance with Section 26 10 00 Basic Materials and Methods.

1.2 SUBMITTALS

- A. Submit for approval manufacturer's data sheets for all conductor types.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Insulated conductors shall be as manufactured by Encore, Southwire, or approved equal.
- B. Unless otherwise indicated, all wire and cable conductors shall be copper.
- C. Conductors shall be not smaller than #12 AWG except that #10 AWG minimum is required for the entire length of 120 volt branch circuits whose distance to the center of the load exceeds 75 feet. #14 AWG may be used for signal and remote control circuits. #16 AWG may be used for taps to individual recessed lighting fixtures on circuits protected by over-current devices rated at 20 amperes or less and contained within flexible metal conduits that do not exceed 6 feet in length. Other conductors smaller than #14 AWG may be used only where specifically indicated on the drawings or specified herein.
- D. Conductors #10 AWG and smaller shall be solid, dual rated type THWN/THHN.
- E. Conductors #8 AWG and larger shall be stranded, dual rated type THWN/THHN.
- F. Each conductor shall bear easily readable markings along entire length, indicating size and insulation type.
- G. Insulation on conductors #10 AWG and smaller shall be suitably colored in manufacture.
- H. Conductors in any location subject to abnormal temperature shall be furnished with an insulation type suitable for temperature encountered.
- I. Where no indication is made of wire size, the conductor shall be of N.E.C. size to match its overcurrent protective device, but in no case smaller than #12 AWG.

PART 3 EXECUTION

3.1 SPLICES, TAPS, AND CONNECTIONS

- A. Splices in conductors #10 AWG and smaller shall be made with twist-on spring steel devices UL listed as Pressure Cable Connectors, with integral insulating covers rated 75°C at 600 volts, except

that those used for connections to lighting fixtures and other heat-producing equipment shall comply with temperature ratings marked on the equipment but not less than 90°C.

- B. Splices in copper conductors #8 AWG and larger shall be made with mechanical devices UL listed as Pressure Cable Connectors and insulated with thermoplastic tape UL listed for use as sole insulation. Tape may be omitted from connectors supplied with securely fastened insulating covers which completely enclose the connector and the conductors. Insulating covers shall be rated 75°C at 600 volts.
- C. Connect solid wires to equipment, switches, and devices equipped with binding screw terminals by looping the wire under the screw head in such a manner that the loop is tightened as the screw is tightened. Straight-in wiring under screw terminals is not acceptable.
- D. Stranded wires shall not be inserted into back-wiring holes on devices, nor shall they be directly connected to screw head terminals. They shall be fitted with insulated crimp-on type spade terminals for connection under the screw head.

3.2 COLOR CODING

- A. All wiring shall be color coded.
- B. On 120/208V, 3 phase, 4 wire power systems, conductor insulation shall be color coded Black (Phase A), Red (Phase B), Blue (Phase C), and White (Neutral).
- C. Insulation for grounding conductors on all systems shall be Green.
- D. Conductors #8 AWG and larger may be identified with two or more bands of proper color plastic tape applied near each splice and termination. Painting of wire will not be acceptable.
- E. Phase sequence shall be "A", "B" and "C" from left to right, top to bottom or front to back when facing equipment.
- F. Control and signal wiring shall not use the above-named colors except green for grounding. Any other colors or striping may be used but the coding shall provide same color or striping between any two terminals being joined.
- G. Switch legs, including "Travelers" shall be the same color as phase circuit conductors.

3.3 BRANCH CIRCUIT RACEWAY WIRING

- A. Run a separate neutral for each 120 Volt circuit.
- B. A neutral shall not serve more than one circuit. The neutral carrying all or any part of the current of any specific load shall be contained in the same raceway or enclosure with the phase wire or wires also carrying that current.
- C. Circuits shall be connected to panels as shown in the panel schedules.
- D. Conductors supplying lighting outlets may be combined in the same raceways with conductors supplying receptacles; but lighting outlets and receptacle outlets shall not be connected to the same circuits unless specifically indicated on the drawings.

3.4 SERVICE & FEEDER CONDUCTORS

- A. Unless specifically shown otherwise, each feeder and each set of service conductors shall be installed in a separate raceway.
- B. Where paralleling of conductors is shown for feeders or service entrance, it is absolutely required they be exactly the same length between terminations.
- C. Where service or feeder conductors are so installed that the conductor markings cannot be read without moving or twisting conductors, they shall be provided with suitable tags indicating the conductor size and insulation.

END OF SECTION

SECTION 26 12 20

METAL-CLAD CABLE SYSTEMS

PART 1 GENERAL

1.1 SCOPE

- A. Furnish and install a complete system of Metal-Clad Cable for branch circuit, signal, and remote control wiring as specified herein. Comply with Section 26 10 00 Basic Materials and Methods.
- B. Other branch circuit cable systems such as Types AC, NM, and NMC are not permitted.

1.2 APPLICATIONS

- A. Metal-Clad Cables may be used in lieu of wire in metal raceway only for concealed work in dry locations above suspended ceilings and within stud partitions.
- B. Cables may not be run in, or through, concrete or masonry, fire-rated partitions, smoke partitions, or floors.

1.3 SUBMITTALS

- A. Submit for approval manufacturer's data sheets for metal-clad cable systems.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Metal-Clad Cables shall be UL listed as type MC with copper conductors, THHN insulation and full size green insulated grounding conductors. Minimum sizes shall be #12 AWG for branch circuits, #14 AWG for signal and remote control. Maximum size shall be #10 AWG.
- B. Cable connectors shall be UL listed for grounding the metal sheath. Connectors shall be of steel or malleable iron with insulated throats.
- C. Cables shall be color-coded in manufacture. Color-code shall comply with Section 26 12 00 Conductors.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Cables shall not be run exposed. Conduit skirts may be provided on surface mounted panelboards to conceal cables between panel tops and ceilings.
- B. Except where installed in continuous rows, lighting fixtures shall be individually connected to a concealed outlet box. Cables may not be looped from fixture to fixture.
- C. Cables above ceilings shall be supported from overhead structure clear of ductwork, suspended ceilings, and ceiling hanger wires.

END OF SECTION

SECTION 26 13 00

GROUNDING AND BONDING

PART 1 GENERAL

1.1 SCOPE

- A. The electric system neutral and all non-current-carrying metal parts, raceways, and enclosures shall be permanently and effectively grounded.
- B. Grounding and bonding shall be provided in strict accordance with the National Electrical Code, and as specified herein and on the drawings.
- C. The Contractor shall note that required grounding conductors and connections are not all shown on the drawings. NEC requirements apply.

1.2 SUBMITTALS

- A. Submit for approval manufacturer's data sheets for grounding and bonding materials.

PART 2 PRODUCTS

2.1 MATERIALS AND APPLICATIONS

- A. Grounding conductors shall be of THWN insulated copper, unless otherwise indicated.
- B. Grounding bus bars in distribution equipment shall be bare copper.
- C. Aluminum and aluminum alloys are not acceptable as grounding materials.
- D. Clamps for attaching conductors to water pipes and ground rods shall be of bronze. Ground rod clamps shall be U.L. listed for direct burial.
- E. Clamps for attaching conductors to building steel shall be of steel, bronze, or malleable iron.
- F. Threaded hubs for bonding metal raceways to the contained grounding electrode conductors and to the water pipe clamps shall be of bronze or malleable iron. Similar hubs shall be used to bond the same raceways to the conductors and to sheet metal equipment enclosures.
- G. Driven grounding electrodes shall consist of copper clad steel rods. Rods shall be 10 feet long and 3/4" diameter unless otherwise indicated.
- H. Bonding bushings shall be of steel or malleable iron with non-removable plastic throats rated 150°C.
- I. Bonding locknuts and wedges for service conduits shall be of zinc coated steel.

PART 3 EXECUTION

3.1 ELECTRICAL EQUIPMENT GROUNDING

- A. All non-current-carrying metal parts, raceways, and enclosures of the electrical system and of equipment supplied through the electrical system shall be permanently and effectively grounded.
- B. Equipment grounding conductors shall be provided for each feeder and for each branch circuit and shall be contained within the same raceways as the feeder and branch circuit conductors. The equipment grounding conductor shall be THWN insulated copper, not smaller than #12 AWG.
- C. Copper bonding strips normally included in small sizes of liquid-tight flexible metal conduit and dependent upon the terminal connectors for bonding continuity will not be accepted in lieu of the equipment grounding conductors specified herein.
- D. Grounding terminals on wiring devices, including switches, shall be connected to the equipment grounding conductor included in the branch circuit raceway, and to the device box with suitable jumpers and lugs bolted to the box, not the plaster ring. "G" clips are not acceptable, and "self-grounding" type device mounting screws will not be accepted as the device grounding method.
- E. Where metal raceways enter sheet metal enclosures through knockouts provide bonding bushings and jumpers to the enclosure under any of the following conditions:
 - 1. Branch circuit conduit exceeds 1" in size.
 - 2. Feeder conduit regardless of voltage and size.

3.2 GROUNDING OF OTHER SYSTEMS

- A. All metal piping systems including water piping, gas piping and sprinkler piping shall be permanently and effectively bonded to the electrical equipment ground systems as required by N.E.C. 250.
- B. Structural metal systems shall be permanently and effectively bonded to the electrical grounding electrode system as required by N.E. C. 250.

3.3 GROUNDING ELECTRODE SYSTEM

- A. The grounding electrode system for the service neutral and service equipment shall include connections to the following:
 - 1. The water main at the nearest accessible point to where it enters the building and on the street side of the main valve. This connection shall remain accessible after construction is complete.
 - 2. A ground rod using #4 AWG copper conductor. Ground rods shall be driven to a depth equal to their length plus six inches. Provide additional ground rods not less than 10 feet apart where needed to comply with NEC ground resistance limitations, and resistance limitations specified herein.
 - 3. Structural metal building frame, where applicable.
- B. Grounding electrode conductors shall be without splice and shall be contained within steel raceways and bonded to the raceway at both ends. Raceway may be omitted only where specifically indicated on the drawings.
- C. A mechanical clamp-type ground conductor connection is acceptable only if the connection is readily accessible for inspection and tightening. Any connection point not readily accessible shall be made by the thermal welding process.

- D. The Contractor shall test the ground resistance of the completed grounding electrode system as required by Section 26 01 00, Electrical General Requirements. If test indicates a resistance to ground in excess of 25 ohms it shall be reduced to 25 ohms or less by providing additional ground rods.
- E. Prior to making the final main bond jumper connection from the grounding electrode conductor to the system neutral, the contractor shall demonstrate by megger test adequate isolation from ground of the system neutral. This test will require that the system neutral be suitably isolated from service neutral if it has been grounded in any way.

3.4 SEPARATELY DERIVED SYSTEMS

- A. The secondary of each Generator whose neutral is not solidly connected to the service neutral is considered to be a Separately Derived System.
- B. The Grounding Electrode Conductor for the neutral and equipment of each Separately Derived System shall be connected to the nearest accessible member of the grounded structural metal building frame where applicable; or, in the absence of suitable structural metal, to the nearest accessible cold water pipe. This connection shall remain accessible after construction is complete.
- C. Grounding Electrode Conductors for Separately Derived Systems shall be without splice and shall be contained within steel raceways and bonded to the raceway at both ends. Raceway may be omitted only where specifically indicated on the drawings.
- D. Bond the following together within the main circuit breaker enclosure of each Generator, unless otherwise indicated:
 - 1. Grounding Electrode Conductor described above.
 - 2. Generator neutral.
 - 3. Circuit breaker enclosure.
 - 4. Equipment Grounding Conductor included in raceway with Generator output conductors on line side of circuit breaker.
 - 5. Equipment Grounding Conductor included in raceway with feeder conductors on load side of circuit breaker.
- E. For each outdoor generator, provide a ground rod system with a No. 4 AWG copper ground conductor connected to the generator frame, generator enclosure and output circuit breaker enclosure.

END OF SECTION

SECTION 26 14 00

BOXES

PART 1 GENERAL

1.1 SCOPE

- A. Furnish and install outlet boxes, switch boxes, pull boxes, terminal boxes and junction boxes complete as shown and specified.

1.2 SUBMITTALS

- A. Submit for approval manufacturer's data sheets for all box types.

