SECTION 260500 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, tools, materials, accessories, parts, transportation, taxes, and related items, essential for installation of the work and necessary to make work, complete, and operational. Provide new equipment and material unless otherwise called for. References to codes, specifications and standards called for in the specification sections and on the drawings mean, the latest edition, amendment and revision of such referenced standard in effect on the date of these contract documents. All materials and equipment shall be installed in accordance with the manufacturer's recommendations.

1.2 LICENSING

A. The Contractor shall hold a license to perform the work as issued by the authority having jurisdiction.

B. Plumbing contract work shall be performed by, or under, the direct supervision of a licensed master plumber.

C. Electrical contract work shall be performed by, or under, the direct supervision of a licensed electrician.

1.3 PERMITS

A. Apply for and obtain all required permits and inspections, pay all fees and charges including all service charges. Provide certificate of approval from the Authorities Having Jurisdiction prior to request for final payment.

B. Provide electrical inspection certificate of approval from Middle Department Inspection Agency, Commonwealth Inspection Agency, or an Engineer approved Inspection Agency prior to request for final payment.

1.4 CODE COMPLIANCE

A. Provide work in compliance with the following:

1. 2020 Building Code of New York State.

2. 2020 Fire Code of New York State.

3. 2020 Plumbing Code of New York State.

4. 2020 Mechanical Code of New York State.

5. 2020 Fuel Gas Code of New York State.

6. 2020 Property Maintenance Code of New York State.

7. 2020 Energy Conservation Code of New York State

8. Accessible and Usable Buildings and Facilities, ICC A117.1 (2009).
9. New York State Department of Labor Rules and Regulations.
10. New York State Department of Health.
11. 2017 National Electrical Code (NEC).
12. Occupational Safety and Health Administration (OSHA).
13. Local Codes and Ordinances.
14. Life Safety Code, NFPA 101.

1.5 GLOSSARY

ACI	American Concrete Institute
AGA	American Gas Association
AGCA	Associated General Contractors of America, Inc.
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AFBMA	Anti-Friction Bearing Manufacturer's Association
AMCA	Air Moving and Conditioning Association, Inc.
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing Materials
AWSC	American Welding Society Code
AWWA	American Water Works Association
FM	Factory Mutual Insurance Company
IBR	Institute of Boiler & Radiation Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IRI	Industrial Risk Insurers
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association

NYS/DEC	New York State Department of Environmental Conservation
SBI	Steel Boiler Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
UFPO	Underground Facilities Protective Organization
UL	Underwriter's Laboratories, Inc.
OSHA	Occupational Safety and Health Administration
XL - GAP	XL Global Asset Protection Services

1.6 DEFINITIONS

Acceptance	Owner acceptance of the project from Contractor upon certification by Owner's Representative.
As Specified	Materials, equipment including the execution specified/shown in the contract documents.
Basis of Design	Equipment, materials, installation, etc. on which the design is based. (Refer to the article, Equipment Arrangements, and the article, Substitutions.)
Code Requirements	Minimum requirements.
Concealed	Work installed in pipe and duct shafts, chases or recesses, inside walls, above ceilings, in slabs or below grade.
Coordination Drawings	Show the relationship and integration of different construction elements and trades that require careful coordination during fabrication or installation, to fit in the space provided or to function as intended.
Delegated-Design Services	Performance and Design criteria for Contractor provided professional services. Where professional design services or certifications by a design professional are specifically required of a Contractor, by the Contract Documents. Provide products and systems with the specific design criteria indicated. If criteria indicated is insufficient to perform services or certification required, submit a written request for additional information to the Engineer. Submit wet signed and sealed certification by the licensed design professional for each product and system specifically assigned to the Contractor to be designed or certified by a design professional. Examples: structural maintenance ladders, stairs and platforms, pipe anchors, seismic compliant system, wind, structural supports for material equipment, sprinkler hydraulic calculations.
Equal, Equivalent, Equal To, Equivalent To, As Directed and As Required	Shall all be interpreted and should be taken to mean "to the satisfaction of the Engineer".
Exposed	Work not identified as concealed.
Extract	Carefully dismantle and store where directed by Owner's Representative

	and/or reinstall as indicated on drawings or as described in specifications.
Furnish	Purchase and deliver to job site, location as directed by the Owner's Representative.
Inspection	Visual observations by Owner's site Representative.
Install	Store at job site if required, proper placement within building construction including miscellaneous items needed to affect placement as required and protect during construction. Take responsibility to mount, connect, start-up and make fully functional.
Labeled	Refers to classification by a standards agency.
Manufacturers	Refer to the article, Equipment Arrangements, and the article, Substitutions.
Prime Professional	Architect or Engineer having a contract directly with the Owner for professional services.
Product Data	Illustrations, standard schedules, performance charts, instructions, brochures, wiring diagrams, finishes, or other information furnished by the Contractor to illustrate materials or equipment for some portion of the work.
Provide (Furnish and Install)	Contractor shall furnish all labor, materials, equipment and supplies necessary to install and place in operating condition, unless otherwise specifically stated.
Relocate	Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready for use.
Remove	Dismantle and take away from premises without added cost to Owner, and dispose of in a legal manner.
Review and Reviewed	Should be taken to mean to be followed by "for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents".
Roughing	Pipe, duct, conduit, equipment layout and installation.
Samples	Physical full scale examples which illustrate materials, finishes, coatings, equipment or workmanship, and establishes standards by which work will be judged.
Satisfactory	As specified in contract documents.
Shop Drawings	Fabrication drawings, diagrams, schedules and other instruments, specifically prepared for the work by the Contractor or a Sub-contractor, manufacturer, supplier or distributor to illustrate some portion of the work.
Site Representative	Owner's Inspector or "Clerk of Works" at the work site.
Submittals Defined (Technical)	Any item required to be delivered to the Engineer for review as requirement of the Contract Documents. The purpose of technical submittals is to demonstrate for those portions of the work for which a submittal is required, the manner in which the Contractor proposes to conform to the information given and design concepts expressed and required by the Contract Documents.

1.7 SHOP DRAWINGS/PRODUCT DATA/SAMPLES

A. Provide submittals on all items of equipment and materials to be furnished and installed. Submittals shall be accompanied by a transmittal letter, stating name of project and contractor, name of vendor supplying equipment, number of drawings, titles, specification sections (name and number) and other pertinent data called for in individual sections. Submittals shall have individual cover sheets that shall be dated and contain: Name of project; name of prime professional; name of prime contractor; description or names of equipment, materials and items; and complete identification of locations at which materials or equipment are to be installed. Individual piecemeal or incomplete submittals will not be accepted. Similar items, (all types specified) shall be submitted at under one cover sheet per specification section (e.g. valves, plumbing fixtures, etc.). Number each submittal by trade. Indicate deviations from contract requirements on Letter of Transmittal. Submittals will be given a general review only. Corrections or comments made on the Submittals during the review do not relieve Contractor from compliance with requirements of the drawings and specifications. The Contractor is responsible for: confirming and correcting all quantities; checking electrical characteristics and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner. If submitting hard copies, submit four (4) copies for review.

B. If submittals are to be submitted electronically, all requirements in Item A apply. Submittals shall be emailed in PDF format to specific email address provided by the Construction Manager, General Contractor, Architect or Project Manager. Name of project shall be in subject line of email. Send emails to mealbasubmittalclerk@meengineering.com.

C. Refer to Division 01 for additional requirements.

1.8 PROTECTION OF PERSONS AND PROPERTY

A. Contractor shall assume responsibility for construction safety at all times and provide, as part of contract, all trench or building shoring, scaffolding, shielding, dust/fume protection, mechanical/electrical protection, special grounding, safety railings, barriers, and other safety feature required to provide safe conditions for all workmen and site visitors.

1.9 EQUIPMENT ARRANGEMENTS

A. The contract documents are prepared using one manufacturer as the Basis of Design, even though other manufacturers' names are listed. If Contractor elects to use one of the listed manufacturers other than Basis of Design, submit detailed drawings, indicating proposed installation of equipment. Show maintenance clearances, service removal space required, and other pertinent revisions to the design arrangement. Make required changes in the work of other trades, at no increase in any contract. Provide larger motors, feeders, breakers, and equipment, additional control devices, valves, fittings and other miscellaneous equipment required for proper operation, and assume responsibility for proper location of roughing and connections by other trades. Remove and replace doorframes, access doors, walls, ceilings, or floors required to install other than Basis of

Design. If revised arrangement submittal is rejected, revise and resubmit specified Basis of Design item which conforms to Contract Documents.

1.10 SUBSTITUTIONS

A. If Contractor desires to bid on any other kind, type, brand, or manufacture of material or equipment than those named in specifications, secure prior approval. To request such approval, Contractor shall submit complete information comparing (item-for-item) material or equipment offered with design material or equipment. Include sufficient information to permit quick and thorough comparison, and include performance curves on same basis, capacities, power requirements, controls, materials, metal gauges, finishes, dimensions, weights, etc., of major parts. If accepted, an addendum will be issued to this effect ahead of bid date. Unless such addendum is issued, substitution offered may not be used.

1.11 UTILITY COMPANY SERVICES

A. Division 26 shall make arrangements with National Grid for electric service to the Owner's distribution equipment. Provide underground or overhead electric service as called for and transformers, meter sockets or meter compartments as required by the Utility Company. Coordinate all activities between the Owner and Utility Company. The installation of the electric service shall comply with the published Utility Company standards

B. Division 22 shall make arrangements with National Grid for gas service to the Owner's distribution system. Provide service to the building as required by the Utility Company. Coordinate all activities between the Owner and Utility Company. The installation of the gas service shall comply with the published Utility Company standards

1.12 ROUGHING

A. The Contract Drawings have been prepared in order to convey design intent and are diagrammatic only. Drawings shall not be interpreted to be fully coordinated for construction.

B. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, interferences, etc. Make necessary changes in contract work, equipment locations, etc., as part of a contract to accommodate work to avoid obstacles and interferences encountered. Before installing, verify exact location and elevations at work site. DO NOT SCALE plans. If field conditions, details, changes in equipment or shop drawing information require an important rearrangement, report same to Owner's Representative for review. Obtain written approval for all major changes before installing.

C. Install work so that items both existing and new are operable and serviceable. Eliminate interference with removal of coils, motors, filters, belt guards and/or operation of doors. Provide easy, safe, and code mandated clearances at controllers, motor starters, valve access, and other equipment requiring maintenance and operation. Provide new materials, including new piping and insulation for relocated work.

D. Coordinate work with other trades and determine exact route or location of each duct, pipe, conduit, etc., before fabrication and installation. Coordinate with Architectural Drawings. Obtain from Owner's Representative exact location of all equipment in finished areas, such as thermostat, fixture, and switch mounting heights, and equipment mounting heights. Coordinate all work with the architectural reflected ceiling plans and/or existing Architecture. Mechanical and electrical drawings show design arrangement only for diffusers, grilles, registers, air terminals, lighting fixtures, sprinklers, speakers, and other items. Do not rough-in contract work without reflected ceiling location plans.

E. Before roughing for equipment furnished by Owner or in other Divisions, obtain from Owner and other Divisions, approved roughing drawings giving exact location for each piece of equipment. Do not "rough in" services without final layout drawings approved for construction. Cooperate with other trades to insure proper location and size of connections to insure proper functioning of all systems and equipment. For equipment and connections provided in this contract, prepare roughing drawing as follows:

1. Existing Equipment: Measure the existing equipment and prepare for installation in new location.

2. New Equipment: Obtain equipment roughing drawings and dimensions, then prepare roughing-in-drawings. If such information is not available in time, obtain an acknowledgement in writing, then make space arrangements as required with Owner's Representative.

1.13 COORDINATION DRAWINGS

A. Before construction work commences, Divisions for all trades shall submit coordination drawings in the form of CAD drawing files, drawn at not less than 1/4 in. scale. Such drawings will be required throughout all areas, for all Contracts. These drawings shall show resolutions of trade conflicts in congested areas. Mechanical Equipment Rooms shall be drawn early in coordination drawing process simultaneous with all other congested areas. Prepare Coordination Drawings as follows:

1. Division 23 shall prepare the base plan CAD coordination drawings showing all ductwork, all pertinent heating piping, and equipment. These drawings may be CAD files of the required Ductwork Shop Drawings. The drawings shall be coordinated with lighting fixtures, sprinklers, air diffusers, other ceiling mounted items, ceiling heights, structural work, maintenance clearances, electric code clearance, reflected ceiling plans, and other contract requirements. Reposition proposed locations of work after coordination drawing review by the Owner's Representative. Provide adjustments to exact size, location, and offsets of ducts, pipes, conduit, etc., to achieve reasonable appearance objectives. Provide these adjustments as part of contract. Minor revisions need not be redrawn.

2. Division 23shall provide CAD files and submit the base plan CAD Coordination Drawings to all Divisions.

3. Divisions 21 and 22 shall draw the location of piping and equipment on the base plan CAD Coordination Drawings, indicating areas of conflict and suggested resolutions.

4. Divisions 26, 27 and 28 shall draw the location of lighting fixtures, cable trays, and feeders over 1-1/2 in. on the base plan CAD Coordination Drawings, indicating areas of conflict and suggested resolution.

5. The General Construction Trade shall indicate areas of architectural/structural conflicts or obstacles on the CAD Coordination Drawings, and coordinate to suit the overall construction schedule.

6. The General Construction Trade shall expedite all Coordination Drawing work and coordinate to suit the overall construction schedule. In the case of unresolved interferences, he shall notify the Owner's Representative. The Owner's Representative will then direct the various trades as to how to revise their drawings as required to eliminate installation interferences.

7. If a given trade proceeds prior to resolving conflicts, then if necessary, that trade shall change its work at no extra cost in order to permit others to proceed with a coordinated installation. Coordination approval will be given by areas after special site meetings involving all Divisions.

B. The purpose of the coordination drawing process is to identify and resolve potential conflicts between trades, and between trades and existing or new building construction, before they occur in construction. Coordination drawings are intended for the respective trade's use during construction and shall not replace any Shop Drawings, or record drawings required elsewhere in these contract documents.

1.14 EQUIPMENT AND MATERIAL REQUIREMENTS

A. Provide materials that meet the following minimum requirements:

1. Materials shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less, in accordance with NFPA 255.

2. All equipment and material for which there is a listing service shall bear a UL label.

3. Potable water systems and equipment shall be built according to AWWA Standards.

4. Gas-fired equipment and system shall meet AGA Regulations and shall have AGA label.

5. Fire protection equipment shall be UL listed and FM approved.

B. Exterior and wet locations shall utilize materials, equipment supports, mounting, etc. suitable for the intended locations. Metals shall be stainless steel, galvanized or with baked enamel finish as a minimum. Finishes and coatings shall be continuous and any surface damaged or cut ends shall be field corrected in accordance with the manufacturer's recommendations. Hardware (screws, bolts, nuts, washers, supports, fasteners, etc.) shall be:

1. Stainless steel where the associated system or equipment material is stainless steel or aluminum.

2. Hot dipped galvanized or stainless steel where the associated system or equipment is steel, galvanized steel or other.

1.15 CUTTING AND PATCHING

A. Each trade shall include their required cutting and patching work unless shown as part of the General Construction Contract. Refer to General Conditions of the Contract for Construction, for additional requirements. Cut and drill from both sides of walls and/or floors to eliminate splaying. Patch cut or abandoned holes left by removals of equipment or fixtures. Patch adjacent existing work disturbed by installation of new work including insulation, walls and wall covering, ceiling and floor covering, other finished surfaces. Patch openings and damaged areas equal to existing surface finish. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

1.16 PAINTING

A. Paint all insulated and bare piping, pipe hangers and supports exposed to view in mechanical equipment rooms, penthouse, boiler rooms and similar spaces. Paint all bare piping, ductwork and supports exposed to the out-of-doors with rust inhibiting coatings. Paint all equipment that is not factory finish painted (i.e. expansion tanks, etc.).

B. All painting shall consist of one (1) prime coat and two (2) finish coats of non-lead oil base paint, unless otherwise indicated herein. Provide galvanized iron primer for all galvanized surfaces. All surfaces must be thoroughly cleaned before painting. Review system color coding prior to painting with the Owner's Representative or Architect.

C. All items installed after finished painting is completed and any damaged factory finish paint on equipment furnished under this contract must be touched up by the Contractor responsible for same.

D. Include painting for patchwork with color to match adjacent surfaces. Where color cannot be adequately matched, paint entire surface. Provide one (1) coat of primer and two (2) finish coats or as called for in the Specifications.

E. All primers and paint used in the interior of the building shall comply with the maximum Volatile Organic Compound (VOC) limits called for in the current version of U.S. Green Building Council LEED Credits EQ 4.1 and EQ 4.2.

F. Refer to Division 9 - Finishes, for additional information.

1.17 CONCEALMENT

A. Conceal all contract work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, notify Owner's Representative before starting that part of the work and install only after his review. In areas with no ceilings, install only after Owner's Representative reviews and comments on arrangement and appearance.

1.18 CHASES

A. New Construction:

1. Certain chases, recesses, openings, shafts, and wall pockets will be provided as part of General Construction Trade. Mechanical and Electrical trades shall provide all other openings required for their contract work.

2. Check Architectural and Structural Design and Shop Drawings to verify correct size and location for all openings, recesses and chases in general building construction work.

3. Assume responsibility for correct and final location and size of such openings.

4. Rectify improperly sized, improperly located or omitted chases or openings due to faulty or late information or failure to check final location.

5. Provide 18 gauge galvanized sleeves and inserts. Extend all sleeves 2 in. above finished floor. Set sleeves and inserts in place ahead of new construction, securely fastened during concrete pouring. Correct, by drilling, omitted or improperly located sleeves. Assume responsibility for all work and equipment damaged during course of drilling. Firestop all unused sleeves.

6. Provide angle iron frame where openings are required for contract work, unless provided by General Construction trade.

1.19 PENETRATION FIRESTOPPING

A. Fire-Stopping for Openings Through Fire and Smoke Rated Wall and Floor Assemblies:

1. Provide materials and products listed or classified by an approved independent testing laboratory for "Penetration Fire-Stop Systems". The system shall meet the requirements of "Fire Tests of Penetrations Fire-Stops" designated ASTM E814.

2. Provide fire-stop system seals at all locations where piping, tubing, conduit, electrical busways/cables/wires, ductwork and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire-stop seal between sleeve and wall for drywall construction.

3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire-stop system. The installation shall provide an air and watertight seal.

4. The methods used shall incorporate qualities which permit the easy removal or addition of electrical conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion, and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating.

5. Plastic pipe/conduit materials shall be installed utilizing intumescent collars.

6. Provide a submittal including products intended for use, manufacturer's installation instructions, and the UL details for all applicable types of wall and floor penetrations.

7. Fire-stopping products shall not be used for sealing of penetrations of non-rated walls or floors.

B. Acceptable Manufacturers:

1. Dow Corning Fire-Stop System Foams and Sealants.

2. Nelson Electric Fire-Stop System Putty, CLK and WRP.

3. S-100 FS500/600, Thomas & Betts.

4. Carborundum Fyre Putty.

5. 3-M Fire Products.

6. Hilti Corporation.

1.20 NON-RATED WALL PENETRATIONS

A. Each trade shall be responsible for sealing wall penetrations related to their installed work, including but not limited to ductwork, piping, conduits, etc. See individual specification sections for requirements.

1.21 SUPPORTS

A. Provide required supports, beams, angles, hangers, rods, bases, braces, and other items to properly support contract work. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above.

B. For precast panels/planks and metal decks, support mechanical/electrical work as determined by manufacturer and the Engineer. Provide heavy gauge steel mounting plates for mounting contract work. Mounting plates shall span two or more studs. Size, gauge, and strength of mounting plates shall be sufficient for equipment size, weight, and desired rigidity.