PART 2 PRODUCTS

2.1 MATERIALS AND APPLICATIONS

- A. Unless specifically noted or approved otherwise, boxes shall be of zinc coated steel or cast ferrous alloy as manufactured by Steel City, Raco, Crouse-Hinds, Appleton, or approved equal.
- B. For exposed work on the exterior of the building, and in damp or wet interior locations, boxes shall be of cast metal with threaded conduit hubs and gasketed covers; or of zinc coated sheet steel of NEC gauge and size with screw fastened gasketed covers and threaded conduits hubs of zinc coated malleable iron and no knockouts or extraneous openings. Cover screws shall be stainless steel.
- C. For exposed work in interior dry locations less than 8 feet above a floor or platform in other than Electrical, Mechanical or Communications Closets or Equipment Rooms, boxes shall be of cast metal with threaded conduit hubs and matching covers; or of zinc coated sheet steel of NEC gauge and size with screw fastened covers and no knockouts or extraneous openings. Cover screws shall be steel.
- D. For exposed work in interior dry locations in Electrical, Mechanical, or Communications Closets or Equipment Rooms; or, in other dry areas, 8 feet or more above a floor or platform, boxes 5" square and larger shall be NEC gauge and size of zinc coated sheet steel. 4" octagonal, 4" square and 4-11/16" square "knockout" boxes shall be of zinc coated steel, NEC gauge and size. Box extensions are not permitted on exposed "knockout" boxes, and covers shall be of the raised surface type. "Handy" boxes are not permitted.
- E. For concealed work, fixture outlet boxes shall be 4" octagonal minimum, provided with plaster rings in plastered surfaces. Concrete ring boxes shall be used in poured concrete. Switch and outlet boxes in plastered and dry walls shall be 4" square minimum or one-piece multi-gang with appropriate plaster rings. Switch and outlet boxes in exposed brick, block or tile walls shall be single or multi-gang one-piece boxes not less than 3-1/2" deep with square corners and with internal device mounting holes, equal to Steel City Type GW. Boxes in walls finished with ceramic tile or wood paneling shall be 4" square minimum or one-piece multi-gang boxes, fitted with appropriate tile rings having square corners and internal device mounting holes. Gangable boxes are not permitted.
- F. Floor boxes on ground slab shall be high-strength rigid PVC, approved for use on grade. The overall outside box dimensions shall be 8.76" L x 5.58" W x 6.00" H with an inside diameter of

5.00". There shall be one wiring compartment with optional divider that allow capacity for up to two duplex receptacles and/or communication services with a total cubic inch capacity of 100 cubic inches. The boxes shall provide the following number of conduit hubs: two 1" for power and two 1-1/2" for communications. The boxes shall be fully adjustable. Provide with four pre-wired 20A, 125V receptacles and four openings for communications jacks. Hubbell System One or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Set recessed boxes with edges flush with finished surfaces.
- B. Immediately after installation cover boxes to prevent entrance of foreign matter.
- C. Scaling of plans for outlet locations is not necessarily accurate enough for the intent of these specifications. It is the Contractor's responsibility to comply with the evident intent for centering or symmetric arrangement in ceiling and wall spaces. Special attention is also directed to the location of any outlets which are built into, or located in relation to, other features such as shelving, work counters, and equipment. The Contractor shall consult plans and shop drawings on such features and locate outlets as thereby indicated.
- D. Mounting heights indicated herein and on the drawings are approximate dimensions of the center of the box to the floor, and may vary slightly in order to clear obstructions and match joints in masonry. References to "Horizontal" and "Vertical" apply to the orientation of the long dimension of a single-gang plate and of the device mounting strap. Alignment tolerance shall be 1/16 inch.
 - 1. Wall receptacle, data, and telephone outlets shall, unless otherwise indicated, be installed vertical, 18" up.
 - 2. Outlets indicated as "counter height," as well as boxes for wall switches, fire alarm manual stations, and wall telephones shall be installed vertical, 46" up, clear of wall cabinets, back-splashes, and wainscot interferences.
 - 3. Fire alarm signal devices shall be installed with the top of the device approximately 6" below the ceiling or with the bottom of the device 80" above the floor, whichever is lower.
- E. Switch boxes beside doors shall be on the strike side, with edge approximately 2" from door jamb or trim.
- F. Junction and pull boxes may be used as necessary to facilitate wiring provided they are hidden from sight (but accessible), or installed in locations where exposed wiring is permitted, or flush mounted at locations approved by the Architect/Engineer.

END OF SECTION

SECTION 26 15 00

WIRING DEVICES

PART 1 GENERAL

1.1 SCOPE

- A. The Contractor shall furnish and completely install lighting switches, convenience outlets, and special purpose receptacles along with appropriate outlet boxes and device plates as indicated on the drawings and as herein specified.
- B. Where connection to an item of equipment is required under this contract, and where such equipment requires a receptacle for connection, the Contractor shall furnish and install the appropriate device, whether or not the device is specifically shown or specified.

1.2 SUBMITTALS

- A. Submit for approval catalog data sheets for all wiring devices.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Wiring devices and device plates shall be manufactured by General Electric, Hubbell, Bryant, Arrow Hart, Pass and Seymour, Leviton, or Eagle.
- B. Catalog numbers of one or more of the manufacturers are used herein and on the drawings to set a standard of quality and capacity. Equivalent products of the other named manufacturers are also acceptable, provided they are submitted and approved in accordance with Section 26 01 00, Electrical General Requirements.
- C. All wiring devices of any one general type (e.g. all duplex receptacles or all light switches) shall be of the same manufacturer, and shall match throughout.

2.2 WIRING DEVICES AND PLATES - GENERAL

- A. Wiring devices shall be industrial specification grade unless otherwise indicated.
- B. Unless otherwise indicated or directed, wiring devices shall be white in color.
- C. Unless otherwise indicated, plates for flush outlets shall be nylon, standard size and white color. Those for surface cast boxes shall be of steel, of shape and finish to match the box. Screws shall be steel to match the plate.
- D. Each wiring device (including each switch) shall be equipped with a Hex-Head green grounding screw for grounding the device and plate to the outlet box and to the equipment grounding conductor run with the circuit conductors. "Self-Grounding" type mounting screws will not be accepted as the device grounding method.

2.3 SWITCHES

- A. Switches used for lighting control shall be listed to Fed. Spec. W-S-896E and rated 20 amps, 120-277 VAC, side wired, Hubbell 1221 series.
- B. Switches used for disconnecting small single-phase motors and appliances shall be listed to Fed. Spec. W-S-896E and rated 20 or 30 amps to match the branch circuit rating and comply with their horsepower ratings, 120-277 VAC, side-wired, Hubbell 1221 and 3031 series.
- C. Weatherproof switches shall be equipped with stainless steel covers UL listed for wet locations with cover closed, Pass and Seymour WP-1.
- D. Switches with collars around the operating toggle will not be accepted.

2.4 RECEPTACLES

- A. Receptacles shall be listed to UL498 and Fed Spec W-C-596. Unless otherwise indicated or required, receptacles shall be the duplex type, side and back wired, with nylon face. On circuits supplying two or more such receptacles, they shall be rated 15 amps, 125 volts, NEMA 5-15R. Duplex receptacles on individual circuits shall be rated 20 amps, 125 volts, NEMA 5-20R.
- B. Where no other features are indicated on the drawings provide Hubbell 5262 and 5362 series for 5-15R and 5-20R respectively.
- C. Where indicated on the drawings provide Ground Fault Circuit Interrupter receptacles, Hubbell GF5262 and GF5362 series for 5-15R and 5-20R respectively. GFCI receptacles shall be Class A, listed to UL standard 943.
- D. Where indicated on the drawings provide weatherproof receptacles consisting of Ground Fault Circuit Interrupter receptacles as specified above with stainless steel covers UL listed for wet locations with cover closed, Pass and Seymour CA2-GH.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Devices shall be mounted tightly to boxes and be adjusted plumb and level. Devices shall be mounted flush with its associated coverplate. Ears on flush devices shall be in uniform contact with wall surfaces, or the devices shall be fitted with Caddy RLC device levelers. Device plates shall not be used for support of flush devices.
- B. Where two or more devices are indicated for gang installation, they shall be trimmed with gang type plates.
- C. Grounding type receptacles shall be grounded with insulated copper grounding conductors routed with the circuit conductors.
- D. The Contractor shall provide suitable testers, and demonstrate, when directed, that receptacles are operational and correctly wired; and that ground fault circuit interrupter type receptacles will trip when current to ground has a value in the range of 4 through 6 milliamperes.

END OF SECTION

SECTION 26 16 00

RACEWAY AND OUTLET SYSETMS

PART 1 GENERAL

1.1 SCOPE

- A. Contractor shall furnish and install systems of raceways, outlet boxes, equipment boards, and cabinets as indicated on the drawings and as herein specified to accommodate the installation by others of wiring and equipment.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Raceways, and boxes, shall be in compliance with the relevant sections of these specifications.
- B. Wall outlets shall consist of standard 4" x 4" x 2-1/2" outlet boxes with single device rings. Trim plates shall be blank to match wiring device trim plates, unless otherwise indicated.
- C. Special outlets including floor outlets shall be as noted on the drawings.
- D. Equipment boards shall be of size noted or shown on the drawings, and shall be constructed of 3/4" plywood, with finish grade on front. Paint board with gray fire-retardant paint.

PART 3 EXECUTION

3.1 COORDINATION

- A. Contractor shall fully coordinate with the telephone and system installer, and shall install service entrance raceways, backboards, and grounding conductors in accordance with their requirements.

3.2 INSTALLATION

- A. Install pull boxes as necessary to limit runs between pull points to two 90 degree bends (or equivalent) and to 100 feet in length, unless other arrangements are approved by the wiring installers.
- B. Leave all raceways with 100 lb. test nylon pull cord.
- C. Install raceways and boxes in accordance with relevant sections of these specifications.
- D. Unless specifically noted otherwise, provide an individual 1" conduit from each indicated outlet to equipment cabinet or terminal board for the system involved.
- E. Provide all conduits not terminating on boxes with plastic bushings.
- F. At the equipment terminal board, terminate all conduits with plastic bushings.

END OF SECTION

SECTION 26 19 00

MISCELLANEOUS MATERIALS

PART 1 GENERAL

1.1 SCOPE

- A. Contractor shall furnish and install miscellaneous materials as indicated on the drawings and as herein specified.

1.2 SUBMITTALS

- A. Submit for approval manufacturer's data sheets on each device specified by this section.

PART 2 PRODUCTS

2.1 CONTROL RELAYS

- A. The relay coil shall operate satisfactorily with coil voltages within 85% to 110% of its voltage rating. Unless otherwise noted, contact rating shall be 10 amps, continuous for the applied voltage level.
- B. Control relays shall be Cutler Hammer D7PR Series, or approved equal.
- C. Time delay relays shall be Cutler Hammer TR Series, or approved equal with on-delay or off-delay as required, and repetitive accuracy of plus or minus 0.2%.
- D. Relays shall be installed in a suitable enclosure to fit the environment of their location.

2.2 CONTACTORS

- A. Contactors shall be "electrically held" or "mechanically held" type, as indicated on drawings.
- B. Electrically held contactors shall include auxiliary contacts as indicated and line and load terminal connectors.
- C. Mechanically held contactors shall be industrial type, single or dual solenoid operator, with mechanism capable of withstanding reduction or loss of control voltage without change of position. Contactor shall incorporate control power cut-out contacts so that the magnetic solenoid operator is only momentarily energized during the instant the switch changes position.
- D. Contactor core and coil assembly, or operators, shall operate satisfactorily with coil voltage within 85% or 110% of its voltage rating.
- E. All contacts shall be of non-welding, non-corroding silver alloy.
- F. Rating of contactors shall be as indicated on drawings. Auxiliary relays shall be provided as applicable. Contactors shall be contained in a suitable enclosure for the environment of their location. Contactors shall be suitable for a continuous load not less than 100% of their electrical rating.

G. Contactors shall be Square D Type L or LX Series, or approved equal.

2.3 INDIVIDUAL PUSHBUTTONS, SELECTOR SWITCHES AND INDICATING LIGHTS

- A. Pushbuttons shall be heavy-duty, oil-tight, momentary or maintained contact, as applicable, devices rated 600 volts with the number of buttons and the marking of nameplates in accordance with NEMA Publication ICS.
- B. Pushbuttons shall be designed with the indicated number of normally open circuit closing contacts, normally closed circuit opening contacts, or combination thereof. Pushbuttons shall have positive make and break non-welding, non-corroding silver alloy contacts.
- C. Selector switches for control circuits shall be heavy-duty, oil-tight maintained contact devices with the number of positions and the marking of nameplates as indicated on drawings or otherwise specified.
- D. Indicating lights for control circuits shall be oil-tight, instrument type devices with threaded base and collar for flush mounting and translucent convex lens. Indicating lights shall be long life type, rated 7500 hours, minimum. Provide Owner with two spare indicating lights of each size and type used.
- E. Pushbuttons, selector switches and indicating lights shall be contained in an enclosure suitable for the environment of their location, and shall be Square D Class 9001, Type T Series, or equivalent as accepted by the A-E, and shall be Square D Class 9001, Type T Series, or approved equal.

2.4 CONTROL CIRCUIT TRANSFORMERS

- A. Control circuit transformers shall be provided within the enclosure of magnetic contactors when indicated on drawings or specified otherwise and the line voltage is in excess of 120 volts. The transformer shall be dry type single phase, 60 hertz alternating current with a 120 volt isolated secondary winding in accordance with NEMA Publication STL "Specialty Transformers".
- B. The rated primary voltage of the transformer shall be not less than the rated voltage of the controller. The rated secondary current of the transformer shall be not less than continuous duty current of the control circuit.
- C. The voltage regulation of the transformer shall be such that with rated primary voltage and frequency the secondary voltage will not be less than 95% or more than 105% of rated secondary voltage.
- D. The source of supply for control circuit transformers shall be taken from the load side of the main disconnecting device. The primary and secondary windings of the transformer and control circuit wiring shall be protected against overloads and short circuits with properly selected fuses. The secondary winding of the control circuit transformer shall be grounded.

2.5 TIME SWITCHES

- A. Time switches for the control of tungsten-lamps loads, fluorescent -lamp loads, resistive heating loads, motors and magnetically operated devices shall consist of a digital programmable timer and switch assembly in a suitable enclosure, as indicated and herein specified.
- B. Timer shall operate from 120, 208, 240 or 277V.

- C. Battery reserve power shall be provided which will automatically operate the timer in case of electric power failure for a period of not less than 30 days.
- D. The switch mechanism shall include a heavy-duty, general purpose, precision snap-action switch. Provision shall be made for manual "OFF" and "ON" operation of the switch.
- E. Time switches shall be manufactured by Tork, Sangamo, General Electric, or approved equal.