C. For finished areas without a finished ceiling system such as classrooms, offices, conference rooms, etc., where decking and structure is exposed, and ductwork/piping/conduit is exposed: All mounting brackets, channel support systems and mounting hardware for ductwork, piping, lighting, etc. shall be concealed and approved by the Architect/Engineer prior to the installation. AirCraft cable style hanging for ductwork is required. It is recommended that room mockups be done and receive Architect/Engineer approval prior to proceeding with installation.

D. Equipment, piping, conduit, raceway, etc. supports shall be installed to minimize the generation and transmission of vibration.

E. Materials and equipment shall be solely supported by the building structure and connected framing. Gypboard, ceilings, other finishes, etc. shall not be used for support of materials and equipment.

1.22 ACCESS PANELS

A. Provide access panels for required access to respective trade's work. Location and size shall be the responsibility of each trade. Access panels provided for equipment shall provide an opening not smaller than 22 in. by 22 in. Panels shall be capable of opening a minimum of 90 degrees. Bear cost of construction changes necessary due to improper information or failure to provide proper information in ample time. Access panels over 324 square inches shall have two cam locks. Provide proper frame and door type for various wall or ceiling finishes. Access panels shall be equal to "Milcor" as manufactured by Inland Steel Products Co., Milwaukee, Wisconsin. Provide General Construction trade with a set of architectural plans with size and locations of access panels.

1.23 CONCRETE BASES

A. Provide concrete bases for all floor mounted equipment. Provide 3,000 lb. concrete, chamfer edges, trowel finish, and securely bond to floor by roughening slab and coating with cement grout. Bases 4 in. high (unless otherwise indicated); shape and size to accommodate equipment. Provide anchor bolts in equipment bases for all equipment provided for the project, whether mounted on new concrete bases or existing concrete bases.

1.24 HVAC EQUIPMENT CONNECTIONS

A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.

B. Provide final connections to all equipment as required by the equipment. Provide final connections, including domestic water piping, wiring, controls, and devices from equipment to outlets left by other trades. Provide equipment waste, drip, overflow and drain connections extended to floor drains.

C. Provide for Owner furnished and Contractor furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, insulation, sheet metal work, controls, dampers, as required.

1.25 PLUMBING EQUIPMENT CONNECTIONS

A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.

B. Provide roughing and final connections to all equipment. Provide loose key stops, sanitary "P" traps, tailpiece, adapters, gas or air cocks, and all necessary piping and fittings from roughing point to equipment. Provide installation of sinks, faucets, traps, tailpiece furnished by others. Provide cold water line with gate valve and backflow prevention device at locations called for. Provide continuation of piping and connection to equipment that is furnished by others. Provide relief valve discharge piping from equipment relief valves.

C. Provide valved water outlet adjacent to equipment requiring same. Provide equipment type floor drains, or drain hubs, adjacent to equipment.

D. Install controls and devices furnished by others.

E. Refer to Contract Documents for roughing schedules, and equipment and lists indicating scope of connections required.

F. Provide for Owner furnished and Contractor furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, as required.

1.26 ELECTRICAL EQUIPMENT CONNECTIONS

A. Provide complete power connections to all electrical equipment. Provide control connections to equipment. Heavy duty NEC rated disconnect ahead of each piece of equipment. Ground all equipment in accordance with NEC.

B. Provide for Owner furnished and Contractor furnished equipment all power wiring, electric equipment, control wiring, switches, lights, receptacles, and connections as required.

1.27 STORAGE AND PROTECTION OF MATERIALS AND EQUIPMENT

A. Store Materials on dry base, at least 6 in. aboveground or floor. Store so as not to interfere with other work or obstruct access to buildings or facilities. Provide waterproof/windproof covering. Remove and provide special storage for items subject to moisture damage. Protect against theft or damage from any cause. Replace items stolen or damaged, at no cost to Owner.

B. Refer to Division 01 for additional information.

1.28 FREEZING AND WATER DAMAGE

A. Take all necessary precautions with equipment, systems and building to prevent damage due to freezing and/or water damage. Repair or replace, at no change in contract, any such damage to equipment, systems, and building. Perform first seasons winterizing in presence of Owner's operating staff.

1.29 OWNER INSTRUCTIONS

A. Before final acceptance of the work, furnish necessary skilled labor to operate all systems by seasons. Instruct designated person on proper operation, and care of

systems/equipment. Repeat instructions, if necessary. Obtain written acknowledgement from person instructed prior to final payment. Contractor is fully responsible for system until final acceptance, even though operated by Owner's personnel, unless otherwise agreed in writing. List under clear plastic, operating, maintenance, and starting precautions procedures to be followed by Owner for operating systems and equipment.

1.30 OPERATION AND MAINTENANCE MANUALS

A. Submit by email (preferred) or digital media, thru the normal project submittal process. Include a copy of each final approved Shop Drawing, wiring diagrams, piping diagrams, spare parts lists, final testing and balancing report, as-built drawings and manufacturer's instructions. Include typewritten instructions, describing equipment, starting/operating procedures, emergency operating instructions, summer-winter changeover, freeze protection, precautions and recommended maintenance procedures. Include name, address, and telephone number of installing contractor and of supplier manufacturer Representative and service agency for all major equipment items. Provide a table of contents page and dividers based upon specification section numbers. Submit in a compiled and bookmarked PDF format as outlined below.

B. Provide content for Operation and Maintenance Manuals as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer and Commissioning Agent will comment on whether content of operation and maintenance submittals is acceptable.

2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

C. Submit Operation and Maintenance Manuals in the following format:

1. Submit by uploading to web-based project software site, or by email to Architect, as a formal project submittal in conformance with the project specific submittal procedures. Enable reviewer comments on draft submittals.

2. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

3. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in the table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

D. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing Owner training. Engineer and Commissioning Agent will comment on whether general scope and content of manual are acceptable.

E. Final Manual Submittal: Submit O&M manual in final form prior to requesting inspection for Substantial Completion and at least 2 weeks before commencing Owner training. Engineer and Commissioning Agent will return copy with review comments.

1. Correct or revise O&M manual to comply with Engineer's and Commissioning Agent's comments. Submit copies of each corrected manual within 2 weeks of receipt of Engineer's and Commissioning Agent's comments.

F. Refer to Division 01 for additional requirements.

1.31 RECORD DRAWINGS

A. The Contractor shall obtain at his expense one (1) set of construction Contract Drawings, (including non-reproduction black and white prints or electronic files) for the purpose of recording as-built conditions.

B. The Contractor shall perform all survey work required for the location and construction of the work and to record information necessary for completion of the record drawings. Record drawings shall show the actual location of the constructed facilities in the same manner as was shown on the bid drawings. All elevations and dimensions shown on the drawings shall be verified or corrected so as to provide a complete and accurate record of the facilities as constructed.

C. It shall be the responsibility of the Contractor to mark EACH sheet of the contract documents in red and to record thereon in a legible manner, any and all approved field changes and conditions as they occur. A complete file of approved field sketches, diagrams, and other changes shall also be maintained. At completion of the work, the complete set of red marked contract documents, plus all approved field sketches and diagrams shall be submitted to the engineer and used in preparation of the record drawings.

D. A complete set of red marked contract drawings shall be submitted, at one time, as the "Record" set. If there are no changes to a specific drawing, the contractor shall indicate "NO CHANGES" on that drawing. ALL drawings shall be included in the "Record" set.

E. The complete set of red marked Contract Documents or electronic files shall be certified by the Contractor as reflecting record conditions and submitted to the engineer for review.

F. The Contractor shall have the marked up set scanned, if they are not already electronic files, and then submit them to the Engineer as the "Record Set".

G. Refer to Division 01 for additional requirements.

1.32 FINAL INSPECTION

A. Upon completion of all Engineering Site Observation list items, the Contractor shall provide a copy of the Engineering Site Observation Report back to the Engineer with each items noted as completed or the current status of the item. Upon receipt, the Engineer will schedule a final review.

1.33 COMMISSIONING

A. Refer to General Commissioning Requirements in Division 01 for additional requirements.

1.34 TEMPORARY HEATING AND COOLING

A. Refer to the General Conditions of the Contract for Construction and Supplemental General Conditions.

1.35 MAINTENANCE OF HVAC SYSTEMS DURING TEMPORARY USE PERIODS

A. Provide each air handling system with a set of prefilters in addition to the permanent filters. Furnish four sets of prefilters for each system for use when system is operated for temporary heating or cooling. During such use, change prefilters as often as directed by Owner's Representative. Provide MERV-8 filters in all open ended ducts, return grilles and registers to keep dust out of ductwork. Change as often as necessary. Remove all such temporary filters upon completion. Use supply fans only. Do not operate return fans.

B. Blank-off outside air intake opening during temporary heating period. Install first set of permanent filters and prefilters.

C. Adjust dampers on supply system.

D. Set all heating coil control valves for manual operation.

E. Do not install any grilles or diffusers at room terminal ends of ducts until permission is given.

F. Assume responsibility for systems and equipment at all times, even though used for temporary heat or ventilating. Repair or replace all dented, scratched or damaged parts of systems prior to final acceptance.

G. Remove concrete, rust, paint spots, other blemishes, then clean.

H. Just prior to final acceptance, remove used final filter and install new set. Deliver all unused sets of prefilters to the Owner and obtain written receipt. Properly lubricate system bearings before and during temporary use. Maintain thermostats, freeze stats, overload devices, and all other safety controls in operating condition.

1.36 TEMPORARY FACILITIES

A. Refer to the Division 1 Sections, General Conditions and Supplemental General Conditions.

1.37 TEMPORARY LIGHT AND POWER

A. Refer to the Division 1 Sections, General Conditions and Supplemental General Conditions.

1.38 CLEANING

A. It is the Contractor's responsibility to keep clean all equipment and fixtures provided under this contract for the duration of the project. Each trade shall keep the premises free from an accumulation of waste material or rubbish caused by his operations. The facilities require an environment of extreme cleanliness, and it is the Contractor's responsibility to adhere to the strict regulations regarding procedures on the existing premises. After all tests are made and installations completed satisfactorily:

1. Thoroughly clean entire installation, both exposed surfaces and interiors.

2. Remove all debris caused by work.

3. Remove tools, surplus, materials, when work is finally accepted.

1.39 SYSTEM START-UP AND TESTING

A. Prior to commencement of work, the Division(s) effecting such system shall survey all building mechanical, plumbing, fire protection and electrical systems and components and make written notice to the Owner's Representative regarding any damage, missing items and/or incomplete systems. Prior to the conclusion of this project, the Contractor shall verify with the Owner's Representative that all building systems have been returned to their original conditions.

1.40 TRANSFER OF ELECTRONIC FILES

A. M/E Engineering, P.C. will provide electronic files for the Contractor's use in the preparation of sheetmetal shop drawings, coordination drawings, or record drawings related to the project, subject to a and the following terms and conditions:

1. The Contractor shall submit a formal request for electronic drawing files on the M/E Engineering, P.C. website, by utilizing the following website link: http://www.meengineering.com/contact-pages/contractor-request.

2. M/E Engineering, P.C. makes no representation as to the compatibility of these files with the Contractor's hardware or the Contractor's software beyond the specific release of the referenced specifications.

3. M/E Engineering, P.C. can only provide CAD files of M/E/P/FP drawing levels for which we are the Engineer of Record. CAD files of Architectural backgrounds, reflected ceiling plans, structural plans, etc. must be obtained separately from the Architect of Record.

4. Data contained on these electronic files is part of M/E Engineering, P.C.'s instruments of service shall not be used by the Contractor or anyone else receiving data through or from the Contractor for any purpose other than as convenience in the preparation of shop drawings for the referenced project. Any other use or reuse by the Contractor or by others will be at the Contractor's sole risk and without liability or legal exposure to M/E Engineering, P.C. The Contractor agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against M/E

Engineering, P.C., its officers, directors, employees, agents or sub-consultants which may arise out of or in connection with the Contractor's use of the electronic files.

5. Furthermore, the Contractor shall, to the fullest extent permitted by law, indemnify and hold harmless, M/E Engineering, P.C. from all claims, damages, losses and expenses, including attorney's fees arising out of or resulting from the Contractor's use of these electronic files.

6. These electronic files are not contract documents. Significant difference may arise between these electronic files and corresponding hard copy contract documents due to addenda, change orders or other revisions. M/E Engineering, P.C. makes no representation regarding the accuracy or completeness of the electronic files the Contractor receives. In the event that a conflict arises between the signed contract documents prepared by M/E Engineering, P.C. and electronic files, the signed contract documents shall govern. The Contractor is responsible for determining if any conflicts exist. By the Contractor's use of these electronic files the Contractor is not relieved of the Contractor's duty to comply with the contract documents, including and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, field verify conditions and coordinate the Contractor's work with that of other contractors for the project.

1.41 ENERGY INCENTIVES

A. The Contractor, his Subcontractors and Suppliers shall provide to the Owner all paperwork necessary to support the Owners pursuit of incentives related to energy conservation as offered by the utility company or state sponsored incentive programs. This shall include at a minimum, receipts, and quantities and data sheets for energy efficient equipment such as: lighting, motors, variable frequency drives, etc.

END OF SECTION

SECTION 260501 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The drawings are diagrammatic, unless detailed dimensioned drawings are included, and show only approximate locations of equipment, fixtures, panelboards, conduits, and wiring devices. Exact locations are subject to the approval of the Owner's Representative. The general run of electrical feeders, branch circuits, and conduits, indicated on the drawings, is not intended to be the exact routing. Exact routings of conduit shall suit the job conditions.

B. Circuit designations, in the form of "Home Runs" on branches, indicate the designation of the branch circuit, the size and the quantity of branch circuit conductors, and the panel board or interconnection box from which the branch circuit is served.

C. Make measurements at the site and in the building during construction for all systems installed as the work progresses in such a manner that the equipment, piping, vents, ducts, conduit, and boxes will fit in the space available. Maintain headroom and if in unfinished areas, be as neatly installed, as obscure and "out-of-the-way" as physically possible. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. In general, ductwork shall be given preference except where grading of piping becomes a problem, followed by piping then electrical wiring. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and /or furnish other equipment as required for ample maintenance space.

D. Any changes in the size or location of the material or equipment supplied, which may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of the Owner's Representative and approval received before such alterations are made.

1.2 QUALITY ASSURANCE

A. Electric equipment shall be installed in a neat and workmanlike manner. All methods of construction, details of workmanship, that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative.

B. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions, etc., correspond to the nomenclature dictated by those manufacturers. Where "or equal" is stated, equipment shall be equal in every way to that of the equipment specified and subject to approval. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

1.3 SUBMITTALS

A. Submit product data for the following equipment, materials and products, including all fittings and accessories:

1. Conduit
2. Surface Metal Raceway
3. Expansion Fittings
4. Wireway and Wire Trough
5. Channel Support Systems
6. Conductors
7. Poke-Through Service Fittings
8. Terminal and Equipment Cabinets
9. Flush Floor Boxes
10. Wiring Devices Including Dimmers
11. Telephone/Data Communication Outlets
12. Television Outlets
13. Occupancy/Vacancy Sensors
14. Lighting Control Contactors
15. Boiler Shutdown Switches
16. Underground Pullboxes (Handholes) and Covers
17. Manholes and Covers
18. Water Proofing Seals
19. Flashing, Sealing, Firestopping Materials
20. Testing reports prior to energizing equipment and materials.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduit, Raceway and Tubing:

1. Rigid Metal Conduit shall be hot-dipped galvanized or electro-galvanized steel, UL listed "rigid metal conduit."

a. Acceptable Manufacturers:

1) Republic Conduit
2) Allied Tube and Conduit
3) Wheatland Tube Company
4) Approved equal

2. Electrical Metallic Tubing shall be electro-galvanized steel; UL listed "electrical metallic tubing."

a. Acceptable Manufacturers:

1) Republic Conduit
2) Allied Tube and Conduit
3) Wheatland Tube Company
4) Approved equal

3. Flexible Metal Conduit shall be constructed one continuous length of electro-galvanized, spirally wound steel strip with interlocking convolutions and interior surfaces free from burrs and sharp edges. Shall be UL listed "flexible metal conduit" or "liquidtight flexible metal conduit" as required.

   a. Acceptable Manufacturers:

      1) Republic Conduit
      2) Allied Tube and Conduit
      3) Wheatland Tube Company
      4) American Flexible Conduit Company

4. Rigid Non-Metallic Conduit (Schedule 40 for concrete encasement, Schedule 80 for direct burial or where exposed) shall be UL listed "rigid non-metallic conduit" for application in underground, encased, and exposed applications in accordance with Article 352 of the National Electrical Code. The conduit shall be made from polyvinyl chloride (PVC) and shall be rated for 90ºC conductors. Conduit and fittings shall be tested in accordance with the testing requirements defined in NEMA TC-2, NEMA TC-3, UL-651 and UL-514.

   a. Acceptable Manufacturers:

      1) Carlon
      2) Heritage Plastics
      3) PW Eagle

5. Surface Metal Raceway shall be .040 in. steel UL listed "Surface Metal Raceway". Use manufacturer's standard fittings designed to be used with the specific raceway.

   a. One-Piece Raceway:

      1) Buff or ivory finish.

      2) Acceptable Manufacturers:

         a) Wiremold "700" Series (Design Make)
         b) Mono Systems
         c) Approved equal

   b. Two-Piece Raceways:

      1) Ivory finish.

      2) Duplex or special receptacles as specified in wiring devices.

      3) Corners, turns, tees and elbows shall have suitable turning radius for the intended cable.

4) Provide divider in raceways utilized for power and communications. Utilize wire clips 18 in. on center to hold in the conductors/cables.

5) Utilize rounded head screws for mounting.

6) Acceptable Manufacturers:

a) Wiremold 6000 (Design Make)
b) Mono Systems
c) Approved equal

B. Conduit Fittings:

1. Fittings for rigid metal conduit shall be fully threaded and shall be of the same material as the respective raceway system. Fittings for electrical metallic tubing shall be single screw indenter fittings for conduits up to 2 in. and double screw indenter fittings for conduits 2 in. and larger. Connectors shall also have insulated throat up to and including 1 in. size. For sizes 1-1/4 in. and larger, provide plastic insulating bushing. Die-cast, pressure cast fittings shall not be used. Fittings for rigid non-metallic conduit shall be solvent cemented in accordance with the manufacturer's instructions.

a. Acceptable Manufacturers:

1) O.Z. Gedney
2) Steel City
3) Thomas & Betts
4) Crouse-Hinds
5) Carlon

2. Expansion Fittings shall be watertight, combination expansion and deflection type designed to compensate for movement in any direction. Fittings shall have flexible copper braid bonding jumpers, neoprene sleeve and stainless steel bands, use aluminum body fittings for rigid aluminum conduit.

a. Acceptable Manufacturers:

1) Crouse-Hinds, Type "DX"
2) O.Z./Gedney, Type "DX"
3) Approved equal

C. Wireway and Wire Trough:

1. Wireway and Wire Trough shall be hinged cover type wireway with provisions for full lay-in along the entire length of run. Wireway shall be steel, enclosed with gray enamel finish. Provide NEMA 1 units for interior/dry/clean locations and NEMA 12 for interior dry maintenance/shop/utility locations. Size to meet NEC fill requirements or larger as noted on Contract Documents. Provide knockouts along runs. Recess in wall where required for flush mounted equipment. Hinge shall be on the bottom of front face for horizontal mounting.