2.6 PHOTOCCELL CONTROL DEVICES

- A. Photocell control devices for control of outdoor fixtures and natural daylight utilization for indoor spaces shall be fixture mounted or individually mounted as indicated on drawings, or otherwise specified.
- B. Fixture-mounted photocell control devices shall include a snap-action switch with a rating of not less than 1000 watts incandescent load and 1200 volt-amp reactive or HID load at rated voltage and frequency. Device also shall have an inherent time delay in excess of 5 seconds, built-in surge protection, and the appropriate lock type receptacle base. The device shall be enclosed in a weatherproof enclosure. Device rating shall be 120 or 277 volts, as applicable, 60 hertz. The device shall be factory preset to turn "ON" lights at approximately 3 footcandles with a ratio of "ON" to "OFF" of about 1 to 2.
- C. Individually mounted photocontrol devices shall have the same characteristics as fixture mounted devices, except that they shall be field adjustable for "ON" "OFF" operation from 2 to 50 footcandles, have a capacity of up to 2000 watts of incandescent load, be outlet box mounted, and not require surge protection.
- E. Photocontrol devices shall be as manufactured by Tork, Sangamo, General Electric, or approved equal.

2.7 SPECIAL ENCLOSURES

- A. Special enclosures designed in accordance with UL and NEMA Standards shall be provided as required to protect devices and equipment from wet, dusty, corrosive, hazardous or flammable atmospheres. Enclosures shall be NEMA Type 3R, 3S, 4X, 7, 9, 12, or 13 in accordance with the environmental conditions present in the specific location.
- B. Enclosures shall be made of metal unless otherwise specifically noted.
- C. NEMA Type 4X enclosure shall be made of corrosion-resistant, chromium nickel stainless steel conforming to UL Standard No. 50 "Cabinet and Boxes".
- D. NEMA Type 7 and 9 enclosures shall be made of cast iron, bolted-type UL listed for the use intended. Cast metal enclosures shall be not less than 1/8" thick at every point, except that it shall be not less than 1/4" thick at tapped holes for conduits.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Devices specified by this section shall be installed such that only one wire is terminated on any given screw.

END OF SECTION

SECTION 26 40 00

SECONDARY DISTRIBUTION EQUIPMENT

PART 1 GENERAL

1.1 SCOPE

- A. Provide equipment for over-current protection, switching, disconnecting, transformation, and control of services, separately derived systems, feeders, and branch circuits as indicated on the drawings and as herein specified.

1.2 SUBMITTALS

- A. Submit for approval manufacturer's data sheets for fuses, enclosed switches and circuit breakers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Distribution equipment, other than fuses, shall be manufactured by Square D, General Electric, Siemens, or Cutler-Hammer. Equipment design features and components indicated on the drawings are those of Cutler-Hammer, and the standard construction features of that manufacturer shall be considered as minimum requirements, with additional requirements as specified herein and on the drawings.
- B. Fuses shall be manufactured by Bussmann, Gould Shawmut, or Littelfuse.

2.2 OVER-CURRENT PROTECTION DEVICES

- A. Unless otherwise indicated, circuit breakers shall be provided as the overcurrent protection devices for services, separately derived systems, feeders, and branch circuits. Fuses may be used only where indicated on the drawings, or required by the nameplate for equipment connected, or specified herein.
- B. Molded-case and insulated-case circuit breakers shall be the static or thermal-magnetic type, quick-make and quick-break for manual and automatic operation. Multipole breakers shall be common trip. Circuit breakers shall be bolted in place where possible. Thermal-magnetic breakers shall be calibrated at 40°C or ambient compensated. Ampere ratings, frame sizes, and short circuit ratings shall be as indicated on the drawings. Series ratings may be applied only where specifically indicated on the drawings. Individual enclosures shall be NEMA 1 indoors, 3R outdoors, unless otherwise indicated. Other circuit breakers shall be suitable for installation in Panelboards as hereinafter specified.
- C. Single-pole 15 and 20 amp circuit breakers shall be SWD rated.
- D. Fuses shall be the non-renewable, time delay, cartridge type, UL Class RK5 unless otherwise indicated; for installation in Safety Switches as hereinafter specified.

2.3 SWITCHING EQUIPMENT

- A. Fusible switches shall be incorporated into Safety Switches as hereinafter specified. Manual operation shall be quick-make and quick-break. Fuse holders shall be the Class R rejection type unless otherwise indicated.
- B. Safety Switches shall be the NEMA heavy duty type, horsepower rated, with interlocked covers that are defeatible, non-fusible except where fused switches are indicated or fuses are required. Switch mechanisms shall be quick-make and quick-break. Enclosures shall be NEMA 1 indoors, NEMA 3R outdoors unless otherwise indicated. Fuse holders, where required, shall be as specified above for fusible switches. Switch shall have provisions for padlocking switch handle open or closed.
- C. Switches for disconnecting small single-phase motors and appliances shall comply with Section 26 15 00 Wiring Devices.

2.4 ENCLOSED CIRCUIT BREAKER

- A. Circuit breakers shall be enclosed in U.L. listed enclosures, NEMA 1 indoors and NEMA 3R outdoors unless otherwise indicated.
- B. Circuit breaker handle shall be accessible from outside enclosure with cover closed.
- C. Enclosure shall have provisions for padlocking circuit breaker handle open or closed.

2.5 APPLICATION

- A. Distribution Equipment shall be sized for installation with required clearances at the locations shown on the drawings. Alternative arrangements may be submitted to the Architect/Engineer by the Contractor for approval, in the form of shop drawings, drawn to scale and showing actual dimensions of proposed equipment and required clearances.
- B. Unless otherwise indicated, Distribution Equipment shall be connected with wire and cable as specified in Section 26 12 00 Conductors. In general, these specified conductors are rated for a maximum operating temperature of 75°C and are sized for that temperature rating in an ambient of 30°C. Distribution equipment, including terminal lugs, temperature sensitive devices, and enclosures shall be designed, sized, and labeled for field connection with conductors as specified.
- C. Power conductors shall be properly tightened and/or torqued as recommended by the equipment manufacturer supplying the lugs/terminals used for terminating the conductors.
- D. Lugs/terminals shall comply with UL standards UL486A and UL486B.

2.6 IDENTIFICATION

- A. Equipment nameplates; and nameplates for individually mounted switches, circuit breakers, and motor starters shall comply with Section 26 10 00 Basic Materials and Methods.
- B. Group-mounted circuit breakers in Panelboards shall be provided with nameplates as described above; or they shall be identified with numerals and cardboard directories in metal or heavy polycarbonate directory frames. Directories in metal frames shall be protected with rigid plastic covers. Directories shall be sized to permit all circuit designations to be read without removing the card from the frame.

- C. Manufacturer's nameplates or labels on custom fabricated or factory assembled custom equipment shall contain sufficient identification to expedite the future procurement of parts, additions, and shop drawings.
- D. Service Equipment shall be UL labeled as "Suitable for use as Service Equipment." Service disconnects shall be clearly identified.
- E. Label all receptacles, light switches and disconnect switches with feeder panel name and branch circuit number. Use dyno-type labeling with black background with white letters. Labels to be installed on the exterior front cover of disconnect switches and under cover plates of receptacles and switches.
- F. Label all power, lighting and distribution panels with name, voltage, # phase, # wires and feeder information. Labels to be engraved laminated phenolic nameplates. For example:

PP103A 120/208V
3 Phase 4 W
Fed from DP201C

In addition, each major piece of mechanical equipment and low voltage system will be labeled with the device name and source of power.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Distribution Equipment shall be installed in strict accordance with the manufacturer's instructions for handling, support, connections, assembly, protection, energization, adjustment, and similar procedures.
- B. Fastening methods shall comply with Section 26 10 00 Basic Materials and Methods.
- C. Floor mounted equipment shall be provided with 4" high concrete pads and shall be secured to the concrete pad. Pads shall have a 3/4 inch chamfer on each accessible side.
- D. Equipment interiors shall be thoroughly cleaned of dust, dirt, trash, and other foreign material prior to energization of the equipment.
- E. Exterior Safety Switches that are readily accessible to unauthorized persons shall have their covers padlocked closed by the Contractor. Keys shall be identified and delivered to the Owner.
- F. Upon completion of the project, furnish to the Owner one complete set of replacement fuses, consisting of three fuses of each type and rating used.
- G. Directory cards for Panelboards shall be neatly filled-in with a typewriter to indicate the type and location of the load on each circuit or feeder.

END OF SECTION

SECTION 26 40 10

SURGE PROTECTION DEVICE SYSTEM

PART 1 GENERAL

1.1 SCOPE

- A. These specifications describe the electrical and mechanical requirements for a high energy Surge Protection Device System (SPD). The specified system shall provide effective high energy surge current diversion, sine wave tracking as required for electrical line noise filtering and be suitable for application in ANSI/IEEE C62.41 Category A, B, and C environments, as tested by ANSI/IEEE C62.11, C62.45 and MIL-STD-220A. The system shall be connected in parallel with the protected system; no series connected elements shall be used which limit load current or kVA capability.

1.2 STANDARDS

- A. The SPD surge protection system shall be designed and manufactured, and where appropriate, listed to the following standards:
 1. Underwriters Laboratory (UL)
 2. UL1449 3rd Edition: Surge Protective Devices (SPD)
 3. UL1283 5th Edition: Electromagnetic Interference Filters
- B. Institute of Electrical & Electronic Engineers (IEEE)
 1. C62.41.1: IEEE Guide on the Surge Environment in Low-Voltage (1000V and less) AC Power Circuits
 2. C62.41.2: IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits
 3. C62.45: IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits
 4. C62.62: IEEE Standard Test Specifications for Surge Protective Devices for Low Voltage (1000V and Less) AC Power Circuits
 5. C62.72: IEEE Guide for the Application of Surge Protective Devices for Low Voltage (1000V and Less) AC Power Circuits
- C. National Electrical Manufacturers Association (NEMA)
- D. National Fire Protection Association, NFPA 70, National Electric Code (NEC)
- E. Federal Information Processing Standards Publication 94 (FIPS 94), Guideline on Electrical Power for ADP Installations
- F. MIL-STD 220A

1.3 SYSTEM DESCRIPTION

- A. Storage temperature range shall be -55 to +85 C (-67 to +187 F)
- B. Operating Temperature range shall be -40 to +50 C (-40 to +122 F)

- C. Operation shall be reliable in an environment with 0% to 95% non-condensing relative humidity.
- D. The SPD shall generate an audible noise level of not more than 45 dba at 5 feet.
- E. The unit shall not generate any appreciable magnetic fields and shall be suitable for use directly inside computer rooms.
- F. The system shall be capable of operating up to an altitude of 12,000 feet above sea level.
- G. The SPD maximum continuous operating voltage shall be greater than 115% of the nominal system operating voltage to ensure the ability of the system to withstand temporary RMS overvoltage (swell) conditions.
- H. The operating frequency range of the system shall be at least 47 to 63 Hertz.
- I. Protection Modes
 - 1. All Modes. L-N, L-L, L-G, (N-G where applicable)
Note: L = Line, N = Neutral, G = Ground
- J. The SPD shall have a minimum UL 1449 3rd Edition Nominal Discharge Current Rating (I_n) of 10,000 Amps. When used in conjunction with a UL 96A certified Lightning Protection System the (I_n) rating shall be 20,000 Amps.
- K. UL 1449 3rd Edition Listed, bearing the official UL 3rd Edition gold hologram label.
 - l. UL 1283 5th Edition Listed.
- M. The Surge Protective Device (SPD) shall be a stand alone configuration. Systems that must be integral to the switchgear will not be considered.
- N. All SPD systems shall be permanently connected, parallel designs. Series suppression elements shall not be acceptable.
- O. The SPD shall be marked with a Short Circuit Current Rating (SCCR) and shall not be installed at a point on the system where the available fault current is in excess of that rating per the National Electric Code, Article 285, Section 6.
- P. All SPD units shall be from the same manufacturer.
- Q. SPD designs that limit the 100% rated surge protection shall not be acceptable.
- R. Hybrid design utilizing:
 - 1. Thermally Protected Metal Oxide Varistors
 - 2. Filter capacitors to suppress EMI/RFI electrical noise.

1.4 DOCUMENTATION

- A. The manufacturer shall furnish an installation manual with installation, start up, trouble-shooting guide and operating instructions for the specified system.

- B. Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, component and connection locations, mounting provisions, connection details and wiring diagram.
- C. Documentation of specified system's UL 1449 3rd Edition Listing and voltage protection ratings of all protection modes shall be included as required product data submittal information.
- D. Independent fuse coordination tests from a nationally recognized independent testing laboratory.
- E. The manufacturer shall provide a full five year warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable national or local electrical codes. Manufacturer shall make available local field engineering service support. Where direct factory employed service engineers are not locally available, travel time from the factory or nearest dispatch center shall be stated.

PART 2 PRODUCTS

2.1 MODULAR SURGE PROTECTION FOR SERVICE ENTRANCE/MAIN DISTRIBUTION AND CRITICAL EQUIPMENT APPLICATIONS:

- A. Configured for the voltage as shown on the riser diagram and/or panel schedules.
- B. The SPD surge current ratings shall be based on the electrical system ampacity listed in the table below.

Electrical System Ampacity @ SPD Install Point	Surge Protection (kA)	
	Per Mode	Per Phase
2500 – 6000A	300	600
1200 – 2000A	250	500
600 – 1000A	200	400
250 – 400A	150	300
125 – 225A	100	200

- C. The SPD shall be rated for 208/120Vac 3 Phase, 4 Wire + Ground, Wye.
- D. Modes of Protection: The SPD system shall provide surge protection in all possible modes (L-N, L-G, L-L, and N-G). Each replaceable module shall provide the uncompromising ability to deliver full surge current rating per mode.
- E. SPD modules shall be configured to isolate individual suppression component failures without causing total loss of surge protection in that mode.
- F. Opening of supplementary protective devices, internal or external, shall not be permissible during UL 1449 3rd Edition Nominal Discharge testing.
- G. Optional Connection Methods: Terminal Block, 60A #6AWG.
- H. Each individual module shall feature a green LED indicating the individual module has all surge protection devices active. If any module is taken off-line, the green LED will turn off and a red LED will illuminate, providing *individual module* as well as *total system* status indication.
- I. Monitoring: Solid State Status Indication Lights.