Provide all elbows, tees, pullboxes, fittings, hangers, reducers, supports, supports, etc., to meet installation requirements.

a. Acceptable Manufacturers:

1) Square D "Square Duct"
2) General Electric
3) Hoffman
4) Meco

D. Channel Support Systems:

1. Channel Support Systems shall be provided for racking of conduit, trapeze suspensions, equipment support, cable racks and panel racks. Provide poured-in-place inserts for supporting channels at poured concrete walls and ceilings. Channel shall be steel with electroplated zinc finish for interior dry locations. Provide necessary accessories such as bolts, screws, anchors, connection plates, and straps as required to perform the necessary functions. Wet location and exterior channel support systems shall be steel with hot dipped galvanized finish and stainless steel hardware as a minimum. Cut ends shall be touched up with suitable matching finish.

a. Acceptable Manufacturers:

1) Unistrut
2) Globe
3) Kindorf
4) B-Line

E. Conductors and Cables:

1. Conductors shall be insulated for 600 volts, unless otherwise noted, and shall be standard AWG and kcmil sizes. Conductors shall be 98% copper or 99.5% aluminum (#2AWG and larger), thermal plastic or cross-linked polymer insulated, heat and moisture resistant. Conductors shall be stranded, except for conductors used for fire alarm system wiring. Conductor sizes No. 18 AWG and smaller shall be a solid single strand; No. 16 AWG and larger shall be multiple stranded. Minimum conductor size shall be #12 AWG except smaller sizes may be used for communications and special systems. Conductor sizes shall be as called for. Conductors shall be labeled with UL seal and be marked with the manufacturer's name, wire size and insulation type. Insulation for all 600 volt conductors shall be Type THHN/THWN-2 for conductor sizes #8 AWG and smaller or Type XHHW-2 for conductor sizes #6 AWG and larger, unless otherwise noted. All exterior and underground conductors shall be XHHW-2. Luminaire fixture wire shall conform to the latest Underwriters Laboratories requirements. Flexible cords and cables for general portable use shall be Type SO or SOOW or as noted. Cables for special use shall be of the type specified for the application.

a. Color Coding:

1) All circuits shall be color coded according to the following schedule.

	Three Phase 120/208V 240V	**Three Phase 277/480V**
Ground	Green	Green
Neutral	White	Gray
A or L1	Black	Brown
B or L2	Red	Orange
C or L3	Blue	Yellow

b. Acceptable Manufacturers:

1) General Cable
2) Prysmian
3) South Wire
4) Okonite
5) Senator

2. Metal Clad, Type "MC" Cable shall consist of thermal plastic insulated copper conductors of size and quantity indicated, protected by a positive interlocked armor of galvanized steel. The conductors shall be twisted together and shall have an overall moisture and fire resistant fibrous covering. The cable shall provide an adequate path for equipment grounding as required by the NEC and have an integral green insulated full size equipment grounding conductor running its entire length. The cable shall meet the requirements of the NEC for "Type MC" Metal Clad Cable and shall bear the UL Label.

a. Acceptable Manufacturers:

1) Southwire
2) AFC Cable
3) Approved equal

F. Permanent Splices:

1. The shielded power cable splice must meet the requirements of ANSI/IEEE and meeting the cable voltage rating. It must be rated for continuous operation at 90ºC, with an emergency overload rating of 130ºC. The splice shall be made of peroxide cured EPDM rubber. The splice kit must contain all of the necessary materials required to make one inline splice (except for the connector), including a solderless mechanical ground jumper. The splice shall be designed for splicing tape shielded, wire shielded, and UniShield cables without the requirement of additional adapters. It shall be rated for indoor, outdoor and direct burial applications.

2. Acceptable Manufacturers:

a. 3M Brand

b. Elastimold
c. Raychem
d. Approved equal

G. Terminal Lugs and Connectors:

1. The copper lug shall be capable of continuous operation at the current rating of the cable it is used on. The lug shall be UL listed per UL 486A, using industry standard crimping tools and dies. Terminal lugs shall be solderless, pressure type with UL label for "CU/AL" conductor terminations. The lug shall be a closed-end compression (crimp) type, constructed of seamless, tin-plated copper. The lug shall be made with a chamfered inside end, for ease of conductor insertion. Both one and two hole lugs shall be NEMA sized for standard stud sizes and spacing. The lug shall be designed for use at voltages up to 35 kV.

   a. Acceptable Manufacturers:

      1) 3M Scotchlok 30,000 and 31,000 Series
      2) Burndy
      3) O.Z./Gedney
      4) Thomas and Betts

2. The copper conductor connection shall be capable of continuous operation at the current rating of the cables it is used on. The connection shall be UL listed per UL 486A, using industry standard crimping tools and ides. The connector shall be an inline compression (crimp) type, constructed of seamless, tin-plated copper. The connector shall be constructed with chamfered inside-ends and with center cable stops. The connector shall be designed for use at voltages up to 35 kV.

   a. Acceptable Manufacturers:

      1) 3M Scotchlok 10,000 and 11,000 Series
      2) Burndy
      3) O.Z./Gedney
      4) Thomas and Betts

3. "Split-bolt" Connectors shall be solderless type.

   a. Acceptable Manufacturers:

      1) Burndy
      2) Kearney
      3) O.Z./Gedney
      4) Thomas and Betts
      5) Anderson

4. "TWIST ON" Connectors shall be spiral steel spring type and insulated with vinyl cap and skirt.

   a. Acceptable Manufacturers:

1) 3-M Company "Scotch-Lok"
2) Ideal "Wing-Nuts"
3) Approved equal

H. Boxes:

1. Outlet boxes shall be galvanized steel, not less than 2-1/8 in. deep, unless restricted by the surroundings, 4 in. square or octagonal, with knockouts. Boxes and associated fittings, plates and devices shall be mechanically fastened (screwed), friction fitting is not acceptable. Outlet boxes exposed to moisture, exterior, wet or damp locations shall be cadmium cast alloy complete with external threaded hubs and gasketed screw fastened covers. Minimum box size shall be as indicated in the NEC for the conductors and devices installed. Boxes shall be approved for the environmental condition where they will be installed.

   a. Acceptable Manufacturers:

      1) Steel City
      2) Raco
      3) Appleton
      4) Crouse Hinds

2. Telephone/Data Communications Outlet Boxes:

   a. 4 in. x 4 in. x 2-1/8 in. minimum outlet box with single gang plaster ring with cover plate suitable for indicated communications outlet and conduit routed to accessible ceiling space. Cover plate shall match the receptacle cover type.

3. Pull and junction boxes shall be constructed of not less than 14 gauge galvanized steel with trim for flush or surface mounting in accordance with the location to be installed. Provide screw-on type covers. Boxes installed in damp or wet locations shall be of raintight construction with gasketed cover and threaded conduit hubs. In no case shall boxes be sized smaller than as indicated NEC for conduit and conductor sizes installed. Boxes shall be approved for the environmental condition of the location where they will be installed.

   a. Acceptable Manufacturers:

      1) Hoffman
      2) Keystone
      3) Approved equal

4. Flush floor junction boxes shall be recessed cover boxes designed for flush mounting in masonry. Provide checkered plate gasketed cover suitable for foot traffic. Make: O.Z. Gedney Type YR or approved equal.

5. Flush Floor Boxes: Boxes shall be cast in place with height adjustability prior to pour. Provide power, communication and/or audio/visual outlets as indicated. Installation shall be suitable for the intended floor finish: if carpet, then provide a carpet flange, if tile/terrazzo/concrete finish, then provide a collar flush with

finished floor and no flange. Units shall meet UL scrub water protected requirements. To have integral ground terminal.

a. Acceptable Manufacturers:

1) Acceptable manufactures shall include the following and shall meet the requirements herein.

a) Wiremold - Evolution Series

b) Approved equal.

6. Flush Poke-Through Service Fitting (Power/Communication):

a. Provide flush poke-through suitable for installation in a cored floor opening. Shall be complete with junction box, conduit and flush devices as indicated on plans. The complete assembly shall be suitable for two hour fire rated floors, be UL CEYY listed and have UL scrub water protected metallic color as selected by the Architect and trim ring. Cover shall be suitable for carpet, tile, wood and concrete. Unit protrusion above floor plane shall not exceed 0.2". Extend or reduce unit raceway length as needed to accommodate floor thickness and project conditions. Provide indicated devices in units.

b. Acceptable Manufacturers:

1) Wiremold - Evolution Series
2) Approved equal

I. Terminal and Equipment Cabinets:

1. Terminal and equipment cabinets shall be code gauge galvanized steel with removable endwalls. Fronts shall be of code gauge steel, flush or surface type (as indicated) with concealed trim clamps, concealed hinges, flush lock, and grey baked enamel finish. Boxes and front shall be UL listed and shall be minimum 35 in. H x 24 in. W x 6 in. D. Provide removable insulated plywood terminal board mounted on inside back wall of cabinet.

a. Acceptable Manufacturer:

1) Square D "Mono-Flat"
2) Approved equal

J. Wiring Devices:

1. Wiring Devices (toggle switches, key switches, receptacles, dimmers, occupancy sensors, etc.) shall be specification grade as a minimum. Switch handle and receptacle face shall be as directed by the Architect. Provide device cover plates of satin finish type 302 stainless steel in finished areas and rounded raised (Steel City 450/460 series) only for surface mounted locations in unfinished areas. Provide neoprene gasketed cast aluminum/zinc box with hinged rain tight cast

aluminum/zinc lockable while in use cover with stainless steel hardware for devices designated "WP".

a. Acceptable Manufacturers:

1) Pass and Seymour
2) Hubbell
3) Leviton

2. Toggle/Snap Switches:

a. Units shall be quiet operation, quick make/quick break, rated for 20A/120-277V/1hp at 120/277V, side/back wired, with nylon/polycarbonate toggle, self-grounding mounting screw clip plate (not staple), ground terminal and silver alloy contacts. Units shall meet latest Federal Specification WS-896, NEMA WD-1 and UL Test 20. Single pole units shall be Hubbell HBL1221, P&S 20AC1 or Leviton 1221-2. Provide two pole, three way, four way, illuminated handle, keyed, etc. type of the same quality and model.

3. Receptacles:

a. Provide receptacles where indicated on the drawings and where called for. Provide type receptacle as indicated and if not indicated then utilize general receptacle.

b. General Receptacle: Units shall be NEMA 5-20R, duplex, 20A, 125V, side/back wired, #14 to 10AWG screw terminals with nylon face, indented brass contacts for three point connection, self-grounding mounting screw clip plate (not staple), ground terminal Meet requirements of Federal Specification W-C-596, NEMA WD-6 and UL 498.

1) Units shall be: Hubbell 5352, P&S CRB5362 or Leviton 5352.

c. Ground Fault Interrupting Receptacles: Units shall be as specified above for General Receptacle and have 5mA interrupting ground fault level, test/reset front buttons, full through feed capability, power off on reverse wired sensing, 10kA short circuit current rating, be tamper/weather resistant and in compliance with UL 943. Unit shall self-test function to periodically test the components automatically and indicate a failure condition utilizing an LED. Shall be Hubbell GFR5362, P&S 2096TR or Leviton S7599TR.

d. Dryer Receptacles: To be NEMA 14-30R single receptacle in suitable box and steel cover plate painted to match the surrounding. Shall be Hubbell, P&S or Leviton highest grade available.

e. Special Receptacles: provide other type receptacles as indicated herein or on the drawings. Such receptacles shall be Hubbell, P&S or Leviton highest grade available.

4. Lighting Dimmers:

   a. Provide lighting dimmer where indicated suitable for the type of luminaire for even continuous control. Unit shall be rated for the indicated connected load plus 25% minimum (even when ganged). Review luminaire schedule for type and loading. Provide for three-way control as indicated.

   b. Dimmers to be Lutron "Nova" NT-(1000W minimum) with debuzzing coil for incandescent.

   c. Low voltage dimming shall be as recommended by the luminaire manufacturer for magnetic or solid state.

   d. LED dimmers shall be as recommended by the luminaire manufacturer and be listed for use with the associated driver.

   e. Device color shall match the toggle switch.

   f. Acceptable Manufacturers:

      1) Lutron
      2) Approved equal

5. Television Outlets:

   a. 4 in. x 4 in. outlet box with single gang plaster ring with coax connector and plate and conduit routed to accessible ceiling space. Cover plate shall match the receptacle cover type.

6. Emergency Shutdown Pushbutton:

   a. Where called for provide emergency shutdown/emergency power off push button. Unit shall be Square D Class 9001 Type K NEMA 13 oil tight pushbutton with the following:

      1) Red mushroom head 1-1/2 in. button, hinged protective flip up cover, push to operate, pull to reset.

      2) Maintained contact operation with one normally open and one normally closed 10A 120V contacts. Provide relay for additional contacts.

      3) Red pilot light.

      4) Engraved legend plate indicating "XX - Emergency Stop" with XX = the system name.

7. Occupancy/Vacancy (Automatic/Manual) Sensors:

   a. Sensors shall comply with the following as a minimum:

1) Zero crossing switching operation (switch on/off only where sine wave is at zero volts) suitable for linear, non-linear and electronic/magnetic fluorescent ballasts for the loads indicated. Where the load to be controlled exceeds the sensor load rating provide a separate relay of adequate rating.

2) Failure of the unit shall be to the on/closed position or manual operation.

3) Motion sensitivity adjustment (dip switch or dial) and time delay adjustment (5 to 20 minutes minimum, dip switch or dial).

4) Line voltage input and switching. Field selectable for 120 or 277 VAC, 60 Hz.

5) UL listed and have a five (5) year manufacturer full replacement warranty.

6) Test mode feature to override the set time delay to allow adjusting of the sensitivity.

7) Sensor locations shall be adjusted during construction and at occupancy as recommended by the manufacturer for optimal sensing and operation.

8) Operation shall have adjustable time delay. Occupancy sensors shall have automatic on and vacancy sensors shall have manual on.

9) Adjustable controls/settings shall only be accessible when the front cover is removed or from the back of the unit.

10) Unit color shall match the project devices except for the ceiling mounted units which shall match the ceiling color. All color selections shall be by the Architect.

11) Ultrasonic sensing shall not be affected by air movement and shall operate at 32 kHz minimum (shall not interfere with hearing aids or other equipment).

12) Provide components as needed for the indicated control.

13) A factory authorized representative shall coordinate and instruct the start up services of the sensors providing placement recommendations, connection guidance and start up supervision and adjustment.

b. Wall Mounted - Passive Infrared (PIR):

1) Unit shall fit into a standard single gang electrical box, have an on/off button and utilize PIR technology motion sensing. Selectable manual or automatic on mode.

2) Minimum Switching Capacity: 120 V - 800 W, 277 V - 1200 W.

3) The sensing shall be 180° and the sensitivity area to be a minimum of:

a) Major Motion (Walking/Arm Wave): 35 ft. x 30 ft.

b) Minor Motion (Small Motion at Desk): 20 ft. x 15 ft.

4) Ambient light level sensing (adjustable 20-300 fc) to prevent "on" operation when the ambient light level is greater than the set point level.

5) High impact resistant sensor lens.

6) Acceptable Manufacturers:

a) Pass & Seymour Model OS300S (Design Make)
b) Hubbell
c) Watt Stopper
d) Sensor Switch

c. Wall Mounted - Dual Technology (PIR and Ultrasonic):

1) Unit shall fit into a standard single gang electrical box, have an on/off button and utilize PIR and ultrasonic technology motion sensing. Both types of sensing are needed for contact closure but only one is needed to keep it closed. Selectable manual or automatic on mode.

2) Minimum Switching Capacity: 120 V - 800 W, 277 V - 1200 W.

3) The sensing shall be 180° and the sensitivity area to be a minimum of:

a) Major Motion (Walking/Arm Wave): 35 ft. x 30 ft.

b) Minor Motion (Small Motion at Desk): 20 ft. x 15 ft.

4) Ambient light level sensing (adjustable 20-300 fc) to prevent "on" operation when the ambient light level is greater than the set point level.

5) High impact resistant sensor lens.

6) Acceptable Manufacturers:

a) Hubbell Model AD2000 (Design Make)
b) Watt Stopper
c) Cooper
d) Sensor Switch

d. Ceiling Mounted - Occupancy Sensor - Dual Technology:

1) Unit shall mount to standard octagonal box, have adjustable sensitivity/time delay, have auxiliary contact (form C, 0.5A at 24 VDC) and utilize PIR and ultrasonic technology motion sensing. Both types of sensing are needed for contact closure but only one is needed to keep it closed. Auxiliary contact shall indicate movement sensing and be selectable to utilize time delay or not.

2) Shall have self contained rated contacts or control a separate switch pack. If a self contained unit then the ratings and function shall meet or exceed the switch pack specifications.

3) Sensing shall be 360° with a minimum operating area of:

a) Major Motion (Walking/Arm Wave): 50 ft. x 30 ft.

b) Minor Motion (Small Motion at Desk): 40 ft. x 20 ft.

c) Corridor (Major Motion): 50 ft. x 16 ft.

4) Units shall be suitable for overlap of motion detection areas without reduction in spacing and false operation.

5) Sensing shall be suitable for a ceiling/mounting height of up to 12 ft. minimum.

6) The maximum depth shall be 1.5 in. below the ceiling/box.

7) Acceptable Manufacturers:

a) Hubbell Model ATD2000CRP (Design Make)
b) Watt Stopper
c) Cooper
d) Sensor Switch

e. Ceiling Mounted - Vacancy Sensor - Dual Technology:

1) Unit shall mount to standard octagonal box, have adjustable sensitivity/time delay, have auxiliary contact (form C, 0.5A at 24 VDC) and utilize PIR and ultrasonic technology motion sensing. Both types of sensing are needed for contact closure but only one is needed to keep it closed. Operation shall require manual operation of momentary wall switch for lighting to be switched on and automatic off. Auxiliary contact shall indicate movement sensing and be selectable to utilize time delay or not.

2) Shall have self contained rated contacts or control a separate switch pack. If a self contained unit then the ratings and function shall meet or exceed the switch pack specifications.

3) Sensing shall be 360° with a minimum operating area of:

a) Major Motion (Walking/Arm Wave): 50 ft. x 30 ft.

b) Minor Motion (Small Motion at Desk): 40 ft. x 20 ft.

c) Corridor (Major Motion): 50 ft. x 16 ft.

4) Units shall be suitable for overlap of motion detection areas without reduction in spacing and false operation.

5) Sensing shall be suitable for a ceiling/mounting height of up to 12 ft. minimum.

6) The maximum depth shall be 1.5 in. below the ceiling/box.

7) Provide momentary switch(es) and any other needed equipment for indicated operation.

8) Acceptable Manufacturers:

a) Hubbell Model ATD2000CRP (Design Make)
b) Watt Stopper
c) Cooper
d) Sensor Switch

f. Switch Pack:

1) Provide a minimum of one (1) switch pack for each ceiling mounted occupancy sensor. Provide additional units for multiple circuits (quantity to match the quantity of circuits).

2) Unit shall be plenum rated with line voltage side into a metallic box.

3) Low voltage power shall be suitable for a minimum of three (3) occupancy sensors. Multiple sensors shall be able to control a single switch pack.

4) Minimum switching capacity shall be 20A (all types of loads) at 120/277VAC.

g. Testing:

1) Each occupancy sensor shall be fully tested for proper operation of all functions after installation.

2) Testing shall include sensitivity, time delay, ambient lighting level, etc.

3) Operation and settings shall be acceptable to the Owner.

K. Underground Pullboxes (Handholes):

1. Sidewalk and Grass Areas: Boxes shall be comprised of composite material with stainless steel hardware and ANSI Tier 8 rating minimum. Provide conduit/duct openings per the plans/schematics with spare capacity for 2 - 2" in each side wall, minimum. Box shall be minimum 2'-0" wide x 2'-0" long x 3'-0" deep inside dimensions, or larger as required to meet NEC requirements. Cover shall be imprinted with either "Electric", "Telephone", etc. to designate type of service. Provide 18 in. of #2 crushed stone under pullbox and 18 in. beyond. Refer to drawings per details and locations.

a. Manufacturers:

1) Quazite
2) Old Castle
3) Approved equal

2. All Other Areas: Boxes shall have ANSI Tier 22 rating (22,500lb weight rating) and be comprised of steel reinforced concrete walls and bottom sections using 5,000 psi, minimum concrete. Bottom shall have 12 in. diameter sump opening and 3/4 in. ground rod opening. Knockouts and openings shall be positioned for conduits/ducts. Provide two (2) rows of anchor bolt inserts for cable rack supports to permit installation of two (2) cable rack supports on each side wall and one (1) cable rack support on each end wall. Provide hot dipped galvanized steel pulling irons at 45° angle between floor and wall opposite each opening. Provide 24 in. x 24 in. opening for frame and cover and a suitable masonry "Throat" between top of box and cover frame to allow for variation in final finished grade. Frame and cover shall be case iron. Provide 4 in. drain to local site daylight. Refer to drawings per details and locations.

a. Manufacturers:

1) Pullbox: Lakelands precast.
2) Cover: Neenah Foundry Company, roadway type.
3) Approved equal.

L. Ductbanks:

1. Ductbanks shall be rigid non-metallic conduit system. Provide all sleeve joints, couplings, bend sections, bends, elbows, offsets, angle couplings, bell ends, caps, base spacers and intermediate spacers as required to meet field conditions. All bends, stub-ups and wall, slab or floor-building penetrations shall be rigid steel conduit without exception.

M. Waterproofing Seals:

1. Provide expanding link type seal, for installation between duct/conduit, and sleeve or core-drilled hole in concrete.

2. Make: Link Seal, manufactured by Thunderline Corp., or approved equal.

N. Flashing, Sealing, Fire-stopping:

1. Fire-Stopping for Openings Through Fire and Smoke Rated Wall and Floor Assemblies:

a. Provide materials and products listed or classified by an approved independent testing laboratory for "Through-Penetration Fire-Stop Systems". The system shall meet the requirements of "Fire Tests of Through-Penetration Fire-Stops" designated ASTM E814.

b. Provide fire-stop system seals at all locations where piping, tubing, conduit, electrical busways/cables/wires, ductwork and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire-stop seal between sleeve and wall for drywall construction.

c. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire-stop system. The installation shall provide an air and watertight seal.

d. The methods used shall incorporate qualities, which permit the easy removal or addition of electrical conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating.

2. Acceptable Manufacturers:

a. Dow Corning Fire-Stop System Foams and Sealants
b. Nelson Electric Fire-Stop System Putty, CLK and WRP
c. S-100 FS500/600, Thomas & Betts
d. Carborundum Fyre Putty
e. 3-M Fire Products

PART 3 - EXECUTION

3.1 INSTALLATION

A. Unless otherwise noted, wiring for all systems indicated in the contract documents shall consist of insulated conductors installed in raceways. Raceways shall be continuous from outlet box to outlet box and from outlet box to cabinet, junction or pull box. Secure and bond raceways to all boxes and cabinets so that each system of raceways is electrically continuous throughout. Unless otherwise indicated on the drawings, install all wiring in the following raceway system:

1. Wiring 600 Volts or Less in Dry Locations: Electrical metallic tubing or type MC cable.

2. Wiring 600 Volts or Less in Outdoors, Above Grade Locations: Rigid metal conduit.

3. Wiring 600 Volts or Less Installed Below Grade, in Concrete Floor Slabs or Below Ground Floor Slab: Rigid non-metallic conduit with rigid metal conduit bends and penetrations through building floors and walls.

4. Flexible metal conduit shall be used for final connection to all motors, final connection to rotating or vibrating equipment, final connections to dry type transformers and final connections to recessed lighting fixtures. Liquidtight flexible conduit shall be used in all wet or damp locations. Maximum length of flexible conduit shall be 36 in., except that from outlet boxes to lighting fixture maximum length shall be 6 ft. Provide green insulated equipment grounding conductor in all flexible metal conduit.

5. Surface metal raceway may be used for surface runs in finished area where concealed conduit cannot be run or where specifically indicated on drawings. Submit detailed description and/or layout for approval prior to roughing.

6. Where allowed, branch circuits may be type MC cable between homerun junction box and equipment/device connection in drywall partitions only. Homerun junction box to be a maximum of 20 ft. from equipment/device.

B. Raceways:

1. Sized as indicated on the drawings. Where sizes are not indicated, raceways shall be sized as required by the National Electrical Code in accordance with the quantity, size, and type of the insulation conductors to be installed. Raceways shall be minimum 1/2 in. trade size for branch circuit wiring and minimum 3/4 in. trade size for all telephone intercommunications, instrumentation, fire alarm, television and computer systems and for all branch circuit "Home Runs" to panelboards.

2. Installed to provide adequate grounding between all outlets and the established electrical system ground.

3. Cut square, free of burrs due to field cutting or manufacture, and bushed where necessary.

4. Installed with exterior surfaces not less than 6 in. from any surface with normal operating temperature of 200°F or higher.

5. Plugged at the ends of each roughed-in raceway with an approved cap or disc to prevent the entrance of foreign materials during construction.

6. Concealed throughout except where exposure is permitted by the Owner's Representative. All exposed raceways shall be painted to match existing adjacent surface finish as directed by the Architect.

7. Installed parallel or perpendicular to floors, walls and ceilings where exposed wiring is permitted.

8. Installed with a minimum of bends and offsets. All bends shall be made without kinking or destroying the cross section contour of the raceway. Factory made bends are acceptable and should be considered for raceways larger than 2 in.

9. Installed with UL approved rain-tight and concrete-tight couplings and connectors.

10. Firmly fastened within 3 ft. of each outlet box, junction box, cabinet or fitting. Raceways shall not be attached to or supported by wooden plug anchors or supported from mechanical work such as ductwork, piping, etc.

11. Installed with a #14 AWG fish wire in all telephone, intercommunication, "Spare" or "Empty" conduit runs to facilitate future installation of conductors.

12. Installed with expansion fittings at all building expansion joints such that no undue stress is placed on any electrical raceway due to the proper functioning of expansion joints.

13. Arranged in a neat manner for access and allow for access to work installed by other trades.

14. Raceways installed in concrete slabs shall be located so as not to affect structural integrity of slab, and such that conduit shall have a minimum of 1 in. of concrete cover on all sides. Obtain approval from the Owner's Representative prior to installing conduit larger than 1 in. trade size in concrete slabs. Raceways in slabs shall be for floor box use only.

15. Raceways installed below ground floor slab shall be encased in concrete with 3 in. minimum coverage on all sides. Where possible, install conduit directly below slab with concrete envelope poured monolithic with slab. Where this is not possible, support raceways and envelop maximum 5 ft. - 0 in. on centers from underside of structural slab by means of galvanized pipe hangers. Pipe hangers shall be coated with asphalt mastic. Installation shall maintain integrity of waterproofing membrane.

16. If it is necessary to burn holes through webs of beams or girders, call such points to the attention of the Owner's Representative and receive written approval both as to location and size of hole before proceeding with work. All holes shall be burned no larger than absolutely necessary.

17. Become familiar with the general construction of the building and place sleeves, inserts, etc., as required. All penetrations through existing floors shall be core drilled and sleeved.

18. Wherever a cluster of four (4) or more raceways rise out of floor exposed, provide neatly formed 6 in. high concrete envelop, with chamfered edges, around raceways.

19. All raceways shall be supported adequately by malleable iron pipe clamps or other approved methods. In exterior or wet locations, supports shall allow not less than 1/4 in. air space between raceway and wall. Firmly fasten raceway within 3 ft. of each outlet box, junction box, cabinet or fitting. The following table lists maximum spacing between conditions, strength of supporting members, etc.

20. Furnish and install such supports at no additional cost to owner.

Conduit Trade Size	Type of Run	Horizontal Spacing in Feet	Vertical Spacing in Feet
1/2 in., 3/4 in.	Concealed	7	10
1 in., 1-1/4 in.	Concealed	8	10
1-1/2 in. and larger	Concealed	10	10
1/2 in., 3/4 in.	Exposed	5	7
1 in., 1-1/4 in.	Exposed	7	8
1-1/2 in. and larger	Exposed	10	10

21. Where raceways puncture roof, install pitch pockets as required in order that the roof warranty is maintained. Coordinate with representative of roofing material manufacturer.

22. At each flush mounted panelboard, terminal cabinet, control cabinet, etc., provide four (4) spare 3/4 in. raceways from panelboard, etc., to an area above the nearest accessible ceiling space. Make 90° turn above the ceiling, arranged for further continuation of raceway, and cap.

23. Provide a bushing at each conduit termination unless fitting at box where conduit terminates has hubs designed in such a manner to afford equal protection to conductors. Provide grounding type insulated bushings on all conduit sizes 1-1/4 in. trade size and larger, and on all feeder raceways regardless of size. Provide standard bushings for conduits 1 in. and smaller unless otherwise stated.

24. Differing Temperatures: For raceways routed between areas with differing temperatures (interior to exterior, walk in coolers/freezers, environmental chambers, etc.) install raceway as follows:

    a. Provide a thermal break, 4 in. minimum of stainless steel or Schedule 40 PVC conduit within space wall/separation.

    b. Seal raceway penetration through the wall/separation.

    c. Provide a box on each side of the space wall/separation.

    d. Provide raceway interior sealant (duct seal or suitable foam) to provide a complete air barrier after conductors are installed.

    e. Mounting of raceway and boxes on equipment shall be coordinated and approved by the equipment manufacturer.

25. Raceway installed in wet, damp or exterior walls shall have a spacer provided to maintain a space/void between the mounting surface and the raceway.

C. Underground Raceways and Ductbanks:

1. Encase all underground raceways in concrete, No. 1 (NYSDOT 0703-02) crushed stone or pea stone (NYSDOT 0702-0203). Where concrete is called for, form concrete envelope around raceways, 3 in. minimum thickness concrete at top, bottom and sides of raceways, conduits on 7-1/2 in. centers both directions with concrete between raceways. Top of concrete envelope shall be finished not less than 24 in. below finished grade, except where under building slabs. Open trench for its complete length before concrete is poured; if any obstructions are encountered, make provisions to avoid them. Support raceways minimum 3 in. above bottom of trench before pouring. Furnish and install precast concrete, plastic or fiber spacers. Stagger couplings. When concrete is specified, securely tie raceways in place to prevent floating. Pour concrete as soon as possible after placing and securing of raceways. Pull iron-shod mandrel, not more than 1/4 in. smaller than bore of raceway to remove concrete and other obstructions. Clean raceway by drawing through properly sized cylindrical brushes as many times as necessary to remove dirt. Concrete envelopes shall contain reinforcing rods wherever non-metallic raceways are used. Reinforcing shall be continuous runs of No. 4 deformed rods located in all four corners as well as top and bottom of envelope between each raceway. In locations where non-metallic raceways are used, change to heavy wall metallic conduit of same internal diameter before rising out of ground; provide metallic conduit elbows at conduit rise. Carry concrete envelope to a point 12 in. minimum above grade or floor slab at rise point if allowed by site conditions and equipment to be installed. Slope top of concrete away from raceway, chamfer edges. Where raceways pass between exterior and interior and terminate in building, switchgear, pullbox, etc. provide conduit sealing bushing (O-Z Gedney CSB or approved equal) in each raceway to fill all voids around conduit and cables. Upsize the conduit as needed for suitable sealing bushing. Cap all empty conduits watertight. Place conduit in straight lines. Seal, completely waterproof, all duct joints, then complete concrete encasement. Place direct-bury conduit tier-by-tier method, backfilling each layer to achieve proper spacing. Elbows shall have a minimum radius of 42 in. Follow proper low temperature installation procedures as recommended by PVC conduit vendor. Provide marking tape in soil above all duct banks per NEC. Repair or replace all existing utilities and facilities damage, due to ductbank installation, as part of contract.

D. Wiring Methods:

1. Conductors shall not be installed until raceway system, including all outlets, cabinets, bushings and fittings, is completed. Verify that all work of other trades which may cause conductor damage is completed. Use only U.L. approved cable lubricants when necessary. Do not use mechanical means to pull conductors No. 8 or smaller.

2. In general, conductors shall be the same size from the last protective device to the load.

3. All wiring systems shall be properly grounded and continuously polarized throughout, following the color-coding specified. Connect branch circuit wiring at panelboards, as required, in order to provide a "balanced" three-phase load on feeders.

4. Provide insulated green ground conductor in each branch circuit.

5. All feeder connections shall be made to bus and other equipment using solderless, pressure type terminal lugs.

6. For splices and taps, No. 10 AWG and smaller, use solderless "twist on" connectors having spiral steel spring and insulated with a vinyl cap and skirt.

7. For splices and taps, No. 8 and larger, use insulated solderless set screw AL/CU or hydraulically compressed sleeve fittings suitable for the intended use.

8. Use cast connections for ground conductors.

9. Provide minimum 6 in. of spare/slack of each conductor in each junction or pull box and termination.

10. Make all splices and connections in accessible boxes and cabinets only.

11. Cover uninsulated splices, joints, and free ends of conductor with rubber and friction tape of PVC electrical tape. Plastic insulating caps may serve as insulation. Heat shrink sleeves shall be acceptable for crimp type splices.

12. On termination at branch circuit outlets, leave a minimum of 8 in. free conductor for installation of devices and fixtures.

13. Feeder conductors shall be continuous from point of origin to load termination without splice. If this is not practical, contact the Owner's Representative and receive written approval for splicing prior to installation of feeder(s). Where feeder conductors pass through junction and pull boxes, bind and lace conductors of each feeder together. For parallel sets of conductors, match lengths of conductors as near equal as possible.

14. Branch circuit conductors installed in panelboards, and control conductors installed in control cabinets and panels shall be neatly bound together using "Ty-Raps" or equal.

15. Lighting fixtures, detectors, etc., in mechanical equipment, boiler and pump rooms shall be installed with exposed wiring after equipment, ductwork, piping, etc., are in place. In general, lighting shall be as located on the drawings; where conflicts exist, locate lights for best distribution.

16. Provide cable/conductor vertical support in accordance with the NEC.

17. Handholes:

    a. Provide separation of conductors of different systems per NEC requirements.

    b. Pitch all raceways toward the manhole/handhole.

    c. Mortar and brick the throats of manholes/handholes to grade level. Set cover rim to 1 in. above grass areas and flush with finished areas. Waterproof throat with elastic bituminous plastic cement coating.

E. Outlet Boxes:

1. Consider location of outlets shown on drawings as approximate only. Study architectural, process piping, mechanical, plumbing, structural, roughing-in, etc., drawings and note surrounding areas in which each outlet is to be located. Locate outlet so that when fixtures, motors, cabinets, equipment, etc., are placed in position, outlet will serve its desired purpose. Where conflicts are noted between drawings, contact Owner's Representative for decision prior to installation. Comply with the NEC relative to position of outlet boxes in finished ceilings and walls.

2. Prior to installation, relocate any outlet location a distance of 5 ft. in any direction from location indicated on drawings if so directed by the Owner's Representative. Prior to completion of wall construction, adjust vertical height of any outlet from height indicated if so directed by Owner's Representative. The above modifications shall be made at no additional cost to the Owner.

3. Where outlets at different mounting heights are indicated on drawings adjacent to each other (due to lack of physical space to show symbol on drawings), install outlets on a common vertical line.

4. Where switch outlets are shown adjacent to strike side of door, locate edge of outlet box approximately 3 in. from door frame.

5. Outlet boxes in separate rooms shall not be installed "back-to-back" without the approval of the Owner's Representative.

6. Outlet boxes shall be sized to accommodate the wiring, splices and device(s) to be installed in accordance with the NEC.

7. Outlet boxes installed in plaster, gypsum board or wood paneled hollow cavity walls shall be installed flush with raised plaster covers or raised tile covers. Boxes shall be mechanically fastened and supported by two (2) adjacent structural members (studs) with cross brackets (Garvin Industries Model BMB or approved equal).

8. Outlet boxes installed in tile, brick or concrete block walls shall be installed flush and have extra-deep type raised tile covers or shall be 3-1/2 in. deep boxes with square corners and dimensions to accommodate conductors installed.

9. Surface ceiling mounted outlet boxes shall be minimum 4 in. square, 1-1/2 in. deep, galvanized sheet metal.

10. Surface wall mounted outlet boxes shall be cast type boxes.

11. Floor outlet boxes shall be installed flush with finished floor, adjust level and tile as required. Where finished floor is terrazzo, provide boxes specifically designed for installation in terrazzo. Where floors are to receive carpet or flooring material, coordinate with appropriate trade and provide insert. Rectangular covers shall be parallel and perpendicular with the building and, if used, floor tile/floor joints/pattern. Coordinate cover type with the flooring and device type.

12. Install a device cover plate over each and every outlet indicated on drawings. Do not install plates until painting, cleaning and finishing of surfaces surrounding the outlet are complete. Install single one-piece multi-gang covers over multi-gang devices.

F. Toggle Switches:

1. Switches shall be installed in accessible locations near room/space entryway(s).

2. Provide lighted handle switches in mechanical rooms, elevator pits, electric rooms, etc.

G. Junction and Pull Boxes:

1. Install junction and pull boxes in readily accessible locations. Access to boxes shall not be blocked by equipment, piping, ducts and the like. Provide all necessary junction or pull boxes required due to field conditions and size as require by the National Electrical Code.

H. Equipment Mounting Heights:

1. Unless otherwise noted, mount devices and equipment at heights measured from finished floor to device/equipment centerline as follows:

a.	Toggle switches (up position "on")	46 in.
b.	Receptacle outlets (long dimension vertical, ground" pole farthest from floor)	18 in.
c.	Receptacle outlets above counters	8 in. above counters
d.	Receptacle outlets, above hot water or steam baseboard heaters. Do not install receptacle outlets above electric baseboard heaters	30 in.
e.	Receptacle outlets, for refrigerators	48 in.

f.	Receptacle outlets, weatherproof, above-grade	24 in.
g.	Telephone outlets	18 in.
h.	Telephone outlets, wall mounted	46 in.
i.	T.V. outlet	18 in.
j.	Fire alarm manual stations	46 in.
k.	Fire alarm combination audio/visual and standalone visual device (entire strobe lens at heights indicated)	80 in. to bottom of the notification device
l.	Standalone fire alarm audio device	90 in. (min) to 96 in. (max)
m.	Distribution panelboards, to top of backbox	72 in.
n.	Terminal cabinets, control cabinets, to top of backbox	72 in.
o.	Disconnect switches, motor starters, and enclosed circuit breakers.	48 in.

2. Where structural or other interferences prevent compliance with mounting heights listed above, consult Owner's Representative for approval to change location before installation.

I. Hangers and Supports:

1. Provide steel angles, channels and other materials necessary for the proper support and erection of motor starters, distribution panelboards, large disconnect switches, large circuit breakers, pendant mounted lighting fixtures, etc.

2. Panelboards, disconnect switches, circuit breakers, cabinets, large pull boxes, adjustable speed drives, cable support boxes and starters shall be secured to the building structure and not supported from conduits. Small panelboards, etc., as approved by Owner's Representative, may be supported on walls. Racks for support of conduits and heavy electrical equipment shall be secured to building construction by substantial structural supports.

J. Identification:

1. Provide engraved lamicoid identification nameplates on switchboards, main service disconnects, transfer switches, and on all panelboards using designation shown in panelboard schedule. Include voltage, phase, equipment served, voltage source to panel or equipment.

2. Provide engraved lamicoid identification nameplates for each circuit breaker in the main distribution panel listing the panelboard or equipment connected to each device.

3. Provide engraved lamicoid identification nameplates on all items of equipment including individual circuit breaker enclosures and disconnect switches, listing the equipment connected to the particular device provided under Specification Section 262000, including, but not limited to: starters, disconnect switches, adjustable speed drives, circuit breakers, etc. Include voltage, phase, equipment served, voltage source to panel or equipment.

4. Provide complete type written directory for each panelboard listing room number, function, etc., for each circuit breaker.

5. Identify junction and pullboxes for particular service and circuit such as power, lighting, fire alarm, telephone, interphone, public address, nurse call, etc. using stencil lettering on cover.

6. Provide signage at each electrical service room indicating "DANGER - HIGH VOLTAGE - KEEP OUT". Utilize adhesive backed, yellow background, block lettering signage at door.

7. Using adhesive backed printed tape label all receptacle and switch coverplates, power poles, etc. listing panel designation and circuit number. Tape shall be attached to inside of receptacle or switch coverplates.