- J. The modular SPD shall be provided in a NEMA 12 or 4X enclosure.
- K. The SPD shall provide EMI/RFI electrical noise attenuation of 36 to 44dB in the range of 50kHz to 100MHz as defined by MIL-STD-220A test procedures.
- L. Voltage Protection Ratings: The UL 1449 3rd Edition Voltage Protection Ratings “VPR” (6kV, 3000 Amps, 8/20 μ s waveform) shall not exceed the UL assigned values listed below.

Voltage Protection Ratings (VPR) 6kV, 3000A, 8/20 μ s Waveform	Voltage Rating	
	208/120V	480/277V
Line to Neutral	900V	1200V
Line to Ground	800V	1200V
Neutral to Ground	700V	1200V
Line to Line	1200V	2000V

- M. Approved Manufacturers: The following SPD manufacturers and respective models shall be deemed acceptable, subject to conformance with indicated requirements:

THOR SYSTEMS	TSr Product Series
Current Technologies	SL2 Produce Series
Liebert	Interceptor II Series

PART 3 EXECUTION

3.1 INSTALLATION

- A. The installing contractor shall connect the SPD in parallel to the power source, keeping conductors as short and straight as practically possible. The contractor shall twist the SPD input conductors together to reduce input conductor impedance.
- B. A modular SPD shall be close nipped to the distribution panel and shall be supplied by a 60 Amp circuit breaker. (Where possible, a bottom feed modular SPD is preferred, close nipped to top of distribution cabinet.)

END OF SECTION

SECTION 26 42 00

PANELBOARDS

PART 1 GENERAL

1.1 SCOPE

- A. Furnish and install Lighting, Power, and Distribution Panelboards as indicated on the drawings and as herein specified.
- B. Panelboards and their installation shall comply with applicable requirements of Section 26 40 00 – Distribution Equipment.

1.2 SUBMITTALS

- A. Submit for approval panelboard shop drawings which include as a minimum the following information:
 1. Cabinet dimensions.
 2. Mounting requirements.
 3. Bussing arrangement.
 4. Circuit breaker arrangement.
 5. Accessories.

PART 2 PRODUCTS

2.1 BRANCH CIRCUIT PANELBOARDS

- A. Panelboard types, ratings, and contents shall be as shown on the Drawings.
- B. Equipment shall be built to NEMA Standard PB-1, UL Standards UL50 and UL67, and NEC requirements.
- C. Panelboard backboxes shall be constructed of galvanized sheet steel and shall be securely fabricated with screws, bolts, rivets, or by welding. Backboxes shall be a minimum 20" wide and 5-3/4" deep, unless noted otherwise, and heights shall not exceed 72" overall. Top or bottom gutter space shall be increased 6" where feeder loops through panel. End plates shall be supplied without knockouts.
- D. Covers shall be constructed of high grade flat sheet steel with:
 1. Door-in-door construction shall be provided. The inside hinge door shall allow access to device handles only. Door shall close flush with cover and against a full inside trim stop. Hinges shall be inside type. The outer hinged door shall allow access to wiring gutter.
 2. A flush latch and tumbler type lock, so panel door may be held closed without being locked. All such locks shall be keyed alike. Furnish to the Owner two keys with each lock, or a total of 10 keys for the project.
 3. Four or more cover fasteners of a type which will permit mounting plumb on box. Cover shall also have inside support studs to rest on lower edge of backbox while being fastened. For flush mounted panelboards, cover fastening hardware shall be concealed behind the hinged door.

- E. A means shall be provided for readily adjusting projection of panel interior assembly with all connections in place. A method requiring stacking of washers is not acceptable. Interior trim shall fit neatly between interior assemblies and cover leaving no gaps between the two.
- F. Panelboard phase and neutral bus buswork shall be of copper. A copper ground bus shall be provided in each panel.
- G. Minimum short circuit rating of any panelboard assembly shall be 10,000A. Furnish panelboards with higher rating where so noted or where evidently intended by specification of circuit breakers with higher interrupting capacity.
- H. Ampacity of mains shall be equal to, or greater than, the ampacity of the feeder unless otherwise indicated.
- I. Where drawings schedules indicate spaces for addition of future circuit breakers, furnish all necessary buswork, strap, brackets, hardware, and removable blank covers.
- J. Breakers in panelboards shall be physically arranged in locations shown in panel schedules on the drawings where possible. They shall be connected to the phases as shown.
- K. Unless otherwise indicated and where available for the panelboard type specified, circuit breakers shall be of the bolt-on type.
- L. Provide surge suppressor external to panelboard as indicated on the drawings and by Section 26 40 10 of the specifications for limiting surge voltages and to prevent continued flow of follow current while remaining capable of repeating these functions.

2.2 DISTRIBUTION PANELBOARDS

- A. Panelboards rated 600 amperes and greater shall be Distribution Type.
- B. Description: NEMA PB 1, circuit breaker type. Distribution Panelboard shall be Square D Company I-Line construction or GE Spectra type construction.
- C. Panelboard Bus: Copper. One continuous fully rated bus bar per phase with ratings as indicated. Provide copper ground bus and copper neutral in each panelboard equipped with lugs to accommodate all conductors to be connected. Unless otherwise indicated the neutral bus shall be sized 100% of phase bus rating and the ground bus shall be sized a minimum of 25% of the phase bus rating. Where more than one ground bar is furnished, each ground bar will be interconnected with a conductor sized not less than the panelboard feeder ground conductor. Ground bar shall be bonded to enclosure.
- D. Interior trim shall be dead front construction. Main lugs shall be mounted in the mains compartment.
- E. Main circuit breaker and main lug interiors shall be field convertible for top or bottom incoming feed.
- F. Enclosure: NEMA PB 1, Type 1 unless otherwise indicated on drawings; In compliance with UL 50.
 - 1. The operating handle of the top most mounted device shall be no higher than 6 feet 6 inches above the finished floor.

2. Panelboard backbox shall be constructed without pre-punched knockouts.
 3. Cabinet front shall be a four piece surface trim for surface mount standard. Where specifically indicated on the drawings, either a single hinged door or door-in-door construction shall be provided. For door-in-door construction, the inner hinged door shall allow access to the device handles only and the outer hinged door shall allow access to wiring gutter.
 4. Enclosure and front shall be either galvanized steel or stainless steel and shall be finished in manufacturer's standard gray enamel.
 5. The enclosure shall be minimum 26 inches wide.
- G. Minimum fully rated short-circuit rating: RMS symmetrical amperage shall be minimum 22,000 amperes unless otherwise indicated on drawings.
- H. Molded Case Circuit Breakers: NEMA AB 1, UL 489 listed circuit breakers.
1. Manufactured by the same company manufacturing the panelboard.
 2. Circuit breakers used in service entrance equipment should be listed for such use.
 3. Include shunt trip where required or as indicated on the contract documents.
 4. Rating plugs, where used, shall be front accessible.
 5. Breakers shall have minimum interrupting capacity, as indicated for the panelboard on the contract documents.
 6. Breaker frame sizes and trips shall be as indicated on the drawings.
 7. Circuit breakers shall provide positive indication of ON, OFF, and tripped conditions.
 8. All breakers shall be quick-make, quick-break.
 9. Multi-pole breakers shall be common-trip, resulting in all poles opening simultaneously under trip conditions.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Equipment shall be perfectly plumb and level.
- B. Openings in backboxes shall be cut or sawed with tools made for that purpose. Burning of openings is absolutely unacceptable.
- C. Unused openings shall be closed.
- D. Only one solid wire is allowable under a screw. Provide approved lugs for connecting stranded wire or more than one solid conductor.
- E. Centered above the breakers in each panelboard attach a nameplate indicating panel designation - for example "PANEL A", or "PANEL MDP". Nameplates shall comply with Section 26 10 00 Basic Materials and Methods.
- F. Panelboard backboxes shall be mounted with their tops 6'-8" above the floor.

END OF SECTION

SECTION 26 50 00

LIGHTING FIXTURES AND ACCESSORIES

PART 1 GENERAL

1.1 SCOPE

- A. The Contractor shall furnish and completely install Lighting Fixtures and Accessories as indicated on the drawings and as herein specified.
- B. All fixtures shall be equipped with lamps.
- C. A lighting fixture shall be provided for each lighting outlet indicated. Outlets lacking fixture designations shall be brought to the attention of the Architect/Engineer before submitting proposal; otherwise units selected by the Architect/Engineer shall be furnished and installed at no additional charge.

1.2 SUBMITTALS

- A. Submit for approval complete manufacturer's data sheets for all fixtures. Indicate all components, characteristics, and options.
- B. Submit for approval manufacturer's data sheets for all lamps to be furnished.
- C. Submit for approval Lighting Fixture samples as requested by the Architect/Engineer. Samples shall be equipped with lamps, cords, plugs, and ballasts for 120 volt operation.

PART 2 PRODUCTS

2.1 LIGHTING FIXTURES

- A. All fixtures shall be labeled by Underwriters' Laboratories, Inc.
- B. Fixture designations on the drawings generally consist of a letter indicating the fixture type. Fixture types are identified in the Lighting Fixture Schedule or Symbol Schedule, however, the Schedule does not necessarily list all accessories and hardware necessary for the complete installation, nor does it detail the construction to be encountered at the fixture locations. It is the Contractor's responsibility to properly determine and provide correct components, accessories, and hardware required for the installation.
- C. Recessed Compact Fluorescent Fixtures in plaster and gypsum board ceilings shall be equipped with plaster frames. In other ceilings they shall be equipped with plaster frames and/or other devices as approved by the Architect/Engineer, to facilitate removal of fixture and access to the concealed junction box.
- D. Plastic materials indicated to be "acrylic" shall be of 100% virgin methyl methacrylate produced by Rohm and Haas, DuPont, or Cyanimid.
- E. Eight-foot chassis with four footlamps in tandem may be used in lieu of four-foot fluorescent units in continuous rows, except where recessed into ceiling construction which incorporates exposed support members at four-foot intervals.

- F. Recessed Fluorescent Fixtures (Troffers) shall conform to the following minimum requirements unless modified by notes and schedules on the Drawings:
1. Housings shall be of 4-3/8" minimum, 5" maximum depth, and of 22 gauge minimum steel, with deeply formed transverse ribs for rigidity, primed, and finished in baked white enamel. The use of pre-painted steel is acceptable.
 2. Lenses shall be of flat clear K-12 type acrylic of .125" nominal (.115" minimum) thickness in rigid hinged steel or extruded aluminum door frames finished in baked white enamel and secured with inconspicuous spring-loaded or rotary cam type steel latches. Lenses shall be maintained in a flat position with invisible clips, and shall be removable from the door frames using a screwdriver without damaging the lens or the frame.
 3. Joints between housings and door frames shall be totally free of light leaks. Gaskets, if used, shall be invisible and in compression when the door is closed. Gasketing material subjected to rubbing when the door is opened or closed will not be accepted. Flexible and/or removable black baffles will not be accepted.
 4. Ballasts shall be as hereinafter specified. Lampholders shall be rigidly mounted and replaceable without removing the fixture from the ceiling. Lampholder wiring shall not be exposed in the lamp compartment.
 5. Top access plates to facilitate wiring are optional with the Contractor. Each fixture shall be individually connected to a concealed junction box with #16 TFN conductors in 6 feet of 3/8" flexible metal conduit.
 6. Troffers for inverted tee exposed grid ceilings shall be designed to be raised through the ceiling opening, and shall be supported independently of the grid system with two hangers on diagonal corners. Hangers shall be No. 12 AWG and shall be attached to the building structural system. They shall be secured to the ceiling grid at all four corners using sheet metal screws.
 7. Troffers for plaster and gypsum board ceilings shall be furnished with plaster frames.
 8. Troffers for ceilings with concealed suspension systems including plaster, gypsum board, and acoustical tile shall be equipped with suitable adjustable yokes or brackets designed to hook onto the plaster frame or ceiling channels, prevent the channels from spreading, and support the fixture.
 9. Fixtures shall be a regularly cataloged and commonly manufactured product of an established, recognized lighting fixture manufacturer, with published photometric data and Zonal Cavity Coefficients of Utilization based on tests conducted by an independent photometric testing laboratory. Tests and calculations shall be in accordance with current IES standards.
- I Fluorescent fixtures containing three or more lamps shall be ballasted and connected to permit separate switching of center lamp in three-lamp units.
- J. Where modular recessed fixtures are indicated in rectangular patterns or with 90 degree turns in fixture rows, they shall be designed and manufactured with mitered trim flanges, and special plaster frames, as required to retain the modular characteristics of the pattern.
- K. A disconnecting means shall be provided as a part of the UL listed fixture package for all fluorescent ballasted fixtures that will disconnect simultaneously from the source of supply all conductors of each ballast including the ground conductor as required by NEC 410.73(G).

2.2 LAMPS

- A. Lamps shall be manufactured by Osram Sylvania, General Electric, or Philips.

- B. Lamps shall be compatible with the design and photometric characteristics of the lighting fixtures. Where the lighting fixture design offers a choice of lamps, the lamp selection shall be as directed by the Architect/Engineer.
- C. Fluorescent lamps shall be of the energy-saving type, where available.
- D. Unless otherwise indicated, nominal 4-foot "Building Standard" fluorescent lamps shall be the 32 watt, T8 instant-start type or rapid-start type as indicated, fully compatible with the ballasts supplied.

2.3 BALLASTS

- A. Ballasts for fluorescent lamps shall be manufactured by Advance, Jefferson, Magnetek, or approved equal. All fixtures of the same type shall be supplied with ballasts of the same manufacturer.
- B. Fluorescent and ballasts shall be High Power Factor, UL listed and labeled, and designed for operation at 120 or 277 volts as applicable, unless otherwise indicated.
- C. Fluorescent ballasts, unless otherwise indicated, shall be the electronic type, Class P with Ballast Efficacy Factors in compliance with NAECA Requirements. Electronic ballasts shall provide high frequency operation with lamp current crest factors of 1.7 or less and total harmonic distortion of less than 20%. Light output and noise levels shall comply with CBM standards for equivalent electromagnetic ballasts.
- D. Ballasts for fluorescent lamps shall be Rapid Start or instant start as indicated.