K. Spare Parts:

1. Deliver to Owner and obtain receipt for spare parts including key switches, fuses, etc.

3.2 TESTS

A. Branch circuits shall be tested during installation for continuity and identification and shall pass operational tests to determine that all circuits perform the function for which they are designed. For all feeder wiring rated 600 volts or less, provide 1,000 volt "Megger" insulation test prior to energizing feeders. Use a 1,000-volt motor driven megger for all tests. Test voltage shall be applied until readings reach a constant value, and until three (3) equal readings, each one (1) minute apart, are obtained. Minimum megger reading shall be 45 megohms for feeder conductors. Document test results and submit for approval prior to energizing conductors.

END OF SECTION

SECTION 260526 - GROUNDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide grounding system equal to or exceeding the requirements of NEC and as indicated in the contract documents. Raceway system which includes metal conduit, wireways, pullboxes, junction boxes, busway, wire ways, cable trays, enclosures, motor frames, etc., shall be made to form a continuous, conducting permanent ground circuit of the lowest practical impedance to enhance the safe conduction of ground fault currents and to prevent objectionable differences in voltage between metal non-load current carrying parts of the electrical system.

B. Provide solid grounding of building structures and electrical and communications systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits and systems. Types of grounding systems include the following:

1. Electrical Service and Transformer Grounding
2. Building Grounding
3. Equipment Room Ground Terminal Bar
4. Electrical Equipment Grounding

1.2 QUALITY ASSURANCE

A. All methods of construction, details of workmanship, that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions. etc., correspond to the nomenclature dictated by those manufacturers. Where "or equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

B. Electrical Components, Devices and Accessories: Listed and labeled as defined in the NEC by Nationally Recognized Testing Laboratory (NRTL) and marked for intended use.

C. Comply with UL 467 for grounding and bonding materials and equipment.

1.3 REQUIREMENTS

A. Grounding conductors, bonding conductors, jumpers, grounded conductors, etc. shall be sized in accordance with the NEC.

B. Equipment and materials shall be installed in accordance with the manufacturer's recommendations.

C. Provide ground system coordinated with and in accordance with the utility company requirements.

1.4 SUBMITTALS

A. Provide submittals for the following:

1. Ground rods and connectors.

2. Ground bars.

3. Building ground resistance test results.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conductors:

1. Exposed grounding components such as bars, straps, cables, flexible jumpers, braids, shunts, etc., shall be bare copper unless otherwise indicated.

2. Grounding conductors in raceway with 600V circuiting shall be insulated to match the circuit conductors with green color.

3. Grounding conductors used with system voltage greater than 1000V shall be bare unless otherwise indicated.

4. Grounding conductor size shall be as indicated or as required by the NEC whichever is larger, stranded, soft drawn or soft annealed copper, unless otherwise indicated. Sizing shall take into account circuit voltage drop.

5. Acceptable Manufacturers:

a. Same make as for 600 volt conductors.

B. Ground Rods:

1. Provide solid copper or copper clad steel cylindrical rods, 3/4 in. minimum diameter and minimum 10 ft. long with pointed end. Provide units suitable for extension connection when ground rods longer than 10 ft. are indicated.

2. Acceptable Manufacturers:

a. Copperweld
b. Erico
c. Burndy
d. Approved equal.

C. Connectors, Clamps and Terminals:

1. Mechanical connectors and clamps shall be made of copper alloy or silicon bronze. Solderless compression terminals shall be copper, long-barrel, NEMA two bolt. Bolts and washers (Belleville) shall be of comparable material or stainless steel.

    a. Acceptable Manufacturers:

        1) Burndy
        2) Hubbell Anderson Corp.
        3) Thomas & Betts
        4) Approved equal

2. Exothermic Welds:

    a. Provide exothermic welds designed for size and type of intended cable, rods, structure, etc. Solder prohibited for connections, except for medium and high voltage cable metallic tape shields (utilize mechanical and solder).

    b. Acceptable Manufacturers:

        1) Erico "Cadweld"
        2) Burndy "ThermOweld"
        3) Approved equal

3. Pipe Clamp:

    a. Pipe clamp for bonding to pipe type electrode (water pipe, etc.) shall be a suitably sized copper alloy clamp.

    b. Acceptable Manufacturers:

        1) Burndy GAR-BU
        2) O-Z Gedney Type CG
        3) Burndy "Durium"
        4) AFL Global "Everdur"
        5) Approved equal

4. Flexible Strap:

    a. Flexible grounding straps shall be of braided high conductivity copper with two-hole connector. Strap shall have equal to or greater than ampacity of the system it is bonding to. Strap shall provide flexibility in all directions when installed properly.

    b. Acceptable Manufacturers:

        1) Burndy
        2) OZ Gedney
        3) Approved equal

5. Electrostatic Floor Bonding:

a. Listed grounding kit for bonding ESD carpet, vinyl, rubber and epoxy floor coverings and coatings to ground with the following components:

1) 1 in. wide copper grounding tape.

2) Heavy gauge stainless steel ground termination plates with double sided conductive tape and 20 in. long lead wire with a #10 terminal ring at the end.

3) Acceptable Manufacturers:

a) Ground Zero Electrostatics Inc. "Zerostat" Floor Termination and Grounding Kits.

D. Ground Bars

1. Provide ground bars where indicated. Ground bars shall be:

a. 98% conductive copper, minimum.

b. 4 in. x 1/4 in. thick minimum with length as indicated with minimum 36 in. for electric room/MDF and all other minimum of 24 in.

c. Standard NEMA bolt hole patterns with maximum quantity of lug locations. Spacing of 1-1/8 in. apart.

2. Bar shall be mounted to an accessible wall location with galvanized steel hardware and 2000V rated insulators. Mounting shall be suitable for full complement of cabling.

3. Unit shall conform to EIA/TIA standards.

4. Acceptable Manufacturers:

a. Erico
b. Newton Instrument
c. Burndy
d. Harger

PART 3 - EXECUTION

3.1 INSTALLATION

A. Grounding Conductors:

1. Provide grounding conductor(s) with all power circuits. Conductor shall be sized as indicated or as required by the NEC as a minimum and shall be terminated on the equipment, device, enclosure, etc. grounding terminal. Conductor size shall

be for the entire length unless approved by the Engineer where oversized for voltage drop.

2. Conductors above grade to ground electrodes (water piping, structural column, etc.) and to equipment (service entrance, ground bars, ground halos, etc.) shall be installed in metallic conduit with ends bonded to the conduit.

3. Grounding conductors shall be installed to have a minimum radius of 3 in.

4. Grounding conductors in a raceway system shall be terminated/bonded to each box, cabinet, enclosure, etc. through which it passes or terminates.

5. Grounding conductors routed with underground circuits shall be bonded to each ground electrode and metallic cable support system within the raceway system including pull and access locations.

6. Stranded conductors penetrating vapor barriers, foundations, slab on grade and water stop membranes shall have the interstitial spaces between strands filled with solder 4 in. beyond the membrane each side. The conductor shall be sealed to the membrane with a manufacturer approved method.

B. Raceway Systems:

1. All metal supports, cable trays, messenger cables, frames, sleeves, brackets, braces, etc. for the raceway system, panels, switches, boxes, starters controls, etc., which are not rigidly secured to and in contact with the raceway system, or which are subject to vibration and loosening, shall be bonded to the raceway system.

2. Termination of rigid conduit at all boxes, cabinets, and enclosures shall be made up tightly with a double locknut arrangement and a bushing, bushings being of the insulated type. Utilize grounding bushings as specified elsewhere in these specifications.

3. Conduit which runs to or from boxes, cabinets, or enclosures having concentric or eccentric knockouts which partially perforate the metal around the conduit and hence impair the continuity of system ground circuits shall be provided with bonding jumpers connected between a grounding type bushing/locknut on the conduit and a ground bus or stud inside the box, cabinet, or enclosure and attached thereto.

4. Conduit expansion joints and telescoping sections of metal raceways shall be provided with bonding jumpers sized in accordance with the NEC.

C. Ground Rods:

1. Ground rods shall be driven vertically the full length plus 24 in., minimum.

2. Ground rods shall be located in virgin soil or loamy compacted soil.

3. Provide one (1), minimum, ground rod inspection test well for each ground rod/electrode system or as indicated.

D. Connectors Clamps and Terminals:

1. Connectors utilized above grade in dry accessible locations shall be mechanical or exothermic type.

2. Connectors in damp locations, below grade or if not indicated shall be exothermic type.

3. Clean the area near the connecting surfaces prior to any connection to ensure effective contact. Cleaning shall be to the bare metal. Wire brush area if needed to remove rust scale paint, dirt, etc. to expose bare metal.

4. Exothermic connections shall be installed in accordance with the manufacturer's recommendations and tested with heavy blow of a five pound sledge.

E. Flexible Strap:

1. Flexible straps shall be used when bonding vibrating/moveable equipment, with expansion fittings and where recommended by the manufacturer.

2. Sufficient slack shall be provided to compensate for the anticipated vibration, movement and expansion.

F. Ground Grid:

1. Provide a ground electrode grid consisting of a minimum of three (3) 10 ft. ground rods arranged in a delta configuration with a minimum spacing of 20 ft. apart and connected together.

2. Connecting conductors shall be bare #4/0 AWG minimum, buried a minimum of 24 in. below grade.

3. Connect the ground grid to the building electric service and to the main ground bar.

G. Secondary Electrical Systems:

1. The neutral (grounded) conductor of each low voltage, single and/or polyphase system or distribution system, except special isolated double insulated systems, shall be solidly connected to ground at the transformer neutral bushing, or at the main secondary switchgear to the system ground, and shall be sized for current carrying capacity, not to be less than as required by the NEC. Ground connection shall be to the building grounding system, building steel, building water service, building concrete reinforcement and as indicated.

2. Equipment grounding conductors shall extend from the point of termination back to the ground bus of the source panelboard, switchboard, or switchgear.

H. Equipment Grounding:

1. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch circuit conductors.

I. Communications Rooms:

1. For each building communications room or closet provide one (1) wall mounted ground bar bonded to the main building ground bar or electrical service ground with insulated #2 AWG conductor.

2. Local cable trays, equipment racks, etc. shall be bonded to the ground bar by others.

J. Emergency Generators with Three Pole Transfer Switch(es):

1. Generator neutrals are not to be bonded to ground at the generator.

2. Generator neutral shall be connected to the secondary electrical distribution system neutral conductor or bus. Connection shall be made at the transfer switch neutral lug.

3. Generator frames shall be bonded to the ground system with a conductor sized in accordance with the NEC.

K. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors in conduit from building's main service equipment or grounding bus to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes using a bolted clamp connector or by bolting a lug-type connector to a pipe flange using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

L. Power Company Requirements:

1. Size #6 ground conductor from service entrance equipment to meter panel.

2. One size 3/4 in. diameter by 10 ft. ground rod and size #6 circuitry at riser pole.

3. Meet power company requirements.

M. Underground Distribution:

1. Manholes and Handholes: Provide a driven ground rod through opening in the floor/bottom with 4 in. exposed. If necessary due to the site conditions, install the ground rod prior to manhole/handhole installation and provide a #1/0AWG bare conductor from the ground rod with an exothermic connection in the manhole/handhole. Seal the opening with waterproof non-shrinking grout.

2. Bond exposed parts within manhole/handhole such as inserts, pulling rings, cable racks, ladders and cable shields to the ground rod with #2AWG bare conductor minimum. Conductors shall be neatly installed around the perimeter of the unit and support 3 ft. on center with non-corrosive support and hardware.

3.2 GROUND TERMINAL BUS INSTALLATION

A. Install ground terminal bar in rooms where shown on the drawings. Mount bar 18 in. above finished floor by anchors and bolts using 1-1/2 in. long insulated spacer between bar and wall. Use a minimum of two (2) supports 18 in. on center. Connect all grounding electrode system conductors, system enclosure ground bus, and other indicated electrode systems to the terminal bar.

B. Label grounding conductors terminated to bus for equipment, location, electrode, etc served.

3.3 TESTS

A. Test the building ground system before backfilling to ensure continuity and determine system resistance value.

B. Testing procedure shall be a fall of potential type with a moving auxiliary electrode in accordance with IEEE Standard 142 and reviewed/approved by the Engineer. Sufficient test points shall be taken for accurate resistance value.

C. Make resistance measurements in dry weather, no earlier than 48 hours after rainfall. Provide tabulated test results indicating distance between rods and resistance readings on a plotted graph.

D. Test each ground electrode system separately prior to connection to the system or main building ground bar. Test each system ground electrode system a second time after backfilling has occurred and all final connections (building steel, water service, etc.) have been made.

E. Soil type, date, time, meter manufacturer/model number, person performing the test, test witnesses and most recent rainfall shall be noted in test submittal.

END OF SECTION

SECTION 262000 - ELECTRIC DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide a complete electrical service, and distribution system as indicated on the Contract Documents and as specified herein.

1.2 QUALITY ASSURANCE

A. All methods of construction, details of workmanship, that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions, etc., correspond to the nomenclature dictated by those manufacturers. Where "or equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

B. Installation shall be in accordance with NFPA-70 (National Electrical Code), National Electrical Safety Code (NESC), state codes, local codes, and requirements of authority having jurisdiction.

C. Equipment shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published ANSI, NEMA, UL and IEEE Standards.

1.3 SUBMITTALS

A. Submit the following product data/information:

1. Manufacturer and equipment type.

2. Standard catalog information sheet.

3. Detailed shop drawings indicating plan, elevation, end and isometric views. Top and bottom conduit areas shall be clearly shown and dimensioned on the drawings.

4. Single-line diagram.

5. Complete Bill of Materials.

6. All relevant ratings including, but not limited to, voltage, current, interrupting and withstand.

7. Overcurrent Device Information. Model number, available settings, setting ranges, capabilities, etc.

8. Submit available and final settings, programming and adjustments.

B. Submit product data and information for the following equipment, materials, products, etc.:

1. Switchboards.

2. Distribution and branch circuit panelboards.

3. Enclosed circuit breakers.

4. Disconnect switches.

1.4 WARRANTY

A. Provide full system warranty (labor, travel, equipment, etc.) in accordance with Division 1 and a minimum of one (1) year from acceptance.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Distribution Switchboard:

1. Provide distribution switchboard as specified and scheduled herein and shown on the associated drawings. The switchboard shall meet Underwriter's Laboratories enclosure requirements and be furnished with an Underwriter's Laboratory label for service entrance equipment.

2. The switchboard shall be dead front with front accessibility only required. The switchboard framework shall consist of steel channels welded or bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting. The framework is to be formed, code gauge steel, rigidly welded and bolted together to support all cover plates, bussing and component devices during shipment and installation. Each switchboard section shall have as open bottom and an individual removable top plate for installation and termination of conduit. Top and bottom conduit areas are to be clearly shown and dimensioned on the shop drawings. The wireway front covers are to be hinged to permit access to the branch circuit breaker load side terminals without removing the covers. All front plates used for mounting meters, selector switches or other front mounted devices shall be hinged with all wiring installed and laced with flexibility at the hinged side. All closure plates shall be screw removable and small enough for easy handling by one man. The paint finish shall be grey ANSI Standard No., 61 enamel over a rust-inhibiting phosphate primer.

3. The switchboard bussing shall be plated copper and of sufficient cross-sectional area to continuously conduct rated full load current with a maximum average temperature rise of 50°C above an ambient temperature of 25°C. Provide grounding bus. The main horizontal or through-bus shall be rated as indicated on the drawings. The bus bars shall be rigidly braced to comply with the withstand rating of the switchboard. The main horizontal bus bars between sections shall

be located at the back of the switchboard to permit a maximum of available conduit area. The end section shall have bus bar provisions for the addition of a future section. The provisions shall include the bus bars installed and extended to the extreme side of the section and fabricated in such a fashion that the addition of a future section would require only the installation of a single splice bus connection per phase and neutral. The horizontal main bus bar supports, connections, and joints shall be bolted with carriage bolts and Belleville washers. The vertical bus shall be the same rating as the horizontal bus.

4. Each switchboard, as a complete unit, shall be given a single withstand short circuit current rating by the manufacturer. The withstand short circuit current rating shall certify that all equipment is capable of withstanding the stresses of a fault equal to the interrupting capacity rating of the smallest overcurrent protective device contained therein. Such rating shall be established by actual tests by the manufacturer on equipment constructed similarly to the subject switchboard. This test data shall be available and shall be furnished to the Architect/Engineer with the shop drawings submittal.

5. Main disconnect device shall be a molded case circuit breaker, up to 2500A, totally front accessible and front connectable. Main disconnect device shall be a molded case circuit breaker, up to 2500A, totally front accessible and front connectable. Line side circuit breaker connections are to be jaw-type plug on. Provide auxiliary tripping functions as called for. UL Listed as suitable for use as service equipment.

6. Distribution molded case circuit breakers shall be group mounted and shall be totally front accessible and front connectable. The circuit breakers shall be mounted in the switchboard to permit installation, maintenance and testing without reaching over any line side bussing. The circuit breakers shall be removable without disturbing either the line side or load side cable terminations and all line and load side connections are to be individual to each circuit breaker. No common mounting brackets or electrical bus connectors will be acceptable. Line side circuit breaker connections shall be bolt-on type. Provide an externally operable mechanical means to trip the circuit breaker, enabling maintenance personnel to verify the ability of the circuit breaker trip mechanism to operate as well as exercise the breaker latch and operating mechanisms. Each type of circuit breaker assembly shall have undergone and passed heat tests according to UL test procedures and be UL Listed.

7. Ratings shall be as indicated in the Contract Documents. Circuit breakers within the switchboard shall be fully rated for the scheduled interrupting rating. Reducing breaker ratings on the basis of "series rating" is not acceptable.

8. Manufacturers: Subject to compliance with contract documents, the following manufacturers are acceptable:

    a. Square D "QED Power-Style" - Design Make.
    b. Eaton Corporation "Pow-R-Line".
    c. General Electric by ABB "AV-Line".
    d. Siemens "SB Series".

B. Branch Circuit Panelboards (208Y/120 volt):

1. Provide branch circuit panelboard as indicated in the "Panelboard Schedule" and as located on the drawings. Panelboards shall be equipped with quick make/quick break thermal-magnetic, molded case circuit breakers as scheduled.

2. Panelboard bussing and lugs shall be copper. Provide grounding bus in each panelboard, securely bonded to the box. Panelboard bus structure and main lugs or main circuit breaker shall have current ratings as indicated. Such ratings shall be established by heat rise tests, conducted in accordance with UL Standard 67.

3. Provisions for additional circuit breakers shall be such that field addition of connectors or mounting hardware will not be required to add circuit breakers to the panelboard. Bus connections shall be bolt-on.

4. Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than the rating shown on the Panelboard Schedule or on the plans. All panelboards shall be fully rated. "Series Ratings" are NOT acceptable. Reducing breaker ratings on the basis of series rating is not acceptable.

5. The panelboard bus assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be specified in UL Standard 50 cabinets. Wiring gutter space shall be in accordance with UL Standard 67 for panelboards. Each front shall include a door and have a flush, stainless steel, cylinder type lock with catch and spring-loaded door pull. All panelboard locks shall be keyed alike. Doors shall be mounted by completely concealed steel hinges. A circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door. Fronts shall be of code gauge, full-finished steel with rust inhibiting iron phosphate sealer and baked enamel finish. Minimum box width shall be 20 in. Provide door-in-door construction

6. Panelboards with main circuit breaker shall have inherent and listed coordination of the main and branch circuit breakers.

7. Ratings shall be as indicted on the Panelboard Schedule.

8. Manufacturers: Subject to compliance with Contract Documents, the following manufacturers are acceptable:

   a. 208Y/120 Volt and 240/120 Volt:

      1) Square D "NQ" - Design Make.
      2) Eaton Corporation "PRL1".
      3) General Electric by ABB "AQ".
      4) Siemens.

C. Circuit Breakers:

1. Circuit breakers below 400 amp frame shall be molded case with inverse time and instantaneous tripping functions, unless indicated otherwise in contract documents.

2. Circuit breakers 400 amp frame and above shall be 100% rated and equipped with adjustable solid state trip units with front adjustable short time, short time delay, long time, long time delay, and instantaneous trip functions as indicated.