2.4 EMERGENCY EXIT LUMINAIRE

- A. It shall be completely self-contained, provided with maintenance-free battery, automatic charger, and other features. Luminaire must be third-party listed as emergency lighting equipment, and meet or exceed the following standards; NEC, N.C. Building Code, Volume X Energy Code, NFPA-101, and NEMA Standards.
- B. Battery shall be sealed, maintenance-free type, with minimum of 90 minutes operating endurance. Battery shall have a normal life expectancy of 10 years. Batteries shall be high temperature type with an operating range of 0 degree C to 60 degrees C and contain a resealable pressure vent, a sintered + positive terminal and – negative terminal.
- C. Charger shall be full automatic solid state type, full wave rectifying, with current limiting. Charger shall restore the battery to its full charge within 24 hours after a discharge of 90 minutes under full rated load. The unit shall be activated with the voltage drops below 80 percent. A low voltage disconnect switch shall be included if LEAD Battery is used, to disconnect the battery from the load and prevent damage from a deep discharge during extended power outage.
- D. Pilot light shall indicate the unit is connected to AC power. The battery shall have high rate charge pilot light, unless self-diagnostic type. Tests switch shall simulate the operation of the unit upon loss of A.C. power by energizing the lamps from the battery. This simulation must also exercise the transfer relay.
- E. The entire unit shall be warranted for three years. The battery must have an additional two more years' pro-rated warranty. Warranty shall start from the date of project final acceptance. Warranty shall be included in the contract document.

- F. The use of LED is required due to their reliable performance, low power consumption, and limited maintenance requirements. Maximum LED failure rate shall be 25% within a seven (7) year period; otherwise, if exceeded, manufacturer shall replace the complete unit at no charge to the owner.
- G. Contractor shall perform a test on each unit after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes. The battery test shall be done 10 days prior to final inspection. Any unit which fails the test must be repaired or replaced, and tested again. The test shall demonstrate that the batteries conform to the requirements of NEC 700.12 (F).

2.5 EMERGENCY EGRESS LUMINARE

- A. Shall be completely self-contained, provided with maintenance-free 12 volt battery, automatic charger, two lamps, and other features. Luminaire shall be third-party listed as emergency lighting equipment, and meet or exceed the following standards: NEC, N.C. Building Code, Volume X Energy Code, NFPA-101, and NEMA Standards.
- B. Pilot light shall indicate the unit is connected to A.C. power. The battery shall have high rate charge pilot light, unless self-diagnostic type. A test switch shall simulate the operation of the unit upon loss of A.C. power by energizing the lamps from the battery. This simulation must also exercise the transfer relay. If fluorescent emergency unit is used, an LED charging indicator light must be easily visible after installation and a remote test switch shall be installed adjacent to the fixture.
- C. Battery shall be sealed, maintenance free type, with minimum of 90 minutes operating endurance. Battery shall have a normal life expectancy of 10 years. Batteries shall be a high temperature type with an operating range of 0 degree C to 60 degrees C and contain a resealable pressure vent, a sintered + positive terminal and – negative terminal.
- D. Charges shall be fully automatic solid state type, full wave rectifying, with current limiting. Charger shall restore the battery to its full charge within 24 hours after a discharge of 90 minutes under full rated load. The unit shall be activated when the voltage drops below 80%. A low voltage disconnect switch shall be included if LEAD battery is used, to disconnect the battery from the load and prevent damage from a deep discharge during extended power outage.
- E. The entire unit shall be warranted for three years. The battery must have an additional two more years' pro-rated warranty. Warranty shall start from the date of project final acceptance. Warranty shall be included in the contract document.
- F. Contractor shall perform a test on each unit after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes. The battery test shall be done 10 days prior to final inspection. Any unit which fails the test must be repaired or replaced, and tested again. The test shall demonstrate that the batteries conform to the requirements of NEC 700.12 (F).

PART 3 EXECUTION

3.1 COORDINATION

- A. Contractor shall verify ceiling or wall type in or on which each fixture is to be mounted, and shall furnish unit with appropriate trim type, mounting hardware, and accessories to fit the construction; and feed through junction boxes as required to maintain proper access to system wiring.

3.2 INSTALLATION

- A. Lighting fixtures shall be installed in accordance with the manufacturer's instructions.

- B. Lighting fixtures shall be supported from the building structure using corrosion resistant steel hardware in compliance with Section 26 10 00 Basic Materials and Methods. 10 gauge minimum steel wire may be used for support from the structure where concealed above suspended ceilings.
- C. In addition to the supports from the structure, fixtures shall also be secured to suspended ceilings on which they are mounted, or in which they are recessed. Where fixtures are secured to suspended ceilings, the primary supports from the building structure shall be slack.
- D. A minimum of two No. 12 gauge wire supports attached to the structure shall be provided for each lighting fixture unless otherwise indicated or approved by the Architect/Engineer. The supports shall be located at diagonal corners of rectangular fixtures and angled away from fixture. A minimum of three full twists shall be made at each end to secure wire.
- E. Where installed recessed in grid type ceilings, attach each fluorescent fixture to the grid with a minimum of four "earthquake clips" furnished by the Lighting Fixture manufacturer.
- F. Conductors in fixture taps shall be #16 AWG minimum, type TFN, in 3/8" flexible metal conduit of 72" maximum length. A green insulated equipment grounding conductor shall be included.
- G. Mount fixtures plumb and square. Keep rows in perfect line.
- H. At time of project completion, fixtures and lamps shall be clean and fully operational.

END OF SECTION

SECTION 26 62 10

AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.1 SCOPE

- A. Furnish and install an Automatic Transfer Switch as indicated on the drawings and as herein specified. The Automatic Transfer Switch shall be compatible to the associated engine generator set in all respects.
- B. Installation of Automatic Transfer Switch shall comply with the requirements of NEC Article 700, and of the North Carolina State Building Code.

1.2 FUNCTION

- A. Upon failure of the normal power source to the Automatic Transfer Switch, the switch shall function automatically to restore power to designated loads from the Engine-Generator set.
- B. Other system functions and particulars of operation shall be as herein specified, as noted on the drawings, or as evidently intended by the specification of equipment herein.

1.3 SUBMITTALS

- A. Shop drawings shall be submitted on the Automatic Transfer Switch in sufficient detail to demonstrate full compliance with these specifications and provide complete details of the intended installation. The submittal shall include the following information clearly showing that the characteristics of the product submittal equals or exceeds that specified.

- Ampere rating
- Voltage rating
- Number of poles
- Relay information
- Time delays
- Main contacts information
- Coil information
- Control switches information
- Operating instructions

- B. The submittal shall include complete control wiring diagrams.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Automatic transfer switches shall be manufactured by Russelectric, ASCO, Zenith, Kohler, Onan or approved equal.

2.2 CONSTRUCTION FEATURES

- A. The Automatic Transfer Switch shall consist of a standardized assembly of switches and controls for the automatic transfer of loads from one source to another. Manufacturer shall be Russelectric, Zenith, Onan or approved equal. The Automatic Transfer Switch features and controls shall be fully coordinated with the emergency generator.
- B. The Transfer Switch shall be rated for voltage, current and pole configuration as indicated on the drawings for all classes of loads without de-rating. The Transfer Switch shall have a 3-cycle short circuit withstand capability and closing rating as indicated on the drawings, but in no case shall it be less than the short circuit rating of the circuit breaker ahead of the normal input to the transfer switch. The Transfer Switch shall be UL 1008 listed and labeled as "Automatic Transfer Switch for Emergency Systems".
- C. When a 4-pole switch is specified, the continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles.
- D. The Transfer Switch shall be electrically operated, mechanically held and interlocked both electrically and mechanically to positively prevent the connection of the load to both sources simultaneously or interconnection of the two sources. Components of the operating mechanism shall be insulated or electrically dead. Molded case circuit breaker mechanisms may be utilized in the Transfer Switch provided that they are not also used as over-current protective or manual disconnecting devices.
- E. The transfer switch shall be equipped with a safe external manual operator designed to prevent injury to operating personnel. The manual operator shall provide the same contact to contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly. The external manual operator shall be safely operated from outside of the transfer switch enclosure while the enclosure door is closed.
- F. The Transfer Switch shall automatically transfer its load to an emergency supply after failure of its normal supply. Upon restoration of the normal supply, the Transfer Switch shall automatically retransfer its load to the Normal supply. The Transfer Switch shall obtain its operating current from the source to which the load is being transferred. Transfer mechanisms shall be energized only momentarily during transfer, with momentary delay or in-phase monitors to avoid out-of-phase transfer of motor loads.
- G. The Automatic Transfer Switch enclosure shall be NEMA 1 for wall or floor mounting as required. Enclosure shall be fabricated from 12 gauge steel. The enclosure shall be sized to exceed the minimum wire bending space required by UL 1008.
- H. All bolted bus connections shall utilize Belleville compression type washers.
- I. The main contacts shall be of a silver alloy composition.

2.3 AUTOMATIC TRANSFER SWITCH CONTROLS

- A. The transfer switch shall be equipped with a microprocessor based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have two asynchronous serial ports. The controller shall have a real time clock with Nicad battery back-up.
- B. The CPU shall be equipped with self diagnostics which perform periodic checks of the memory I/O and communication circuits, with a watchdog/power fail circuit.

- C. The controller shall use industry standard open architecture communication protocol for high speed serial communications via multidrop connection to other controllers and to a master terminal with up to 4000 ft. of cable. The serial communication port shall be RS422/485 compatible.
- D. The serial communication port shall allow interface to either the manufacturer's or the owner's furnished remote supervisory control.
- E. The controller shall have password protection required to limit access to qualified and authorized personnel.
- F. The controller shall include a 20 character, LCD display, with a keypad, which allows access to the system.
- G. The controller shall include three phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.
- H. The controller shall be capable of storing the following records in memory for access either locally or remotely.
 - 1. Number of hours transfer switch is in the emergency position (total since record reset).
 - 2. Number of hours that emergency power is available (total since record reset).
 - 3. Total transfer in either direction (total since record reset).
 - 4. Date, time, and description of the last four source failures.
 - 5. Date of the last exercise period.
 - 6. Date of record reset.

2.4 SEQUENCE OF OPERATION

- A. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increase to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant.
- B. The transfer switch shall transfer to emergency when the generating plant has reached specified voltage and frequency on all phase.
- C. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source.
- D. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds; factory set at 300 seconds.

2.5 AUTOMATIC TRANSFER SWITCH ACCESSORIES

- A. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.

- B. Programmable three phase sensing of the emergency source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases set at 20%, and phase sequence monitoring.
- C. Time delay engine start signal and transfer switch operation for override of momentary normal source power outage: Programmable 0-9999 seconds; Factory set at 3 seconds.
- D. Time delay on retransfer to normal: Programmable 0-9999 seconds; Factory set at 300 seconds.
- E. Overrun time delay for unloaded engine operation after retransfer to normal: Programmable 0-9999 second; Factory set at 300 seconds.
- F. Time delay on transfer to emergency: Programmable 0-9999 seconds; Factory set at 3 seconds.
- G. A load test switch shall be included to simulate a normal power failure, keypad initiated.
- H. Contact, rated 10 Amps 30 volts DC, to close on failure of normal source to initiate engine starting.
- I. Contact, rated 10 Amps 30 volts DC, to open on failure of normal source for customer functions.
- J. Light emitting diodes shall be mounted on the microprocessor panel to indicate: switch is in normal position, switch is in emergency position and controller is running.
- K. A plant exerciser shall be provided with (10) 7 day-events; programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise generating plant programmable in one minute increments. Also include selection of either "no load" (switch will not transfer) or "load" (switch will transfer) exercise period. Keypad initiated.
- L. Provision to select either "no commit" or "commit" to transfer operation in the event of a normal power failure shall be included. In the "no commit position", the load will transfer to the emergency position unless normal power returns before the emergency source has reach 90% of it's rated values (switch will remain in normal). In the "commit position" the load will transfer to the emergency position after any normal power failure. Keypad initiated.
- M. Two auxiliary contacts rated 10 Amp, 120 volts AC (for switches 100 to 800 amps) 15 amp, 120 volts AC (for switches 1000 to 4000 amps), shall be mounted on the main shaft, one closed no normal, the other closed on emergency. Both contacts will be wired to a terminal strip for ease of customer connections.
- N. A three phase digital LCD voltage readout, with 1% accuracy shall display all three separate phase to phase voltages simultaneously, for both the normal and emergency source.
- O. A digital LCD frequency readout with 1% accuracy shall display frequency for both normal and emergency source.
- P. An LCD readout shall display normal source and emergency source availability.

PART 3 EXECUTION

3.1 TEST DATA

- A. The manufacturer of the Transfer Switch shall furnish a certified test report from an independent testing laboratory (factory tests will not be acceptable) to verify that identified samples of the Transfer Switch have been subjected to three-phase short circuit currents as specified at the system voltage for a minimum of 3 cycles duration, without contact damage or contact welding and without the use of current limiting fuse protection. Oscillograph traces are to be supplied to verify that the test parameters have been met.

3.2 MANUFACTURER'S FIELD SERVICE

- A. The transfer switch manufacturer shall employ a nationwide, factory direct field service organization, available on a 24 hour a day, 365 days a year, call basis.

END OF SECTION

SECTION 26 62 20

ENGINE – GENERATOR SYSTEM - SPARKIGNITED

PART 1 GENERAL

1.1 SCOPE

- A. The Electrical Contractor shall provide a complete, coordinated, and operable auxiliary power system consisting of an engine driven generator, fuel supply facilities, exhaust facilities, control, starting and instrumentation equipment, automatic transfer equipment, battery charging equipment and all required accessories and connections.
- B. System shall comply with the requirements of NEC Articles 445 and 700, and of the North Carolina State Building Code.

1.2 FUNCTION

- A. Upon failure of the normal power source to any Automatic Transfer Switch, the system shall function automatically to restore power to designated loads from the Engine-Generator set.
- B. Other system functions and particulars of operation shall be as herein specified, as noted on the drawings, or as evidently intended by the specification of equipment herein.

1.3 SUBMITTALS

- A. Shop drawings shall be submitted for each item of equipment to be furnished. Submittals shall be in sufficient detail to demonstrate full compliance with these specifications and provide complete details of the intended installation.
- B. Submittal shall include complete control wiring diagrams and piping diagrams.
- C. Submittal shall include detailed, dimensioned shop drawings of the Engine-Generator set and all accessories including, but not limited to, fuel system components, automatic transfer switch, system remote monitor, instrument panel, and silencer.

PART 2 EXECUTION

2.1 MANUFACTURER

- A. This specification and the drawings are based upon equipment manufactured by Cummins-Onan as a basis of quality, function, size and performance. Equivalent products of Generac, Detroit Diesel, Kohler and Caterpillar are also acceptable. The Engine-Generator set assembler shall be the prime manufacturer of either the engine or the generator. The manufacturer shall maintain, within 100 miles of the site, a qualified parts and service organization with personnel factory trained to diagnose and repair the engine and the generator.
- B. Miscellaneous system components shall be as furnished through and recommended by the system installers for proper function of the system.

- C. Products specified are intended to establish minimum required standards of quality and function, and the standard features of those products shall be considered part of this specification. Similar and equal products by other manufacturers will be considered for approval.

2.2 ENGINE-GENERATOR SET

- A. Rating of the generator set shall be based on operation of the set when equipped with all necessary operating accessories such as air cleaners, lubricating oil pump, jacket water pump, governor, alternating current generator, exciter, radiator fan, and supercharger, if used. The set shall be rated as indicated on the drawings for "stand-by" service; however, the rating shall not exceed 115% of the manufacturer's published "prime power" rating with all accessories included.
- B. All materials and parts comprising the units herein specified shall be new and unused, of current manufacture, and of the highest grade, free from all defects or imperfections affecting performance. It is the intent of these specifications to secure current electric generator sets which can be properly maintained and serviced without the necessity of the purchaser carrying expensive parts stock, or being subjected to the inconvenience of long periods of interrupted service due to lack of available parts. The manufacturer shall maintain permanent parts depots from which the parts may be obtained in necessary quantities at any time.
- C. The engine shall operate satisfactorily on piped natural gas at a pressure of 7-20 inches of H₂O and shall be of the vertical, multi-cylinder, four-cycle type, with moving parts housed. The maximum speed of the engine in the service anticipated shall not exceed 1800 RPM. The lubrication system shall be of the forced type. The cylinder liners of the engine shall be removable. The crankshaft shall be fully counterbalanced with all bearing surfaced to case-hardened or equal. There shall be one more main bearing than there are number of cylinders for in-line engines or pairs of cylinders for V-engines. The complete engine generator unit shall be free from critical and torsional vibration within the operating speed range. Each engine shall be furnished with the following accessories: full flow oil filter, dry type air filter, replaceable element fuel filter, electronic governor to maintain engine speed within 3% from no load to full load, engine mounted fan and radiator with duct flange for cooling in 100 degree F. ambient temperature, a battery charging generator and regulator with a capacity of at least 20 amps, and one or more jacket water heaters, thermostatically controlled to maintain coolant temperature at 90 degrees F. shall also be provided.
- D. Engine shall be 1800 RPM, stationary, liquid-cooled, spark-ignited for fuel as specified below:
 - 1. The generator set shall be equipped to operate on natural gas fuel.
- E. The engine governor shall be electronic and shall maintain acceptable frequency regulation from no load to full rated load. The steady state operating band shall be within 2%.
- F. A closed recovery cooling system with sufficient capacity shall be provided to cool the engine when the generator set is delivering full rated load at minimum ambient temperature of 105 degree F. Radiator, fan, engine-driven centrifugal water pump and thermostatic valve shall be provided. System shall be protected against freezing and corrosion.
- G. The alternator shall be designed and built in accordance with applicable NEMA and IEEE Standards. The alternator shall be rated no less than the KW indicated on the drawings @ 125°C. The alternator voltage output and configuration shall be as indicated on the drawings. The generator shall be a brushless type, voltage and frequency regulated, 0.8 power factor rated, drip-proof machine. Insulation shall be NEMA Class "F" or "H" and maximum temperature rise at continuous operation under the rated load shall not exceed the NEMA standard rise for the particular class of insulation. The generator shall have a direct connected exciter and double sealed, pre-lubricated

ball bearings. Voltage regulation shall be within +2% of rated voltage from no load to full load. The voltage regulator shall be of the solid-state design and provide volts-per-hertz operation. It shall be mounted on top or side of the generator and enclosed in a "NEMA RATED" enclosure. A built-in voltage-adjusting rheostat shall provide 10% voltage adjustment. An isolation transformer in the voltage regulator circuit shall be provided. The generator neutral shall be grounded or ungrounded as indicated on the drawings.

- H. Control panel shall be mounted on or adjacent to the generator and shall be completely assembled and wired by the manufacturer in a NEMA IA enclosure. The panel shall include a lube oil pressure gauge, water temperature gauge, engine hour meter, lube oil temperature gauge and an ammeter for battery charging generator.

2.3 STARTING BATTERIES

- A. Provide a minimum of two 12 volt batteries in series (24 volts) of sufficient capacity for the ambient requirements of the installation four 30 second continuous cranking periods, but having not less than a cold cranking amp (CCA) rating of 1200 CCA total. Batteries shall be rack or tray mounted on or adjacent to the engine-generator.
- B. An automatic, solid-state, current limiting, float equalizing battery charger shall be provided. It shall maintain the battery at normal capacity and recharge battery after cranking. The charger shall be 120 volt input with appropriate output. It shall be capable of automatically switching from one rate to another rate to meet the needs of the discharged batteries. It shall be capable of recharging a completely discharged battery in a maximum of 8 hours. It shall also have: overload protection, voltage surge suppressers, D.C. ammeter, D.C. voltmeter, low D.C. voltage alarm relay; with minimum continuous output of 10 amperes D.C. battery charger malfunction alarm contacts and third-party listed.

2.4 EXHAUST SYSTEM

- A. A Maxim or approved equal critical exhaust silencer shall be furnished with the engine. The silencer shall reduce exhaust noise to a maximum dBA level of 85 at a distance of 10 feet. The silencer shall be designed for horizontal mounting and shall be mounted on top of the generator enclosure. A section of flexible, seamless, stainless steel exhaust pipe shall be provided for each engine exhaust outlet. All other exhaust piping shall be schedule 40 black iron of a size recommended by the engine manufacturer. Vertical sections of exhaust piping shall be fitted with suitable condensate traps with drain valves, and exhaust outlets shall be equipped with a flapper type rain caps.

2.5 FUEL SUPPLY SYSTEM

- A. Fuel supply system shall consist of a permanently piped natural gas fuel source by Division 15. All necessary piping and accessories to ensure constant priming, immediate starting, and constant supply of fuel to the engine, all in strict accordance with NFPA Standard No. 30 and the North Carolina State Building Code shall be provided. Regulators for the natural gas and propane fuels shall be provided on the engine.

2.6 REMOTE ANNUNCIATOR

- A. A Remote Annunciator shall be provided for the Engine-Generator set to indicate status of the set with LED indicating lamps and an audible signal for alarm conditions. The Annunciator shall be flush wall mounted adjacent to the ATS unless otherwise indicated in the fire command center. Suitable engraved nameplates shall be provided for identification.

- B. Green LED's shall indicate Normal Battery Voltage, Generator Running, and Generator Supplying Load.
- C. Red LED's shall indicate High Battery Voltage, Low Battery Voltage, and Battery Charger Malfunction.
- D. Yellow LED's with audible alarm shall indicate Oil Pressure Approaching Low Limit and Coolant Temperature Approaching High Limit.
- E. Red LED's with audible alarm shall indicate Engine Shutdown due to Low Oil Pressure, High Coolant Temperature, and Overspeed.
- F. Red LED's with audible alarm shall indicate Low Engine Temperature, Overcrank, and Low Fuel Level.
- G. A flashing red LED with audible alarm shall indicate that Engine Control Switch is not in the "Auto" position.
- H. "Silence" and "Lamp Test" switches shall be included.
- I. Switch for emergency engine shutdown and fuel cutoff. Locate switch on or adjacent to the remote generator annunciator.

2.7 OUTDOOR ENCLOSURE

- A. The enclosure shall be 14 gauge formed construction, modular design, gasketed roof bolts, plush rain ledge on four sides. All bolts shall be 3/9" cadmium plated with lock washers. Hinges shall be continuous type with 1/4" brass pins.
- B. The roof shall be flanged lap raintight construction, complete with roof stiffeners. The doors shall be full length piano hinged with fixed open air intake louvers, and equipped with adjustable plated pad-type latches and matched keys and rubber door stops.
- C. There shall be sufficient doors on each side and on rear to gain easy access to all components of the set. Hinged radiator fill access door and radiator core guard, drip flange and gasketed exhaust exit shall be provided.
- D. Complete enclosure shall be primed with two coats of zinc-chromate and finished and painted with two coats of enamel.
- E. All doors and air intake louvers shall be equipped with plated pad-type latches and matched keys. Vents and louvers shall be screened.
- F. The enclosure shall include all necessary battery racks and cables, lights, and suitable base. Enclosure shall be securely anchored to the base.
- G. Exhaust piping need not be insulated inside enclosure or on enclosure roof, but "DANGER - HIGH TEMPERATURE EXHAUST" warning signs shall be provided. Signs shall be of a permanent type, of a sufficient number and located so as to alert both qualified and non-qualified persons.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All installation shall be as recommended by the Engine-Generator manufacturer for proper operation.

3.2 GENERATOR PERFORMANCE

- A. The voltage regulation from no load to rated load shall be within a 2% band of rated voltage. Steady state voltage modulation shall not exceed one cycle per second.
 - 1. For any step load up to and including 90% of rating the voltage shall recover to and remain within the steady band in not more than 1.5 seconds. The voltage dip shall not exceed 20% of the rated voltage at any time.
 - 2. The frequency regulation from no load to rated load shall conform to the engine governor performance. For any addition of load up to 90% of rated load, the frequency shall recover to the steady state frequency within 5 seconds.

3.3 TESTING

- A. After installation of the complete unit, a unit test, and final adjustments shall be performed by, or under the direct supervision of, a factory trained service technician, provided by the manufacturer of the diesel Engine-Generator set. The contractor shall provide the necessary lube oil for the engine, and a permanent anti-freeze solution in the cooling system to protect from freezing to -20 degrees F. The contractor shall provide a load bank for the performance test of the Engine-Generator System.
- B. The on-site installation test shall be conducted in the following manner:
 - 1. With the prime mover in a "cold start" condition and the emergency load at standard operating level, a primary power failure shall be initiated by opening all switches or breakers supplying the primary power to the building or facility.
 - 2. The test load shall be that load that is served by the generator set.
 - 3. The time delay on start shall be observed and recorded.
 - 4. The cranking time until the prime mover starts and runs shall be observed and recorded.
 - 5. The time taken to reach operating speed shall be observed and recorded.
 - 6. The voltage and frequency overshoot shall be recorded.
 - 7. The time taken to achieve a steady-state condition with all switches transferred to the emergency position shall be observed and recorded.
 - 8. The voltage, frequency, and amperes shall be recorded.
 - 9. The prime mover oil pressure and water temperature shall be recorded, where applicable.
 - 10. The battery charge rate shall be recorded at 5-minute intervals for the first 15 minutes, and at 15-minute intervals thereafter.
 - 11. When primary power is returned to the building or facility, the time delay on retransfer to primary for each switch with a minimum setting of 5 minutes shall be recorded.
 - 12. The time delay on the prime mover cool down period and shutdown shall be recorded.
 - 13. After completion of the test the prime mover shall be allowed to cool for 5 minutes.
 - 14. A four hour load performance test including two hours at building load and ½ hour at full load shall be conducted. The building load shall be permitted to serve as part or the entire load, supplemented by a load bank of sufficient size to provide a load up to 100 percent of the nameplate kW rating of the generator set less applicable derating factors for site conditions. A unity power factor shall be permitted for on-site testing, provided that rated

load tests at the rated power factor have been performed by the manufacturer of the generator set prior to shipment.

3.4 FINAL ACCEPTANCE

- A. The installation shall be supervised, checked and tested by a qualified representative of the engine generator manufacturer. Written certification shall be sent to the designer and/or owner prior to final acceptance.

3.5 DOCUMENTATION AND TRAINING

- A. Documentation. Prior to final acceptance, the manufacturer shall supply three (3) copies of complete instruction manuals to the owner. The manuals shall include operation and maintenance procedures, complete parts lists, dimensional drawings, unit wiring diagrams and schematics and interconnection wiring drawings.
- B. Training. Prior to final acceptance, the manufacturer shall provide comprehensive training to the owner's designated personnel. Training shall cover, but not be limited to, operation, maintenance and troubleshooting of the equipment.

3.6 WARRANTY

- A. The emergency generator, transfer switch and associated equipment shall be warranted by the manufacturer for a period of five (5) years, from the date of final inspection and acceptance. The warranty shall be included in the contract document. The warranty shall include all parts, labor (including travel), expenses and equipment necessary to perform replacement and/or repairs.