3. Listed combination of coordinated circuit breakers shall be verified by the equipment manufacturer utilizing published data sheets. Confirm listings shall be submitted.

4. Lugs shall be mechanical, rated for 60/75° AL/Cu.

5. Branch circuit breakers shall be quick-make, quick-break, thermal-magnetic and trip indicating, and multipole breakers shall have common trip. Single pole 15 and 20 ampere circuit breakers shall be UL listed as "Switching Breakers" at 120V ac or 277 V ac and carry the SWD marking.

6. Ground-Fault circuit breakers shall be quick-make, quick-break, thermal-magnetic, 5 milliampere ground fault sensing and trip indicating, and multipole breakers shall have common trip. The ground fault circuit breakers shall not occupy any more space than a standard breaker of the same number of poles.

7. Arc Flash Energy Mitigation:

   a. Provide the following arc flash energy mitigation system for all circuit breakers 1200A and larger.

   b. Arc Energy Reduction Maintenance Switch

      1) Equipment main circuit breaker shall have a selector switch in the front of the unit enclosure for maintenance periods. The switch shall be labeled "Normal" and "Maintenance". The normal position shall utilize the standard trip settings of the breaker. The maintenance position shall utilize a quicker series of trip settings to reduce the potential arcing energy. The selector switch shall have a protective flip up cover. LED warning light on the face of the unit enclosure shall indicate when in the maintenance mode and have appropriate signage. The system shall be fully wired and tested by a factory authorized/trained technician.

8. Ratings shall be as indicated in the Contract Documents.

9. Manufacturers: Subject to compliance with contract documents, the following manufacturers are acceptable:

   a. Square D Micrologic trip unit - Design Make.

b. Eaton Corporation Optim 550 trip units for circuit breakers 400 - 1600 amp frame or RMS 610 trip units for 2000 amp frame to 6000 amp frame.
c. General Electric Spectra RMS or MicroVersa trip unit.
d. Siemens Sentron Sensitrip III trip unit.

10. Enclosed circuit breakers shall be molded case, thermal-magnetic type, ratings as noted, with overcenter, trip-free, toggle-type operating mechanism, quick make/quick break action and positive handle indication. Multiple pole breakers shall be common trip type. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pose. Provide provisions for padlocking in the "off" position. Breakers shall be calibrated for operation in an ambient temperature of 40°C and shall be suitable for mounting and operating in any position. Breakers shall have removable lugs, UL listed for copper and aluminum conductors. Breakers shall be installed in NEMA 1 general purpose, surface enclosures, unless otherwise noted.

a. Manufacturers: Subject to compliance with Contract Documents, the following manufacturers are acceptable:

1) Square D
2) Cutler Hammer
3) General Electric by ABB
4) Siemens

D. Power Meter

1. Where indicated on the drawings, provide a factory installed unit mounted power meter with the following parameters:

a. LCD or LED display.

b. Line voltage control power.

c. Voltage input with overcurrent protection and disconnecting means.

d. True RMS voltage and current measurement.

e. Metered parameters: Phase current, line voltage, phase voltage, frequency, power factor per phase and three phase total, real power per phase and total, reactive power per phase and total, apparent power per phase and total, total real energy, total reactive energy, total apparent energy, user configured sliding window for real, reactive and apparent power peak demand. Sampling rate shall be 512 sample points per cycle minimum. Waveform capture with adjustable triggers.

f. Accuracy: Energy, and demand power: 0.2% in accordance with ANSI C12.20Instrument current transformers shall be factory wired to shorting blocks to prevent open-circuiting the current transformers under energized conditions. The meter shall also be user programmable for current to any CT ratio.

g. Capable of metering up to 480 volts without external potential transformers. The meter shall also be user programmable for voltage range to any PT ratio.

h. Communications: Modbus RTU, TC/IP, etc.

i. Acceptable Manufacturers:

1) Equipment (Unit Manufacturer)
2) Square D
3) Eaton
4) Shark

E. Disconnect Switches:

1. Shall be heavy-duty type three-pole, with "Quick Make/Quick Break" operating handle mechanically interlocked with the cover, horsepower and voltage rated to match equipment served. Where indicated switches shall be provided with dual-element, time delay, rejection type fuses. Switches shall be installed in NEMA 1, 12 for indoor use, NEMA 4[X] for outdoor use. Provide provisions for padlocking in the "off" position. Provide neutral bar in single phase or three phase, four wire circuits, and ground bar in all switches. Provide auxiliary contacts where called for.

2. All disconnects connected downstream of ASD's shall have a normally open and normally closed auxiliary contacts which shall be wired to the ASD to indicate disconnect is open.

3. Manufacturers: Subject to compliance with Contract Documents, the following manufacturers are acceptable:

a. Square-D - Design Make.
b. Cutler Hammer.
c. General Electric.
d. Siemens.

F. Elevator Control Switch:

1. Provide elevator control switch in a single NEMA 12 enclosure with required relays, control transformer and other options listed below.

2. The elevator control switch shall be constructed, listed and certified to the standards listed below:

a. Enclosure Switches; UL 98.

3. All work shall be performed in accordance with the latest edition of the following:

a. NFPA 70 - Section 620-51 (a-c), 620-62, 620-91 (c).

b. ANSI/ASME A17.1 - Section 102.2 (c) (3).

c. BOCA 3006.2.3.

d. NFPA 72 - Section 3-9.4.4.

4. The elevator control switch shall have an ampere rating as indicated on drawings and shall include a horsepower rated fusible switch with shunt trip capabilities.

5. Provide with current limiting fuses at 200,000 amp RMS symmetrical of size(s) coordinated by the elevator manufacture for protection of their equipment.

6. The elevator control switch shall include a 100VA control power transformer with primary and secondary fuses 120 volt secondary.

7. The elevator control switch shall include an isolation relay external dry contact indication (3PDT, 10 amp, 120 volt).

8. A normally open dry contact from the fire alarm system shall energize an isolation relay and activate the shunt trip solenoid.

9. The switch shall include a 120 volt key test switch and a 1-NO/1-NC mechanically interlocked auxiliary contacts rated 5 amp, 120 volt AC.

10. The switch shall also include the following:

a. "On" pilot light (green).

b. Isolated full capacity neutral.

c. Fire alarm monitor relay.

d. Main switch auxiliary contacts (1-NO/1-NC).

11. Design Make: Eaton Corp.

12. Approved Manufacturers: Littlefuse, VTI, Siemens.

G. Fuses:

1. All fuses rated 600 volts and below shall be rejection type dual-element, time-delay type. Provide two (2) complete sets of fuses for all fusible devices. Deliver spare fuses to the Owner and obtain receipt.

2. Manufacturers: Subject to compliance with Contract Documents, the following manufacturers are acceptable:

a. Fuses 600 Amperes and Below: Bussman Type FRS-R (600 volts), Bussman Type FRN-R (300 volts) or equivalent.

b. Fuses Rated Above 600 Amperes: Bussman Type KRP-C or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment shall be grounded per the NEC.

B. Electrical distribution equipment shall have lugs/terminations suitable for the indicated conductor size. Where conductors have been oversized for voltage drop and where approved by the Engineer it shall be allowed to reduce the conductor size using hydraulically crimpled splice in a box next to the distribution equipment to allow for standard lug termination.

C. Distribution switchboards shall be mounted on 4 in. high concrete pads which shall extend 3 in. on all sides. Securely bolt the unit to the pads for proper horizontal and vertical alignment.

D. Provide pad lockable branch circuit breaker device to hold circuit breaker in the closed position, but not prevent overcurrent protection, for all branch circuits serving fire alarm controls panels, emergency lighting and life safety branch circuits.

E. Identification:

1. Identify all items of equipment as described in Section 260501-3.1, Identification. Identification shall be provided for switchboards, panelboards, transformers, ASD's, motor starters, disconnect switches, enclosed circuit breakers, switchboard main/distribution breakers, MCC's automatic transfer switches, UPS's, generators, surge suppression devices, control panels, switchgear, etc.

2. Switchboards, panelboards, etc. shall have a label indicating name/tag ID, feeder source, conductor color convention and for service entrance locations the available short circuit current.

3.2 ELECTRICAL LOAD TEST

A. Conduct a load test prior to request for final payment and comply with the following:

1. Energize maximum normal light and power load for a period of two hours when scheduled.

2. Record voltage at service and at each panel.

3. Measure current in each phase of all feeders.

4. Adjust transformer taps as directed by engineer after review of report.

5. Provide and install all necessary metering equipment.

6. Owner's Representative or Site Representative shall witness the test.

7. Before final acceptance specified test shall be completed to the satisfaction of the Owner's Representative who shall be sole judge of the acceptability of such tests and who may direct the performance of such additional tests as deemed necessary in order to determine the acceptability of the systems, equipment, material and workmanship. Additional tests required by the Owner's Representative shall be provided at no additional cost. Protective equipment shall be actuated in a manner that clearly demonstrated their workability and operation.

3.3 CLEANING

A. At the completion of the project, while equipment is de-energized, it shall be thoroughly cleaned to a shipped condition using methods in accordance with the manufacturer's recommendations. Utilize vacuum for cleaning and not compressed gas.

3.4 SPARE PARTS

A. Deliver loose equipment to the Owner and obtain receipt for fuses, keys to panelboards, etc.

3.5 DISCONNECT DEVICES

A. All disconnect devices downstream of ASD's: Provide wiring, conduit and connections between ASD and disconnect auxiliary switch to ASD.

END OF SECTION

SECTION 262713 - ELECTRIC SERVICE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide labor, materials, equipment and services for the complete installation of an electric service and related Work required in these Contract Documents. The Utility Company is National Grid.

1.2 UTILITY COMPANY

A. Include all utility company fees and charges for service as part of contract.

1.3 QUALITY ASSURANCE

A. All methods of construction, details of workmanship, that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions, etc., correspond to the nomenclature dictated by those manufacturers. All equipment shall be tested at the factory. Standard factory inspection and operational tests will be acceptable.

B. Installation shall be accordance with utility requirements NFPA 70 (National Electrical Code), National Electrical Safety Code (NESC), state codes, local codes, and requirements of authority having jurisdiction.

C. Equipment shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published ANSI, NEMA and IEEE Standards.

1.4 SUBMITTALS

A. All items of equipment and accessories including the following:

1. Underground ductbank materials.

2. Billing Instrument transformer enclosure.

3. Utility Company mast anchoring detail.

4. Equipment pad/vault.

B. Send three copies of submittals to the Utility Company for review before sending submittals to Engineers. Include one (1) Utility Company approved copy with submittal drawings for review.

1.5 SERVICE CHARACTERISTICS

A. Secondary Service:

1. Low Voltage: 208/120 grounded, wye, three phase, four wire, 60 Hz.

2. Source:

a. Utility Company pad mount transformer, for underground service.

1.6 UTILIZATION VOLTAGES

A. Building power system shall be a nominal 208/120 volt, three phase, four wire, solidly grounded, 60 Hz system.

1.7 UTILITY COMPANY COORDINATION

A. Coordinate entire electric service with Utility Company.

B. Do not interrupt electric system until approved in writing, coordinated so outages occur at Project Site convenience.

C. Coordinate switching requirements with utility company, as approved in writing by the Owner.

1.8 DEMAND CONTROL SYSTEM INTERFACE

A. Coordinate with utility company, and provide all requirements for interfacing demand pulse signaling equipment on utility company kWH/demand metering instrument, and pay all fees and charges.

PART 2 - PRODUCTS

2.1 UNDERGROUND SERVICE DUCTBANK

A. Refer to Section 260501.

2.2 TRANSFORMER PAD

A. Refer to Drawings.

2.3 UTILITY COMPANY METERING ACCOMMODATION

A. Verify all requirements with Utility Company before proceeding.

B. Utility Company shall furnish all billing instrument CT and PT transformers.

C. Provide code gauge metal cabinet, as approved by Utility Company, to house billing instrument transformers.

D. Provide Meter Backboard:

1. Use 3/4 in. x 5 ply marine grade plywood.

2. Paint front and back of plywood with two (2) coats of exterior gray paint.

3. Size as required by utility company.

PART 3 - EXECUTION

3.1 UTILITY COMPANY METERING ACCOMMODATION

A. Verify all installation requirements with utility company before proceeding.

B. Install meter backboard. Space board from wall when located on outside wall. Provide required clearances.

C. Mount CT cabinet where called for and as directed by the Utility Company.

D. Install instrument current and potential transformers in cabinet.

E. Provide 1-1/2 in. rigid galvanized steel conduit from the instrument transformer location to the meter backboard.

F. Install all test devices furnished by the Utility Company.

G. Utility Company shall provide all Utility Company metering instruments. Install all meter sockets as required.

H. Provide wiring from meter instrument to metering transformers as directed by Utility Company.

I. Provide grounding, connections and miscellaneous materials required.

3.2 INSTALLATION AT RISER POLE

A. Terminate at existing riser pole.

B. Stub conduit at position directed by Utility Company.

C. Provide hot dipped galvanized steel rigid conduit at riser.

D. Stub active conduit to height directed by Utility Company and cap.

E. Stub spare conduit to height directed by Utility Company and cap waterproof with threaded cap.

F. Strap conduit to pole every 4 ft.

G. Ground as directed by Utility Company.

END OF SECTION

SECTION 263213 - POWER GENERATION - GENERATOR, AUTOMATIC TRANSFER SWITCH AND ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services for the complete installation of generator, automatic transfer switch and related work required in these Contract Documents.

1.2 QUALITY ASSURANCE

A. All methods of construction, details of workmanship that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions, etc. correspond to the nomenclature dictated by those manufacturers. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

B. Installation shall be accordance with NFPA 70 (National Electrical Code), NFPA 110 (Standard for Emergency and Standby Power Systems), National Electrical Safety Code (NESC), state codes, local codes, and requirements of authority having jurisdiction.

C. Equipment shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published ANSI, NEMA, UL and IEEE Standards. If skintight enclosure is used, the equipment shall conform to UL 2200.

D. System emissions shall meet or exceed the EPA and Code of Federal Regulations 40CFR.

1.3 SUBMITTALS

A. Submit shop drawings only for manufacturers named. Submission of other manufacturers will be rejected unless the terms of equivalents and substitutions stated in the General Provisions are followed.

B. Submit shop drawings on equipment and accessories to include the following:

1. Engine-generator set, including engine, radiator, alternator, circuit protection, fuel consumption, exhaust flow/temperature, noise (dBA), performance ratings (kW, starting kVA, pf, voltage, etc.), thermal ratings, heat generation.

2. Engine controls, including starting controls, governor, etc.

3. Generator instrumentation, voltage regulator, insulation class, etc.

4. Catalog cuts, bill of materials, descriptive data, spare parts list for specified equipment.

5. Mounting arrangement, floor plans, elevations, overall dimensions including accessories, foundation, bedrail, and/or bolts, power and control conduit entrance space.

6. Weatherproof enclosure: dimensions, elevation, plan, attenuation, cooling, accessories, etc.

7. Batteries, mounting rack, accessories.

8. Gas regulator.

9. Automatic transfer switch and accessories.

10. Remote annunciator panel.

11. Software and details of remote monitoring system.

12. Wiring diagrams of all equipment, external and internal connections and interconnections.

13. Emergency shutdown switch.

14. Factory tests and field supervision reports as called for. Include information described in 1.4 below pertaining to field supervision.

C. Composite Instruction Books shall include as a minimum the following:

1. Instructions covering overall equipment.

2. Instructions covering all major and serviceable components, and accessories.

3. Recommended spare parts with current prices.

4. Complete renewal parts information.

5. Quantities of oil/coolant/etc.

6. Instructions, both individually and collectively, shall adequately describe receipt, handling, care, inspection, installation, operation, and maintenance of equipment.

7. Instruction books shall be used for equipment installation, and submitted prior to project closeout.

8. Factory trained maintenance provider contact information.

9. System error code (alarms, faults, etc.) list with descriptions.

1.4 STANDARDS AND TESTS

A. Equipment covered by these specifications shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of all applicable published ANSI,

NEMA, and IEEE Standards, the requirements of NEC, NFPA 37, NFPA 110, UL 1008 and UL 2200 Standards. State and local requirements.

B. Furnish submittals of field test reports covering field tests and inspections performed and conducted by manufacturer's representative.

1.5 FIELD SUPERVISION

A. Submittal shall state that adequate local within 75 mile radius of project locations field supervision and service, by competent qualified representative of the manufacturer, who is regularly engaged in working on this type of equipment, will be available at any time.

B. Submittal shall state address of nearest vendor's place of business, telephone number and name of person to contact for field service.

C. Provide field supervision/service at no additional cost to cover inspection, test, and start-up of this equipment.

D. Submittal shall state the amount of field supervision/service recommended by vendor to cover critical points of installation, inspection, test, and start-up.

E. Provide proposal for a yearly maintenance agreement for time beyond the warranty period.

F. The above data shall be included with submittals.

1.6 RIGGING

A. Provide rigging to unload, move, transport, set in place, erect, etc.

1.7 WARRANTY

A. Provide a warranty for the specified equipment to be free from defects in materials and workmanship, whether functional or nonfunctional, replace or repair without cost, defects which, with normal usage, appear within one (1) year of project closeout.

B. During the warranty period provide preventative maintenance as recommended by the manufacturer for the system every six (6) months.

1.8 TRAINING

A. Provide verbal and written training to facility appointed personnel in the proper and safe manner of operating equipment.

B. Training shall be at a time convenient for the Owner, not during system start up/testing and be a minimum of 4 hours or as needed for the Owner personnel to understand the system operation and maintenance.

1.9 DESCRIPTION OF SYSTEM OPERATION

A. Provide Engine-Generator System to meet the following functions:

1. Arrange system for automatic starting upon failure of normal source voltage.

2. Provide programmable one-second time delay, field adjustable from 0 to 9999 seconds. Delay time between normal source failure and engine**(s)** starting.

3. Initiate engine**(s)** starting cycle from transfer switch auxiliary dry contact.

4. Transfer loads from normal source power to emergency source when engine-generator reaches 90% of its rated voltage.

5. Retransfer emergency loads from emergency generator to normal source ten (10) minutes after normal source has reached 90% or more of normal voltage. Control shall be field programmable from 0 to 9999 seconds.

6. Retransfer emergency loads from emergency generator to normal source instantaneously when normal source has reached 90% or more of normal voltage, if emergency generator has failed while supplying load.

7. Run engine for a period of ten (10) minutes after retransfer of emergency loads to normal source. Engine-generator(s) will then shut down, automatically resetting and leaving all controls ready for the next emergency start condition. Period shall be programmable from 0 to 9999 seconds.

8. Use integral automatic transfer switch time clock to automatically exercise engine once every four weeks for 1 hours. Time clock contacts shall simulate loss of normal voltage; start engine, and shut engine down after fifteen minutes of operation. The load shall not transfer to the emergency source during the exercise time. Provide a selector switch to permit cycling engine-generator under load or no-load conditions.

9. Provide interconnection with Facility building management system. Communication shall be through the Facility network system and shall communicate generator status including, faults.

10. Shall shutdown via remove emergency shutdown button.

PART 2 - PRODUCTS

2.1 ENGINE-GENERATOR SET

A. General: The system shall meet the following parameters.

1. 208Y/120 volts, 12 lead, three phase, four wire, connected, 60 Hz.

2. **[ ]** kW stand-by rating at 0.8 power factor.

3. Minimum motor starting kVA rating shall be **[ ]**, based on 30% instantaneous voltage dip.

4. Suitable for ambient conditions:

   a. Ambient Temperature: -25C to 40°C.

   b. Altitude: 1000ft above sea level.