3.7 MANUALS

- A. Complete parts lists, schematic diagrams, and operating and maintenance manuals shall be supplied to the Owner in three (3) copies.

3.8 MANUFACTURER'S RESPONSIBILITIES

- A. System components shall be furnished through an authorized representative of the manufacturer of the Engine-Generator Sets who shall be responsible through, and with, the Electrical Contractor for the proper installation and application of the system, and for service during the warranty period.

END OF SECTION

SECTION 26 70 20

FIRE ALARM SYSTEM, ADDRESSABLE

PART 1 GENERAL

1.1 SCOPE

- A. Contractor shall furnish and install a complete Fire Detection and Alarm System as indicated on the drawings and as specified herein.
- B. System shall include all devices, wiring, equipment, raceways, and connections required for a complete and satisfactorily operating system, whether or not every such item is specifically shown or mentioned.
- C. System shall be the fully supervised microprocessor based multiplex type utilizing addressable devices.
- D. All initiation devices shall be analog addressable devices. The notification devices shall be installed where required to meet ADA, NFPA 72 and the North Carolina State Building Code.

1.2 STANDARDS AND CODES

- A. The equipment and installation shall comply with the current provisions of the following standards and codes:
 1. The latest edition of the International Building Code.
 2. National Fire Protection Association Standards:

NFPA 70	National Electric Code
NFPA 72	National Fire Alarm Code
NFPA 90A	Air Conditioning Systems
NFPA 101	Life Safety Code
 3. Underwriters Laboratories Inc. Standards:
 - a. Underwriters Laboratories Inc. for use in fire protective signaling systems shall list the system and all components. The UL Label shall be considered as evidence of compliance with this requirement. The equipment shall be listed by UL under the following standards as applicable:

UL 864/UOJZ, APOU	Control Units for Fire Protective Signaling Systems.
UL 1076/APOU	Proprietary Burglar Alarm Units and Systems.
UL 268	Smoke Detectors for Fire Protective Signaling Systems.
UL 268A	Smoke Detectors for Duct Applications.
UL 217	Smoke Detectors Single Station.
UL 521	Heat Detectors for Fire Protective Signaling Systems.
UL 228	Door Holders for Fire Protective Signaling Systems.
UL 464	Audible Signaling Appliances.
UL 1638	Visual Signaling Appliances.
UL 38	Manually Activated Signaling Boxes.
UL 346	Water flow Indicators for Fire Protective Signaling systems.

UL 1971

Visual Signaling Appliances.

UL 1481

Power Supplies for Fire Protective Signaling Systems.

4. Americans with Disabilities Act (ADA).

1.3 CONTRACTOR QUALIFICATIONS

- A. Equipment and materials shall be provided by a factory-authorized distributor to ensure proper specification adherence, final connection, test, turnover, warranty compliance, and service. The factory-authorized distributor is required to have been in the fire alarm industry (service and installation) for a minimum of 5 years.

1.4 SUBMITTALS

- A. Shop drawings shall be submitted for each item of equipment to be furnished.
- B. Submittal shall include:
 1. A complete wiring and conduit layout on the building floor plan
 2. System battery calculations
 3. Notification appliance circuit voltage drop calculations. This data must be prepared by an authorized representative of the system manufacturer. Layout shall indicate conductor sizes, quantities, and color coding for each conduit run, as well as required conduit sizes.
- C. Evidence of listing by Underwriters' Laboratories for all proposed equipment for use as Fire Alarm equipment. (Ref.: Underwriters' Laboratories, Section UOJZ).
- D. A copy of the Contractors Training Certification, issued by the manufacturer of the Fire Alarm Control Equipment, shall be provided. These qualification credentials shall not be more than two years old, to ensure up-to-date product and application knowledge on the part of the installing contractor.
- E. Proof shall be furnished that the manufacturer of the Fire Alarm System Components is certified as an ISO 9001 company in each of the following disciplines: Design Engineering, Manufacturing, Technical Support, Documentation, Training, and Marketing. In lieu of such proof, the manufacturer must be able to show that the method that they employ in those disciplines is equivalent to ISO 9001 requirements.

1.5 CLOSEOUT DOCUMENTS

- A. complete set of record wiring schematics, drawn to scale; showing all device locations, wire routing and connections, etc. shall be provided prior to final inspection.
- B. Warranty Statement from the manufacturer: Warranty statement will state the period of warranty for all of the products proposed for the project, and shall include the name and address of the authorized manufacturers' agent who will honor any and all warranty claims.
- C. Written Certification by the Fire Alarm Contractor that no power supply or circuit in the system has an electrical load greater than 80% of its rated capacity.
- D. A scaled plan of the building showing the placement of each individual item of fire alarm equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.

- E. A Single Line System Block Diagram and written System Operational Overview.
- F. Complete battery and voltage drop calculations which include loads for all system components:
- G. Field Connection Drawings: A complete set of drawings, one for each Fire Alarm Control Panel module which has any external (field) wiring connected to it, and one for each system detector, module or signaling appliance, shall be supplied.
- H. Print-out report detailing the sensitivity of each smoke detector installed in the system. Include date on report.

1.6 SYSTEM FUNCTION

- A. In general, system function shall be as evidently intended by selection of equipment indicated herein.
- B. Activation of any manual station, smoke detector, sprinkler system flow switch, or other alarm initiating device shall cause:
 - 1. The sounding of audible signals throughout the facility.
 - 2. The flashing of alarm indicating signal lights.
 - 3. Indication of the alarm condition at the control panel indicating type of alarm (e.g. whether manual station, smoke detector, etc.) as well as location of initiating device.
 - 4. Release of magnetic door holders (power and controls), shut-down of air handling systems, closing of smoke dampers (power and controls) and other control functions as indicated or required.
 - 5. A local sounding device in the panel shall be activated.
 - 6. All automatic programs assigned to the alarm point shall be executed and the associated notification appliance circuits and control relays addressed and activated.
 - 7. Other functions as noted on the drawings or as evidently intended or required.
- C. All strobes shall be synchronized in common spaces.
- D. Provide a horn silence function with an adjustable delay of 2 minutes to 15 minutes. Delay shall prevent silence function from engaging. Silence function shall be manually activated only and shall not prevent visual alarm from flushing.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Gamewell/FCI: S3
- B. Notifier: NFS-320
- C. Simplex: Grinnell 4010

2.2 SYSTEM COMPONENTS

- A. Control Panel: The panel shall include all modules and components required for specified function, including, but not limited to:

1. 24 VDC system power and supervisory control.
2. Style 4 (Class B) Signaling line circuits providing individual identification of initiating devices, and individual operation of indicating appliances and control relays.
3. Style Y (Class B) notification appliance circuits.
4. Battery, charger, control, and metering. Batteries shall be lead-calcium sealed-cell type. Capacity shall be adequate to operate system for 24 hours minimum in standby, plus 5 minutes in alarm.
5. Modules and/or relays as required for special system functions. Control panel enclosure shall include spare space for a minimum of five additional modules.

B. Multiple Addressable Peripheral Network:

1. The system must provide communications with initiating and control devices individually. All of these devices will be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:
 - a. Alarm
 - b. Trouble
 - c. Open
 - d. Short
 - e. Device missing/failed
2. The fire alarm system shall be microprocessor driven with stored program controllers. Each panel (node) on the network shall use a multiple microprocessor design so that the failure of a single microprocessor will not result in a local failure. Fire alarm systems that utilize only one microprocessor for system (node) and SLC control will not be accepted.
3. An Electronic 100% digital Loop Controller shall be provided in the Fire Alarm Control Panel to interface between the panel and the Analytical Microprocessor-based Detectors and modules.
4. All system programming and history shall be permanently stored in non-volatile memory to ensure that no programming or history is lost. Systems which store initial programming or field programming changes in battery backed memory will not be accepted.
5. Electronic Loop Controller shall detect the electrical location of each connected detector and module. The location and type of each connected device shall be mapped and stored in memory in the loop controller. It shall be possible to access and display this map at any time.
6. It shall be possible to obtain a mapping report of all devices connected to the Electronic Loop Controller for confirmation of "as-built" wiring. The mapping report shall show physical wiring of all connected devices, including T-Taps, device types, and the panel addresses of devices on the circuit. The Electronic Loop Controller shall be capable of reporting any additional device addresses, which may have been added to the circuit, and/or changes that may have been made to the wiring in the data circuit. A specific trouble shall be reported for any and all off-normal non-alarm condition.
7. Addressable devices shall have the capability of being disabled or enabled individually. Up to 250 addressable devices may be multidropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices are unacceptable.
8. The communication format must be a completely digital poll/response protocol. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol. Systems that do not utilize full digital transmission protocol are not acceptable.
9. Each addressable device must be uniquely identified by an address code entered on each device at time of installation. Device identification schemes that do not use uniquely set addresses but rely on electrical position along the communication channel are unacceptable.

10. Wiring types shall be approved by the equipment manufacturer. The system shall allow a line distance of up to 2,500 feet to the furthest addressable device.
11. The system control panel must be capable of communicating with the types of addressable devices specified below. Addressable devices shall be located as shown on the drawings. There shall be no limit to the number of detectors, stations, or Addressable Modules, which may be activated or "in alarm" simultaneously.
 - a. System shall use Analytical Detectors that are capable of full digital communications with the Fire Alarm System using both broadcast and polling communications protocols. Each detector shall be capable of performing independent advanced fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted nuisance alarms caused by environmental events. Signal patterns that are not typical of fires shall be eliminated by digital filters and will not cause a system alarm condition. Devices not capable of combining different fire parameters or employing digital filters will not be acceptable.
 - b. Each detector shall be capable of identifying diagnostic codes to be used for system maintenance. All diagnostic codes shall be stored in the detector. Each smoke detector shall be capable of transmitting pre-alarm, alarm, and maintenance signals to the Fire Alarm Control Panel via the Electronic Loop Controller.
 - c. Each detector shall be capable of automatic electronic addressing and/or custom addressing without the use of DIP or rotary switches, and shall mount on a common base to allow the simple replacement of one detector type with another detector type. The addressing of the detectors will not depend on the electrical position of the detector on the circuit. If devices require DIP switches or rotary dials for addressing, every device shall be physically removed and verified during final checkout with engineer to confirm devices are located and programmed correctly. All of these devices and their bases will also be required to be labeled with engraved lexan labels to identify device address and intended location. Labels shall be red background with white letters; letters shall be a minimum of 1/4" in height.
 - d. Heat Detector shall have a solid state heat sensor, and shall transmit an alarm at a fixed temperature of 135° F (57°C) or due to a temperature Rate of Rise of 15°F/minute (9°C/minute). The detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The heat detector shall be rated for ceiling installation at 70 ft (21.3m) centers and be suitable for wall mount applications.
 - e. Photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to detect visible particulates produced by combustion. The detector shall dynamically examine values from the sensor and initiate a system alarm based on the analysis of data. Detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, aging and humidity. The alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5% smoke obscuration per foot. The photo detector shall be suitable for operation in the following environment:
 - (1) Temperature: 32°F to 120°F (0°C to 49°C)
 - (2) Humidity: 0-93% RH, non-condensing
 - (3) Elevation: no limit
 - f. Mounting base shall support all Smoke detector types detailed in this specification, and have the following minimum requirements:
 - (1) Removal of the respective detector will not affect electronic loop communications with other detectors on that loop.

- (2) Field Wiring Connections shall be made to the room side of the base, so that wiring connections can be made or disconnected by the contractor without the need to remove the mounting base from the electrical box. The base shall be capable of supporting remote alarm annunciation. Bases will have the option of external L.E.D. operation, Relay base or data line isolator base.
 - (aa) Relay base shall mount in a standard electrical box described above and provide Form "C" contacts rated at 1 amp @ 30VDC and listed for "pilot duty".
 - (bb) Isolator bases shall operate within a minimum of 23 msec. Of a short circuit on the data line, shall run self-test procedure to re-establish normal operation, and shall operate in a class 'A' operation as well as class 'B'.
- g. Duct smoke detector shall utilize a photoelectric smoke detector that is readily adaptable for use in air duct smoke detection applications, using a housing that mounts to the outside of the duct. When used for duct smoke detection, the smoke detectors shall not forfeit any of the system functionality which they have when used as area smoke detectors. The duct smoke detection housing shall allow the detector to sample and compensate for, variations in duct air velocity between 300 and 4000 feet per minute. The detector sampling tube shall extend the full width of the duct. Sampling tubes longer than 36 inches shall be supported from both ends. Remote alarm LEDs and Remote Test Stations shall be supported by the duct smoke detector and provided where indicated. All detectors used in duct applications shall be located in accordance with NFPA 72 recommendations.
- h. The Fire Alarm System shall incorporate addressable modules for the monitoring and control of system Input and Output functions over a 2 wire electronic communications loop, using both broadcast and serial polling protocols. All modules shall display communications and alarm status via LED indicators. The function of each connected module shall be determined by the module type, and shall be defined in the system software through the application of a personality code. Simply changing the associated personality code may change module operation at any time. All addressing of the Addressable Modules shall be done electronically, and the electrical location of each module shall be automatically reported to the Fire Alarm Control Panel, where it may be downloaded into a PC, or printed out. The addressing of the modules will not be dependent on their electrical location on the circuit. All field wiring to the Addressable Modules shall be supervised for opens and ground faults and shall be location annunciated to the module of incidence. Diagnostic circuitry, and their associated indicators, with reviewable Trouble Codes, shall be integral to the Addressable Modules to assist in troubleshooting system faults.
 - (1) Addressable Modules shall be used to provide supervised input circuits capable of latching operation for use with contact devices, non-damped Waterflow Switches, non-latching supervisory sprinkler switches.
 - (2) Addressable Control Relay Modules shall provide one form "C" dry relay contact rated at 2 amps @ 24 VDC or 0.5 amps at 120 VAC to, control external appliances or equipment processes. The control relay module shall be rated for pilot duty applications and releasing systems service. The position of the relay contact shall be confirmed by the system firmware.
- i. The Addressable Fire Alarm Stations shall be a lexan double action fire alarm stations and fit in to a standard electrical box. Stations shall be key reset. Station shall be in red with white lettering. Where shown on drawings, provide tamper-resistant manual pull station cover. The cover shall be clear lexan, suitable for

surface mount or semi-flush mount depending on the application. The cover shall have a local sounder option, which when operated, shall sound a local signal only.

12. All appliances which are supplied for the requirements of this specification shall be U.L. Listed for Fire Protective Service, and shall be capable of providing the "Equivalent Facilitation" which is allowed under the Americans with Disabilities Act Accessibilities Guidelines (ADA(AG)), and shall be UL 1971, and ULC S526 Listed. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturers' instructions. All horns shall be electronic, with field selectable jumpers to set operation for either continuous ring or temporal pattern and shall provide an adjustable high output or low output at 98dB or 94dB. In - Out screw terminals shall be provided for wiring, the use of 'pig-tail' type connectors is not acceptable. Strobes shall be supplied by the same manufacturer as the Fire Alarm Control Equipment. The Strobes shall have a red or white plastic faceplate. They shall provide the proper candela output for the project per NFPA 72 spacing guidelines and synchronized flash outputs minimum requirements. The strobe shall have lens markings oriented for wall mounting. In - Out screw terminals shall be provided for wiring. They shall provide synchronized flash outputs as required to comply with code requirements.
- C. Remote LCD Annunciator: Remote LCD annunciator shall have the full ability and duplicate in all fashion the main user interface located on the control panel. This includes the ability to control all system functions, tests, programming, and annunciations. Annunciator shall also include the ability to add programmable switches and or LED's as required for special functions with out the need to add additional wires or cabinets.
- D. Notification Appliance Circuits: Provide where indicated on the plans supervised hard-wired Notification Appliance Circuits (NAC) for the control of 24VDC signaling appliances. Each NAC shall operate as a Class B (Style Y) circuit, and shall be capable of controlling up to 3.5 amps of signaling power.
- E. Relays: Relays for remote control wiring, where the wiring is provided under another contract, shall have DPDT contacts rated 10 amperes at 115 VAC, minimum.
- F. Digital Communicator: A digital communicator shall be provided. One eight circuit communicator shall be installed and connected to two separate telephone numbers in accordance with NFPA 72. All UL Standards and NFPA Standards for reliability shall be met. The Contractor shall verify all conditions relating to telephone numbers on both sending and receiving ends, being reliable according to NFPA Standards. All equipment shall be UL listed and shall provide a detailed narrative description in the operation and maintenance manuals of the final installed conditions and arrangements, including telephone circuits used on-site and numbers call off-site. Once the new system is complete, tested, and accepted, it shall be placed in service and connected to the off-site, central station, fire alarm reporting service. The Contractor shall provide all necessary conductors, conduit and relays to terminate three signals (fire alarm, supervisory alarm, trouble) into a central station service interface and transmitter panel shall be in its own cabinet (not within the main panel) and shall be capable of being disconnected and removed without affecting the building system. The interconnection shall be supervised. Upon any fire alarm initiated by a water flow switch, manual station, thermal detector, or a verified smoke detector alarm, one general alarm signal shall be sent to the central station. Upon the activation of any supervisory switch in the building connected to circuits reporting to the CPU, one separate signal shall be forwarded off-site. Upon the activation of the main FACP trouble, one trouble signal shall be sent to the central station.

G. Spare Components: Furnish spare components to the Owner in the following quantities, but not less than one of each type of device used on the project:

1. Fuses – 2 of each type and size
2. Manual Stations – 2% of installed quantity.
3. Signal Devices – 4% of installed quantity of each type.
4. Automatic Detectors with Bases – 6% of installed quantity of each type.

PART 3 EXECUTION

3.1 INSTALLATION

A. Wiring shall be in accordance with manufacturer's recommendations for proper system operation.

B. Signal line circuit cable for monitoring and control of addressable devices shall be not less than a #18 AWG twisted shielded pair type FPL/FPLR/FPLP fire alarm cable. Unless specifically noted or approved otherwise, other conductors shall be of stranded copper not smaller than #14 AWG, with THWN/THHN insulation. Color coding shall be as follows:

- | | | |
|----|---------------------------------|---------------------|
| 1. | Signaling Line Circuit | Red(+) Black(-) |
| 2. | Notification Appliance Circuits | Blue(+) Black(-) |
| 3. | 24 VDC Operating Power | Yellow(+) Brown(-1) |
| 4. | Door Control Circuits | Orange |

C. All wiring shall be in metal raceway, unless specifically shown otherwise. Raceways shall be sized for the wiring requirements of the system proposed, with maximum conduit fill of 40%.

D. In multistory buildings, all wiring leaving the riser on each floor shall run through a labeled terminal block located in a hinged cabinet accessible from the floor. Terminations shall have pressure wire connectors of the self-lifting or box lug type.

E. Wall-mounted system devices shall be flush mounted where construction permits. Where necessary and approved by the Architect/Engineer, surface mounting enclosures may be utilized. Contractor shall coordinate trim types.

F. Automatic detectors shall be located at least three feet from any HVAC diffuser.

G. An identification map showing all initiating devices and their address numbers shall be provided and mounted beside the main panel for quick and easy location of alarmed or troubled devices. System map shall be mounted under Plexiglas.

H. All junction and connection boxes shall be painted red for easy identification.

I. Field Connected Devices must be installed and wired by a Factory Trained and Authorized Fire Alarm System Sub-Contractor or a licensed electrical contractor under direct supervision of a Factory Trained and Authorized Fire Alarm System Sub-Contractor.

J. All auxiliary Power Supplies or other Fire Panels shall be located in electrical or mechanical rooms. They shall be mounted at a height between 48 to 60 inches from floor level. All such panels shall be "supervised" by the main Fire Alarm Panel. A smoke detector shall be located on the ceiling within five feet of all auxiliary power supplies.

- K. No wiring associated with the fire alarm system shall be spliced other than at device or cabinet terminal blocks. Permanent wire markers shall be used to identify all connections at the fire alarm control panel, power supplies and terminal cabinets.
- L. Provide all necessary power and control wiring for smoke dampers furnished and installed by Mechanical Contractor. Coordinate voltage requirements for smoke damper actuators with Mechanical Contractor.
- M. Duct smoke detectors shall be furnished and wired by Electrical Contractor and installed by Mechanical Contractor. Coordinate installation, including sampling tube, with Mechanical Contractor.

3.2 MANUFACTURER'S RESPONSIBILITIES

- A. Final system connections shall be made by or under the direct supervision of an authorized representative of the manufacturer, who shall verify to the Architect/Engineer that the system has been left in full and proper operating condition.
- B. Manufacturer's representative and a Record of Completion presented upon completion shall verify system installation and operations. The manufacturer's representative shall be responsible for an on-site demonstration of the operation of the system and initial staff training.
- C. Manufacturer shall supply a 2 year warranty from date of manufactured Control System and Field Devices and appliances.
- D. System shall be maintained in perfect operating condition for a period of two years following completion of the project, at no additional cost to the Owner.
- E. Manufacturer shall maintain a service organization with adequate spare parts stock within 50 miles of the installation. Any defects that render the system inoperative shall be repaired within 24 hours of the owner notifying the contractor. Other defects shall be repaired within 48 hours of the owner notifying the contractor.

3.3 SURGE PROTECTION AND GROUNDING

- A. All equipment shall be properly grounded. Main panel shall be grounded directly to 'earth ground'. Surge protection and lightning arrestors shall be installed on the AC supply and all initiating, notification and monitoring circuits. All surge protection shall be Ditek or equivalent.
 - 1. Ditek DTK-LVLP Series for low voltage data and signal line protection.
 - 2. Ditek DTK-HW Series for hard wire AC protection for 120 VAC.

3.4 SYSTEM TEST AND CERTIFICATION/DEMONSTRATION

- A. The completely installed fire alarm system shall be fully tested in compliance with Testing Procedures for Signaling Systems (NFPA 72) under the supervision of a trained manufacturer's representative. The system shall be demonstrated to perform all the functions as specified.
- B. The Fire Alarm System Sub-Contractor shall test:
 - 1. Every alarm initiating device for proper response and program execution.
 - 2. Every notification appliance for proper operation and audible/visual output.

3. All auxiliary control functions such as elevator capture, smoke door and damper release, and functional override of HVAC, ventilation, and pressurization controls.
- C. The Contractor shall provide all necessary two-way radios, ladders and any other materials needed to test the system.
- D. The Engineer and Owner must be notified at least 10 working days prior to the scheduled testing so that he may be present for such testing.
- E. After the system has been completely tested to the satisfaction of the Engineer and Owner, the Fire Alarm System Sub-Contractor shall complete the Fire Alarm System Certification of Completion form published by the NFPA.
- F. The completed form signed by a principal of the Fire Alarm System Sub-Contractor and shall be delivered to the Architect/Engineer with the other system documentation required by these specifications.

3.5 INSTRUCTION OF OWNER

- A. The Fire Alarm System Sub-Contractor shall schedule and execute an instruction class for the Building owner, which details the proper operation of the installed fire alarm system. The instruction shall also cover the schedule of maintenance required by NFPA 72 and any additional maintenance recommended by the system manufacturer. This training shall also include, but not be limited to the following subjects:
 1. How to replace heads and set addresses if not set automatically.
 2. How to locate short in the circuit.
 3. How to replace electronic cards and where to mount them in the panel.
 4. Each electronic card shall be third party listed.
 5. Get familiar with functionality of each electronic card.
 6. How to do dirty head test report and sensitivity test report.
 7. How to synchronize the strobe lighting for the entire building.
 8. How to check the circuit ground fault and how to clear it.
 9. How to interpret the display field codes {A=Alarm, S=Supervisory, T=Trouble, M=Modules}.
 10. How to locate faulty Module from the trouble display codes.
- B. The instruction shall be a minimum of 4 hours in duration and presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.
- C. The Fire Alarm System Sub-Contractor shall provide service and operation manuals or any other curricula that may enhance the instruction of the Building Owners or Local Municipal Fire Department in the operation and maintenance of the system. Also provide software and hardware necessary to troubleshoot and completely program the system.

END OF SECTION

SECTION 02110

SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of surface debris.
- B. Removal of paving, curbs, and structures
- C. Removal of trees, shrubs, and other plant life.
- D. Removal of underground storage tanks.
- E. Topsoil excavation.

1.2 RELATED SECTIONS

- A. Section 02211 - Rough Grading.
- B. Section 02229 - Rock Removal.

1.3 REGULATORY REQUIREMENTS

- A. Conform to Owner, County, Department of Transportation, local fire department, and any other applicable codes for environmental requirements, disposal of debris, burning debris on site, and use of herbicides.
- B. Coordinate clearing Work with applicable utility companies.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Herbicide: as indicated on plans.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that existing plant life designated to remain is tagged or identified.
- B. Identify a waste area for placing removed materials.

3.2 PROTECTION

- A. Locate, identify, and protect utilities that remain from damage.
- B. Protect trees, plant growth, and features designated to remain as final landscaping.
- C. Protect bench marks, and survey control points, and existing remaining structures from damage or displacement.

3.3 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees and shrubs as indicated on plans. Remove stumps and root systems to an adequate depth. Remove surface rocks and other debris.
- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Apply herbicide to remaining stumps to inhibit growth.

3.4 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Remove demolished pavement and curb and other debris from site.
- C. Excavate and remove underground storage tanks, restraining straps, associated plumbing, and other debris.

3.5 TOPSOIL EXCAVATION

- A. Excavate topsoil from\marked areas in accordance with the plans without mixing with foreign materials.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on the plans to depth not exceeding 8 feet and protect from erosion.
- D. Remove topsoil not intended for reuse from site to an appropriate and permitted site.

END OF SECTION

SECTION 02205

SOIL MATERIALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Subsoil materials.
- B. Topsoil materials.

1.2 RELATED SECTIONS

- A. Section 02207 - Aggregate Materials.
- B. Section 02223 - Backfilling.
- C. Section 02225 - Trenching.
- D. Section 02275 - Riprap.
- E. Section 02936 - Seeding.

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with all references, Owner requirements, and applicable state agency requirements.

1.4 REFERENCES

- A. ASTM D698 – Laboratory Compaction Characterizes of Soil Using Standard Effort
- B. ASTM D2487 - Classification of Soils for Engineering Purposes.
- C. ASTM D4318 – Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- D. ASTM D422 – Standard Test Method for Particle-Size Analysis of Soils
- E. ASTM D2974 – Standard Test Method for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State of North Carolina, Owner and the NCDOT. Maintain one copy of all approved permits on site during construction.

PART 2 PRODUCTS

2.1 SUBSOIL MATERIALS

- A. Subsoil Type S1: Conforming to North Carolina Department of Transportation requirements.
- B. Subsoil Type S2:
 - 1. Excavated and re-used material, imported borrows, or select or local borrow.
 - 2. Graded.
 - 3. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
 - 4. Relatively free of organic material.
 - 5. Group symbols GM, SW, SP, SM, SC, ML, CL. MH and CH may be satisfactory with engineers approval. OL, OH and PT are unsatisfactory.

2.2 TOPSOIL MATERIALS

- A. Topsoil Type S3: Conforming to North Carolina Department of Transportation requirements.
- B. Topsoil Type S4:
 - 1. Excavated and reused material.
 - 2. Graded.
 - 3. Free of roots, rocks larger than ½ inch, subsoil, debris, large weeds and foreign matter.
 - 4. Containing a minimum of 4 percent and a maximum of 25 percent organic matter.