5. Maximum of **[ ]** in. L x **[ ]** in. W x **[ ]** in. H (with silencer).

6. **[ ] psi of utility natural gas pressure.]**

7. **Maximum allowable combustion exhaust of [ ] in. WC.**

8. **[Combustion exhaust temperature shall not exceed [ ]°F and [ ] CFM.]**

9. **[System fuel consumption shall not exceed [ ] CFH GPH.]**

B. Engine - Gaseous Fuel:

1. Single fuel carburetion for natural gas.

2. Minimum six cylinder, four stroke cycle, 1800 rpm.

3. Stand-by rating shall be adequate to provide maximum kW output of generator under full load and motor starting kVA requirements. The engine generator set shall be capable of picking up 100% of nameplate kW, after adjusting for site conditions (altitude, temperature), in one step with the engine generator set at operating temperature, in accordance with NFPA-110. A resistive load bank (1.0 pf) shall be acceptable for meeting the load requirements.

4. Carburetor, secondary gas regulator, electric solenoid shutoff valve, strainer (fuel filter), gas shutoff cock.

5. Provide primary gas regulator if required by characteristics of local utility gas supply. Gas pressure available at engine regulator is **[ ]**.

6. Full pressure lubrication system with positive displacement, mechanical, full pressure gear type oil pump, full flow oil filters with replaceable filter element, equipped with spring-loaded bypass valve as an insurance against stoppage of lubricating oil in the event filter becomes clogged; water-cooled oil cooler and thermostat.

7. One or more oil or dry type air cleaners of sufficient capacity to protect engine working parts from dust and dirt.

8. Water cooled with skid mounted, closed loop type radiator, belt-driven pusher fan, centrifugal water circulating pump, thermostat temperature control, liquid-

cooled exhaust manifolds suitable for unit full load operation and 50°C ambient condition. Provide radiator with duct connection flange. Rotating parts shall be protected against accidental contact. The cooling system shall be rated for full rated load operation in 50°C ambient conditions. Low coolant level sensor alarm and shutdown.

9. Provide 50/50 solution of propylene glycol for engine closed loop cooling system.

10. Provide thermostatically controlled water jacket heater suitable for the intended location and wiring, rated for 120 volt, single phase operation. Unit shall be sized to maintain unit temperature for optimum starting conditions. Provide circuit for this from a normal power source.

11. Engine speed isochronous (0% droop) electronic governing system capable of parallel operation with load sharing controls.

12. Battery starting system per manufacturer's recommendations. Voltage shall be suitable for the needed starting capability, batteries and voltage drop.

13. Engine mounted battery charging alternator (belt driven), 35 ampere minimum, and solid-state voltage regulator. Higher charging current unit shall be provided as recommended by the manufacturer.

14. An electric starter capable of three complete cranking cycles without overheating, before overcrank shutdown. Shall comply with NFPA 110.

15. The engine-generator set shall be mounted with vibration isolators on a heavy duty steel rail base to maintain proper alignment between components. The engine-generator set shall incorporate a battery tray with battery hold down clamps within the base rails. Provisions for stub up of electrical and fuel connections shall be within the footprint of the generator set base rails.

C. Generator/Alternator:

1. Synchronous, four pole, compatible with unit rpm, revolving field, fireproof construction. Brushless, permanent magnet exciter with solid state voltage regulator.

2. Insulation rating of alternator shall, at a minimum, meet requirements of NEMA Class H construction to comply with NEMA standard MG1-22.40 and 16.40. Temperature rise of rotor and stator shall be limited to Class F (155°C or 105°C maximum temperature rise of winding, measured by resistance method, at 40°C ambient) for standby rating.

3. Insulation rating of alternator shall, at a minimum, meet requirements of NEMA Class H 180°C construction to comply with NEMA standard MG1. Temperature rise of rotor and stator shall be limited to 150°C maximum temperature rise of winding, measured by resistance method, at 40°C ambient) for standby rating.

4. Voltage regulation within 0.5% plus or minus of rated voltage for any constant load from no load to full load.

5. Frequency regulation shall be isosynchronous from steady state no load to steady state rated load. Speed variations for constant loads from no load to rated load shall not exceed ±0.25% of rated speed, with constant ambient and operating temperature.

6. Provide plus or minus 5% voltage adjustment.

7. Total harmonic distortion (THD) shall not exceed 5% of rated voltage and no single harmonic shall exceed 3% of rated voltage.

8. Telephone influence Factor; TIF shall be less than 50 per NEMA MG1-22-43.

9. Terminal voltage re-established to within 2% of rated voltage within two seconds following any sudden change in load between no load and full load or between full load and no load.

10. Sealed, permanently lubricated ball bearings.

11. Direct-driven generator cooling blower.

12. Provide fixed field connections to AC output leads in extra-large terminal box with removable cover.

13. Provide adequate wiring space for conduits. Power cables shall exit the bottom of the generator.

14. Exciter shall be brushless, permanent magnet type.

D. Generator Auxiliary Equipment:

1. Provide generator output circuit breaker, three pole, common trip, thermal magnetic type, to completely protect the generator from overloads; frame size and trip rating as called for. Provide solid state trip unit and 100% rating for circuit breakers 250A and above with long time, short time and instantaneous adjustable settings.

2. Provide and install a clearly identified NEMA 12 surface mounted remote shutdown switch per generator manufacturer's recommendation similar to ASCO 12404. Provide wiring in conduit per manufacturer's recommendation.

3. Outdoor weather-protective housing with exhaust muffler installed and located within the housing. The housing shall have hinged side-access doors and rear control door. All doors shall be lockable. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color. All hardware (hinges, screws, bolts, door operator, etc.) to be stainless steel. Input and output air dampers with controlled damper motorized actuators shall be spring open and held closed when not in use. **[Unit sound attenuation shall**

limit the noise level to [ ] dB at 21 ft. Provide concrete pad as detail on the drawings. Generator unit shall be UL 2200 labeled with enclosure installed.

4. Battery Heater: Provide pad type battery heater suitable for intended location. Provide circuit for this from a normal power source.

E. Acceptable Manufactures:

1. Cummins/Onan
2. Generac
3. Caterpillar (Design Make)
4. MTU/Detroit Diesel
5. Kohler

2.2 MICROPROCESSOR ENGINE-GENERATOR SET CONTROL

A. The control shall have automatic remote start capability. Starting cycle shall be initiated by auxiliary contact(s) in automatic transfer switch. A panel mounted switch shall stop the engine in the STOP position, start and run the engine in the RUN position, and allow the engine to start and run by closing a remote contact, and stop by opening the remote contact when in the REMOTE or AUTOMATIC position.

B. The control shall include a cycle cranking function. The cranking cycle, nonadjustable, shall consist of an automatic crank period of approximately 15 seconds duration followed by a rest period or approximately 15 seconds duration. Cranking shall cease upon engine starting and running. Two (2) means of cranking termination shall be provided, one as a backup to the other. Failure to start after three cranking cycles (75 seconds) shall shutdown and lockout the engine, and visually indicate an overcrank shutdown on the panel.

C. The control shall shut down and lock out the engine upon: failing to start after the specified time (over crank), overspeed, low lubricating oil pressure, high engine temperature, or operation of a remote manual stop station. Provide audible alarm and visual indication of the particular contact that operated, and reset pushbutton. Provide common fault contacts, wired to terminal board for remote alarm indication.

D. The control shall provide a twelve light (LED) minimum engine monitor on the control panel; one red light for each of the five shut downs (except the remote manual stop), and one yellow light each for the high engine temperature and low engine oil pressure prealarms, and one green run light. The control panel monitor shall include; a flashing red light to indicate the generator set is not in automatic start mode, a yellow light to indicate low coolant temperature, a yellow light to indicate low fuel, a red light to indicated battery charger failure, and one red light for auxiliary use (for a total of twelve). A panel mounted switch shall reset the engine monitor and test the lamps. The engine-generator set starting battery(ies) shall power the monitor. Operation of shut down circuits shall be independent of indication and prealarm circuits. Individual relay signals shall be provided for each indication for external circuit connections (not to exceed 1/2 amp draw) to a remote annunciator. A common contact for external connection to an audible alarm shall be provided.

E. Provide a low coolant level shutdown, which shall be indicated as a high engine temperature fault.

F. The NEMA 1 enclosed control panel shall be mounted on the generator set with vibration isolators. The control shall include surge suppression for protection of solid state components. A front control panel illumination lamp with On/Off switch shall be provided. Control panel mounted indicated meters and devices shall include: Engine Oil Pressure, Oil Temperature, Coolant Temperature, low coolant alarm/shutdown, DC Voltmeter, and Running Time Meter (hours); Voltage adjusting rheostat, locking screwdriver type, to adjust voltage ±5% from rated value; Analog AC voltmeter, dual range, 90 degree scale, 2% accuracy; Analog AC Ammeter, dual range, 90 degree scale, 2% accuracy; Analog Frequency meter, 45-65 Hz, 90 degree scale, ±0.6 Hz accuracy; kW; kVA; power factor; Seven position phase selector switch with OFF position to allow meter display of current and voltage in each generator phase. Provide shorting-type terminal boards for all current transformer secondary windings. Liquid crystal display (LCD) shall be utilized for display of metered items and alarm/trouble indication.

G. Control panel shall have an interior RJ45 outlet for Ethernet connection and provide all information indicated herein for remote monitoring utilizing the manufacturer software.

H. Provide remote annunciator at first floor Aide Station for engine-generator alarm function. Alarm functions for generator are as follows:

1. Visual signals for: Battery charger AC supply failure, battery charger DC output failure, engine-generator running.

2. Visual and audible signals for: Overspeed, low lube oil pressure, high and low water temperature, overcranking (failure to start), overload.

3. Provide all of the indications and audible alarms called for above. Provide alarm silence and lamp test switches.

2.3 BATTERIES

A. Provide batteries as follows:

1. Lead acid type, VDC, quantity and connections as recommended by the generator set manufacturer.

2. Provide corrosion-resistant battery mounting rack, battery interconnecting cables and terminals, etc.

3. Provide battery heating pad suitable for the intended location, 120 VAC and power connection to maintain 10 second starting time.

2.4 AUTOMATIC TRANSFER SWITCH (ATS)

A. Description:

1. The automatic transfer switch shall consist of a power transfer switch and a microprocessor based control module, interconnected to provide complete automatic operation. Double throw, mechanically and electrically interlocked. All main contacts shall be of silver composition. The operating transfer time shall be a maximum of 1/2 of a second. Transfer switch shall be capable of manual transfer in order to meet the requirements of UL 1008 and UL listing requirements as described UL's "Electrical Construction Materials."

2. Operated by momentary energization of a single coil with mechanical latching in both normal and emergency positions.

3. Operating voltage for transfer obtained from source to which load is to be transferred.

4. Three phase, four wire, three pole, solid neutral 120 volt normal and emergency power source contacts.

5. Ampere rating as called for, rated for continuous duty.

6. Provide magnetic blowout coils and arc barriers on each pole.

7. Provide voltage supervisory relays on each phase of both normal and emergency sources, such that transfer and engine start is affected should any one phase of the three phase supply be below 80% of normal voltage.

8. Three-cycle closing and withstand rating minimum 35,000A rms symmetrical amperes without the use of current limiting fuses.

9. Manufacturer's standard mechanical type lugs suitable for aluminum or copper conductors. Provide lugs for each power cable, phase and neutral. Cable size and conductor type as called for. Terminals front connected.

10. Provide dual transfer switch operator with adjustable time delay 0-9999 seconds set at 3 seconds for a neutral position to allow motor loads residual voltage to decay between the time that the closed source is opened and the open source closed.

11. Provide pilot lights (LED's) as follows:

    a. Green, indicating normal switch position.

    b. Red, indicating emergency switch position.

    c. Fuse for each light.

12. Provide the following accessory features:

    a. Adjustable time delay before engine starting, field programmable from 0-9999 seconds. Factory set at 1s.

b. Adjustable time delay on transfer to emergency, field programmable from 0-9999 seconds. Factory set at 3s.

c. Adjustable time delay on retransfer to normal field programmable from 0-9999 seconds, factory set at 300 seconds. Final delay to be coordinated with elevator installation.

d. After retransfer to normal, the engine generator set shall be allowed to run, unloaded, for an additional 0-9999 seconds, factory set to 300 seconds.

e. Test switch, engine start and transfer.

f. Pushbutton to bypass time delay on retransfer back to "normal" position.

g. Engine start contact.

h. Time clock exerciser with transfer. Retransfer shall be automatic at end of exercise period. Provide a bypass switch for manual exercise and a selector switch to permit cycling engine-generator under load or no-load conditions.

i. Auxiliary contacts for normal, emergency and neutral position, two form C for each position. No common wires for auxiliary contacts. Bring wires to terminal block, suitably labeled.

j. Accommodate control input for load shedding. Signal shall drive ATS to neutral position.

k. A contact which closes when normal source fails for initiating engine starting, rated min, 10A @ 32 VDC.

l. A contact which closes when unit is on emergency power and normal power returns and is suitable for use. Contact shall be wired to elevator controller.

m. Provide ground studs to enclosure for mechanical lugs for size #4/0 copper cables.

n. Provide any other accessories as may be required to achieve operation as described in Article 1.9.

o. Provide box of spare fuses and LED's for pilot lights.

p. Provide NEMA 12 sheet metal enclosure for all mounting, front door hinged.

q. All time delay relays shall be field programmable and shall show the actual setting time in minutes or seconds.

B. Design Equipment: Russelectric RMT (single operator) or RMTD (dual operator) series.

C. Make: ASCO, or acceptable generator set manufacturer's ATS utilizing specified make's transfer switch.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. General Requirements:

1. Completely coordinate installation, assure that elements of the system are compatible, operational and correct.

2. Provide rigging to unload, move, and set/bolt in place engine-generator and ATS. Provide concrete pad as detailed on the drawings.

3. Provide miscellaneous bolts, washers, nuts, clips, lockwashers, small hardware, etc., of durium or equal rust resistant material, to make installation complete.

4. Refer to "Grounding" section of specifications.

5. Install equipment plumb, level, and true.

6. Leave maximum space available in front, alongside, etc., all items of equipment, to allow easy access and servicing of serviceable components. Meet NEC requirements.

3.2 WIRING

A. Install power and control wiring between engine-generator set, transfer switch, battery charger, louvers, dampers, controls, coolers, batteries, day tank and all other various and related equipment. Provide all necessary wiring and interface equipment to interconnect generator system with the Facility building management system.

B. Comply with Manufacturer's Instruction Books.

C. Maintain phasing standards as called for and rest of the system.

D. Color code and identify control and power wires and cables as called for.

E. Provide copper, 600 volt insulation minimum, control wiring; do not splice.

F. Provide "crimp-on" type terminal for control wire terminations, as called for.

G. Provide liquid-tight jacketed flexible conduit for all connections to engine, generator, and to day tank. All connections shall account for the anticipated vibration.

H. Provide green ground conductor in each conduit run.

3.3 ENGINE - GENERATOR INSTALLATION

A. Install where indicated. Refer to drawings for installation detains, pad details, etc.

B. Provide necessary anchor bolts at proper locations, place by templates if required, for proper setting of engine-generator.

C. Manufacturer's Representative shall provide lube oil and anti-freeze for initial start-up. Electrical Contractor shall provide all fuel for start-up and testing and leave tank at the full level upon completion.

D. Entire system shall be complete and operational and shall be test operated, including simulated loss of normal power, all control devices shall be operated to test their function.

E. Determine exact requirements, verify locations, and comply with applicable regulations in installing equipment.

F. Provide the services of the manufacturer's representative to check out the system and instruct the Owner in the operation of the system. Furnish written statement to the Owner's Representative that the checkout and instruction service has been provided. Include statement that system operates properly, as called for. Submit statement as a submittal for review.

3.4 FUEL PIPING

A. Division 22 shall provide natural gas piping to engine-generator and make final connection.

B. Provide fuel filter, fuel solenoid valve, secondary regulator, gas shutoff cock, flexible fuel piping and fuel piping diagram.

C. Coordinate fuel piping size with these items.

3.5 IDENTIFICATION

A. For installations that have a single grounding location (connected to the main service entrance) provide signage indicating the following: "WARNING - SHOCK HAZARD EXISTS IF GROUNDING ELECTRODE OR BONDING JUMPER IN THE EQUIPMENT IS REMOVED WHILE ALTERNATE SOURCE(S) IS ENERGIZED."

3.6 ELECTRICAL LOAD TEST

A. Conduct a resistive load bank test to the full capacity of the generator for four hours after completion of installation, but before connecting to the building system. Record system voltage, current, kW, pf, oil pressure and temperature every 15 minutes with the manufacturer recommended values in the test report. Upon successful completion of load bank test, complete connections to building system and perform an operational test as outlined in "B" below.

B. Conduct a full operational test of complete system prior to request for final payment and comply with the following:

1. Start the generator by simulating a loss of utility power at each transfer switch.

2. Energize maximum emergency light and power load for a period of one hour when schedule.

3. Record voltage at generator and at each panel, using the same digital meter at each location.

4. Measure current in each phase of all feeders, using the same digital meter at each location.

5. Record the time from power loss to engine start and power transfer for each transfer unit.

6. Reconnect circuits in an effort to provide balanced (within 10%) load on all feeders.

7. Provide and install all necessary metering equipment.

8. Owner's Representative shall witness the test.

9. Provide complete test report with attendees, time, date, initial parameters, test results and sign off.

10. Before final acceptance, specified tests shall be completed to the satisfaction of the Owner's Representative who shall be sole judge of the acceptability of such test and who may direct the performance of such additional tests as deemed necessary in order to determine the acceptability of the systems, equipment, material and workmanship. Additional tests required by the Owner's Representative shall be provided at no additional cost. Notify Engineer when load bank test is scheduled two (2) weeks prior to actual test.

3.7 EQUIPMENT PROTECTION

A. Provide repair or replacement for all damage and defacement, whether functional or nonfunctional, to all equipment from the time it is unloaded, during installation, and during period of beneficial use, and until installation is accepted.

END OF SECTION

SECTION 265000 - LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

A. Provide interior and exterior lighting systems, including luminaires, hangers, supports, fittings, lamps, wiring, connections and controls, as indicated in the Contract Documents for complete and operational systems. Luminaires, in general, have been specified for the particular type of ceiling in which they are to be installed. Verify the ceiling construction details and provide luminaires suitable for the respective ceiling types and room finish schedule.

1.3 REFERENCES

A. The following standards, criteria, codes, etc. shall be followed in the manufacture and installation of the lighting systems.

1. NFPA
2. NEC
3. IESNA
4. NEMA
5. ANSI
6. UL

1.4 ENERGY CONSERVATION WORK

A. Work installed as part of this Contract will be eligible for energy rebates/incentives available. The energy rebate shall be paid directly to the Owner. The Division 26 contractor shall cooperate with the Owner and the funding source to provide proof of purchase information, quantities involved, fill out forms, etc., to accommodate all required paperwork. Include all costs associated with this requirement.

1.5 QUALITY ASSURANCE

A. Luminaires shall be as specified in the "Luminaire Schedule". Luminaire types, appearance, characteristics, photometrics, finishes, etc., correspond to the specified manufacturer and associated series or catalog number listed in the "Luminaire Schedule". Products of other listed acceptable manufacturers shall be equivalent in every way to that of the luminaire specified. The Engineer reserves the right to disapprove any luminaire type submitted which they feel is not equal in quality, appearance or performance to the luminaire specified.

B. Manufacturer's luminaire series or catalog numbers listed in the "Luminaire Schedule" indicate quality, type, and style, but may not cover required special design details.

Provide luminaires having such special details as noted in the "Luminaire Schedule", as indicated by the specified luminaire model number and as required for proper installation.

C. All luminaires shall be new and bear a Nationally Recognized Testing Laboratories (NRTL) label for the service intended.

D. Luminaires shall be products of manufacturers regularly engaged in the manufacture of the type of luminaires specified and shall be the manufacturer's latest standard design that complies with specification requirements.

E. Verify the availability of all luminaires proposed to be used in the execution of the work prior to submitting same for approval. The discontinuance of production of any luminaire after such approval has been granted shall not relieve the Contractor from furnishing an approved luminaire of comparable quality and design at no additional cost.

F. Photometric and operational data shall be provided only by qualified and certified organizations. Certification documentation shall be submitted with the luminaire information.

G. Should there be any difference between drawings and schedules, secure from Architect/Engineer such information as necessary prior to providing proposal. When finishes are not definitely specified, they shall be as selected by the Architect and not be limited to standard finishes.

H. Locations indicated for luminaires are approximate. Field coordinate exact locations as near as possible to the location indicated. Coordinate with the Engineer for any major location changes.

1.6 SUBMITTALS

A. Product Data: For each luminaire type, include in a single submittal, in order of luminaire designation, the catalog "cut" sheet with complete manufacturer and model number. Product data should include the following:

1. Manufacturer and Catalog Number.

2. Features, accessories, materials and finishes.

3. Physical description and dimensions of luminaires.

4. Life, power input, output (lumens, distribution, CCT, and CRI) and energy-efficiency data.

5. Photometric data and adjustment factors based on laboratory tests (space to mounting height ratio, coefficient of utilization complete values, IES distribution, candlepower distribution by angle and luminaire efficiency). Format shall be in accordance with IES TM-27.

6. Power, signal, and control wiring diagrams between luminaires and controllers.

7. Lens/Louver Type.

8. Driver/ballast with each type luminaire as applicable (type, sound rating, overload protection, voltage, input/fixture wattage, ballast factor, power factor, etc.).

9. Integral battery inverters.

10. Emergency lighting units, including batteries and chargers.

11. Certification of IES LM-79, IES LM-80 and TM-21 testing for LED luminaires. Luminaires shall be tested in accordance with IES LM and TM standards.

12. Proof of Energy Star listing.

13. Warranty.

B. Coordination Drawings: Provide coordination drawings in accordance with Section 260500. Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structure members to which equipment and or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including other luminaires, air outlets and inlets, speakers, sprinklers, access panels, ceiling mounted projectors, etc.

C. Color Chips: Provide color chips of available finishes for luminaires upon request of Architect/Engineer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Luminaires and equipment shall be delivered with NRTL and manufacturer's labels intact and legible. Broken, cracked and damaged materials and equipment shall be removed from the site immediately and be replaced with new materials and equipment. Luminaires and accessories shall be stored in protected dry locations in their original unbroken package or container. Luminaires shall be protected from dust and dampness both before and after installation. Luminaires shall be protected from paint and cleaning solvents during all phases of construction.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division hazard by a NRTL.

C. UL Compliance: Comply with UL 1598 and UL 8750.

D. Recessed Luminaires: Comply with NEMA LE 4.

2.2 LIGHT-EMITTING DIODE (LED) LUMINAIRES

A. Luminaires shall be identical in construction features, options and appearance to the luminaries specified in the Luminaire Schedule. LED luminaires include white and RGBW systems as indicated on the luminaire schedule.

B. Luminaires shall be provided with all cables, controllers, power supplies, drivers, connectors, terminators and accessories required for a complete installation. LED system shall utilize pulse width modulation, non-linear scaling techniques and reverse polarity protection.

C. Provide dimming down to 10% as a minimum, or to percentage indicated or called for on the drawings. Unless otherwise indicated, the dimming control shall be a 0-10VDC signal

D. RGBW LED systems where indicated shall be capable of at least 8-bit control of red, green, blue and white module. RGBW LED system shall be capable of setting each module with a unique and individual address. Each address shall be controlled independently by DMX or alternate method protocol. All RGB LED fixtures shall undergo a minimum of eight-hour burn-in testing during manufacturing.

E. LED luminaires shall be high brightness and binned for forward voltage, luminous flux and wavelength.

F. LED luminaires shall be tested in accordance with IESNA LM-79 (luminous output, power input, luminaire efficacy (lumens/watt), color temperature and color rendering index), IESNA LM-80 (L70, output luminous maintenance, 10,000 hour minimum test, calculation method is not acceptable) and IESNA TM-21/28. Luminaire output shall be a minimum of 100 lumens/watt. Rated life shall be a minimum of 50,000 hours at 70% output. Testing shall be performed by a US Department of Energy (DOE) accredited laboratory.

G. Drivers shall be solid state Class 1 power supply/driver with universal input (120-277V). The system shall have a minimum 90% power factor, 3.5 maximum crest factor, minimum efficiency of 90%, a maximum of 20% THD and overload protection. Adequate heat sink capability shall be provided to ensure the rated life. Unit shall meet FCC rules and regulations.

H. Where indicated luminaires shall have color tuning capability and control. System to have separate dimming (5-100%) and color (3000K to 5000K, or as indicated on drawings) adjustability. Control shall be Dali or DMX512 for controllability as indicated. The system shall utilize the most recent settings when energized.

I. The luminaire (to include LED sources and drivers) shall have a full five (5) year minimum warranty for replacement and labor.

1. Acceptable LED Node Manufacturers:

a. Philips
b. Osram
c. Cree
d. Nichea
e. Lumiled

J. LED Emergency Drivers:

1. LED emergency drivers shall have the following minimum requirements:

a. Operate indicated fixtures at full illumination for 90 minutes minimum.

b. Universal voltage input (120 to 277V).

c. Upon loss of normal power, fixtures shall automatically switch to battery power.

d. Upon restoration of normal power, fixture shall return to normal mode and charge battery.

e. Battery shall be maintenance free, nickel cadmium type with a minimum life expectancy of seven (7) years.

f. Driver shall be suitable for the environment installed.

g. Driver shall be Class 2 and enclosed entirely in the fixture (except for down lights and exterior locations).

h. Units shall be listed for UL924 -Emergency Lighting and Power Equipment.

i. Minimum five (5) year non-prorated full warranty.

j. Factory installed.

k. Shall include an emergency system test switch integral to fixture.

l. Unit shall be self-testing and provide indication of unit failure.

m. Design Make: Iota, ILB-CP series or approved equal.

2.3 LUMINAIRE CONSTRUCTION

A. Metal Parts:

1. Free of burrs and sharp corners and edges.

2. Sheet metal components shall be steel unless otherwise indicated.

3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Lenses:

1. Shall be listed materials tested in accordance with ASTM D-635, "Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position" and burns less than 2/5 inches per minute.

2. The products shall have a smoke density of less than 75 when tested in accordance with ASTM D-2843, standard test method for "Density of Smoke from the Burning or Decomposition of Plastics".

3. The flame spread rating shall not exceed 0-25 and smoke developed rating shall not exceed 450 in accordance with ASTM E-84, standard test method for "Surface Burning Characteristics of Building Materials".

4. Self-ignition shall not occur below 600°F, in accordance with ASTM D-1929, standard test method for "Ignition Properties of Plastics".

5. Materials shall remain in place 15 minutes at 175°F and fall from frame at 200° below ignition temperature in accordance with ASTM D-648, "Deflection Temperature of Plastics Under Flexural Load".

2.4 LUMINAIRE SCHEDULE

A. Luminaire schedule is found on the contract drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION

A. Comply with NECA 1.

B. All luminaires shall be installed as per manufacturer furnished installation instructions.

C. Provide for every luminaire as shown on the plans, or as scheduled on the drawings.

D. Location of all ceiling and wall mounted luminaires shall be as indicated on the Architectural and Electrical drawings. The contractor shall verify ceiling type, construction, and material prior to ordering.

E. Provide luminaires with an IC rating for luminaires installed in direct contact with insulation.

F. Provide plaster frames for plaster ceilings and flanged frames for drywall ceilings.

G. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

H. Luminaires shall be suitable and as recommended by the manufacturer for the actual intended mounting method and materials.

I. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning and relamping.

3. Provide support for luminaire without causing deflection of ceiling or wall.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

J. Flush-Mounted Luminaires:

1. Secured to outlet box.

2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.

3. Trim ring flush with finished surface.

K. Wall-Mounted Luminaires:

1. Attached to structural members in walls, to a minimum 20 gauge backing plate attached to wall structural members, or using through bolts and backing plates on either side of wall.

2. Do not attach luminaires directly to gypsum board.

L. Suspended Luminaires:

1. Pendant and Rods:

a. Pendant mount luminaires from 1/4 in. threaded rods of required length.

b. Sleeve threaded rods with 1/2 in. EMT painted with color as directed by Architect/Engineer.

c. Brace pendants and rods longer than 48 inches to limit swinging.

2. Aircraft Cable:

a. Cables shall be 1/16 in. aircraft cable with end safety fittings. Cable shall be provided with 2 in. diameter mini-canopy and threaded coupler for attachment to a 1/4 in.-20 threaded stud extending 3/4 in. below ceiling.

b. Cable assembly shall include a spring-loaded adjustment device mounted in the fixture.

c. The Contractor shall be responsible for providing required supports for cable attachment.

d. For cord feed to the luminaire provide continuous cord clip of matching color to attach the cord to the cable.

e. Support per manufacturer's recommendations.

3. Support stem mounted, single unit luminaires with approved outlet box and accessories that hold tem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

4. Use tubing or stem for wiring at one point of continuous rows of luminaires and tubing, rod, or wire support for suspension for each unit of length of luminaire chassis, including one at each end.

M. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.

2. Use approved devices and support components to connect luminaire to building structure in a minimum of four locations, spaced near corners of luminaire. Utilize #10 steel wire; similar to that used to support the ceiling grid.

3. Provide UL listed seismic hold-down clips and fasten to luminaires and to ceiling grid members at or near each luminaire corner.

4. Install luminaires of sizes less than ceiling grid as indicated on reflected ceiling plans or center in acoustical panel and support luminaire independently with at least two metal channels spanning and secured to ceiling tees.

N. Cove Lighting:

1. Installed so as to produce a continuous and unbroken band of light with no shadows or light gaps.

O. In-Grade Luminaires:

1. Provide a minimum of 6 in. peat gravel at the bottom of luminaire to allow for drainage. When installed in a concrete walkway, secure luminaire to rebar to prevent luminaire from "floating" when concrete is poured.

2. Seal conduit entry into luminaire to prevent moisture penetration into luminaire from conduit system.

3. Secure faceplate of in-grade luminaires in accordance with manufacturer directions to compress gasket evenly to form a waterproof seal. The use of power tools to secure faceplate is not permitted.

P. Provide all necessary accessories for "end-to-end" mounting where continuous rows of luminaires are indicated. All luminaire assemblies shall be grounded.

Q. Luminaires installed in continuous rows may be fed by a single outlet if luminaires are UL approved and suitable for through wiring in luminaire raceway.

R. New luminaires may be provided to replace existing luminaires indicated to remain or be reused, subject to shop drawing approval.

3.3 REMOTE BALLASTS/DRIVERS

A. Remote ballasts shall be mounted in an approved NEMA 1 enclosure. Remote ballasts shall be located in areas easily accessible to maintenance personnel.

B. Wiring from luminaire to remote ballast shall not exceed the ballast manufacturer's recommendations for distance.

C. Remote ballast shall be clearly labeled indicating fixture served, voltage, panelboard and circuit number served from.

3.4 GROUNDING

A. Ground all non-current carrying parts of all lighting luminaires.

B. All grounding shall be accomplished with NRTL tested grounding connectors suitable for this purpose.

3.5 LABELING

A. Attach a self-adhesive red dot label, 1/2 in. in diameter, to all luminaires with an integral battery backup and/or those tied into an emergency generator. Labels shall be attached to these fixtures or to adjacent ceiling tiles so that they are readily discernible for testing and maintenance purposes.

3.6 FINAL CLEANING

A. Immediately prior to acceptance, damp clean diffusers, glassware, luminaire trim, reflectors, lamps, louvers, lens and similar objects of all luminaires. Remove all dirt, corrosion, foreign material, finger marks, and blemishes. Replace all burned out lamps and failed components.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test of Emergency Lighting: Under supervision of Engineer, interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

D. Replace luminaires damaged during shipment, construction, or installation.

3.8 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260936 "Lighting Controls."

3.9 ADJUSTING

A. Provide adjusting the direction of aim of luminaires to suit occupied conditions. Adjustment may be required during hours of darkness.

B. Final distribution shall be acceptable to the Owner and may take several attempts.

END OF SECTION

SECTION 270510 - COMMUNICATIONS, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents. This section specifies general wiring requirements for systems provided under 27 Series sections of these specifications.

1.2 SUBMITTALS

A. Refer to particular Specification Sections covering all systems. Submit system test reports as called for.

1.3 GENERAL REQUIREMENTS

A. Provide conduit systems and special systems as called for.

1. Provide conduit, wireway, wire terminations, etc., necessary to provide for system functions.

2. Cross-sectional area of wires installed in a conduit shall not exceed 40% of the cross-sectional area called for in the National Electrical Code.

3. Provide separate circuit power source for each system.

4. Where allowable by Code and contract documents, special systems wiring may be installed without conduit. Installation and wire insulation types shall be as described by NEC, Article 725. All low voltage wiring circuits 50V and under shall:

a. Be adequately supported using bridle rings or other approved method when installed horizontally above accessible ceilings or run exposed in unfinished areas.

b. Be run in wall cavity or surface metal raceway where no access is available to wall cavity, in finished areas.

c. Be installed in conduit when installed vertically in Mechanical Rooms from panels and devices up to ceiling.

d. Be installed in conduit in all cases not specifically covered by the above cases, or where subject to physical damage.

e. Have the proper insulation and meet the requirements of NEC Article 300-22 when installed in plenums or other spaces used for environmental air.

B. Identification:

1. Provide consistent color code wiring and identify with permanently attached number to each end of each wire, except where color coding is prohibited to meet UL burglary protection requirements.

C. Termination:

1. Unless special terminations are required, such as coaxial cable termination, wires shall be terminated on screw type terminal blocks with metal terminal cabinets.

D. Wiring Diagrams:

1. Install systems in accordance with manufacturer's certified correct wiring diagrams.

2. Provide record drawings for each system, with wire identification, numbers and colors, as installed.

PART 2 - PRODUCTS

2.1 MAKE AND SERVICE

A. Provide devices and equipment by an established manufacturer for respective systems. All devices and equipment for which there is a listing shall be UL listed and FM approved.

B. Provide system equipment and devices of one manufacturer who maintains a competent service organization and who shall be prepared to offer a service contract for maintenance of the respective system.

C. Provide three service organization inspections for each system at four-month intervals during the year following final acceptance.

D. Correct defects found in the system at the time of these inspections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide complete installation in a neat and workmanlike manner including all accessories and appurtenances for a complete operating system, including equipment mounting backboards, power supplies, wiring, etc.

B. Each system installation shall be supervised, tested, adjusted and approved by authorized representative of the manufacturer of the system devices and equipment.

C. Provide written statement from the authorized representative of the manufacturer of the system devices and equipment that the completed system has been inspected and tested and is approved.

D. Riser and wiring diagrams are not intended as final installation drawings but only as a guide for bidding. Install system based on final wiring drawings prepared by the manufacturer of the system.

3.2 WIRING

A. Wire sizes shall be as recommended by system manufacturer.

B. #14 AWG wire, minimum unless otherwise called for.

C. #12 AWG wire, minimum for alarm signal circuits and all power supplies.

D. Provide #20/2 copper minimum twisted and shielded with overall jacket for audio frequency circuits. Shield shall be Mylar backed aluminum foil with drain wire, or copper braid. Do not provide spiral wrap shielding.

E. Provide coaxial cable as called for, for video and RF distribution.

F. Do not install low level lines such as microphone wires in same conduit with high level lines such as speaker wires.

G. All final wire connections and terminations shall be performed by an authorized representative of the equipment manufacturer who is regularly engaged in, and experienced in this type of work. Subcontracting this work to others is not acceptable.

END OF SECTION

SECTION 272100 - LOCAL AREA NETWORK SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment, services, etc. for a Local Area Network (LAN) system. Provide cabling and final terminations to head end equipment furnished by others.

B. The systems to be provided shall be for a switched LAN environment. The system shall hereafter be referred to as the Data Network System.

C. Basic Intent:

1. Located throughout the building as shown on the drawings, are places where computers and associated equipment are intended to be placed and connected to the network for the purposes of utilizing common resources.

2. The telecommunications room for the data network in the building is located as shown on the drawings.

3. From the telecommunications room, data cables are to be run to the data jacks indicated on the drawings.

D. Scope of Work:

1. The scope of work shall include the items listed below, as described herein and as indicated on the Contract Documents:

a. Horizontal cabling.

b. Complete raceway system (cable tray, J hooks, and conduit) for cabling distribution.

c. Ground of all racks, raceway and equipment.

d. Power for the telecommunication rooms.

1.2 REFERENCE STANDARDS

A. ANSI/TIA/EIA Telecommunications Building Wiring Standards.

B. IEEE Telecommunications Standards.

C. BICSI Methods Manuals.

1.3 QUALITY ASSURANCE

A. Work shall be as specified herein and it shall be neat and orderly installation. All methods of construction, details of workmanship that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative.

B. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

C. Installation shall be accordance with NFPA-70 (National Electrical Code), TIA/EIA, IEEE, IEC, state codes, local codes, and requirements of the authority having jurisdiction.

D. Equipment shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published ANSI, NEMAIEC, TIA/EIA and IEEE Standards.

E. Each item shall be NRTL tested and listed.

F. The system provider must:

1. Provide equipment from manufacturers for which they maintain a contract, distributorship, are an agent, or other formal arrangement for which documentation can be produced showing authority to sell and service the equipment in this territory.

2. Demonstrate that they have successfully installed these systems, utilizing their standard products, for a period of five (5) years.

3. Maintain a service organization to provide both normal and emergency service. Emergency service must be available 24 hours per day; 365 days per year and staff must be adequate to respond within 2 hours of an emergency call.

4. Maintain adequate spare parts inventory to provide both normal and emergency service.

5. Employ service technicians who are trained in accordance with the systems manufacturer's recommendations.

6. Own and demonstrate proficiency in the use of the required test equipment, tools, etc. for the proper installation, set-up, testing and maintenance of the system. If requested, must provide a listing of tools and/or equipment and where appropriate, certifications in the proper training and use of the tools and/or equipment.

1.4 SUBMITTALS

A. Provide the following in a single clear and organized submittal. Package shall be submitted as specified in:

1. Manufacturers catalog sheets, specifications and installation instructions for all components.

2. Dimensioned drawings of all system control cabinets and layouts for all equipment rooms.

3. Cut sheets on all cables.

1.5 SYSTEM DESCRIPTION

A. Provide cabling and raceways for a state of the art Category 6 Local Area Network (LAN).

B. The system shall include, but is not limited to, the following:

1. Equipment cabinets and racks.

2. Premises wiring.

3. Modular jacks, backboxes and faceplates.

4. Terminations and testing.

5. Raceways.

C. The work included in this section is shown on the drawings or described in the specifications, and consists of furnishing all labor, material, services, and skilled supervision necessary for the construction, erection, installation, and connection of all circuits, apparatus, and equipment specified herein or shown on the drawings in a first class, workmanlike manner, and its delivery to the Owner ready for use.

D. Each part of work is to be complete in detail and operable in unison with all other sections, to constitute completely installed computer network systems and connections of same, as shown on drawings and described in specifications.

E. Any other electrical work not listed in this scope of work but shown or specified in the contract documents.

F. Deliver all materials to be stored on site in protective containers. These protective containers shall be clearly marked with unit designation as indicated on drawings or specifications.

G. Owner shall provide the network electronics.

PART 2 - PRODUCTS

2.1 HORIZONTAL SYSTEM PARAMETERS

A. Category 6 UTP Cable:

1. Initially, the manufacturer shall perform qualification tests on each cable. These tests shall be performed in accordance with the latest revision of the ANSI/TIA/EIA 568-B.2 standard prior to shipment.

2. The completed cable, while on the shipping reel, shall be tested at room temperature to insure it meets or exceeds the design specifications. Submit test results to Engineers for review and comment before proceeding.

3. Certification shall be provided to show the results of the tests for each reel.

4. Date of Manufacture: No insulated cable over one year old, from date of manufacture when installed, shall be acceptable.

5. Cable shall have a ripcord.

6. Cable shall be plenum rated, 4 pair, 100 OHM, 23 AWG.

7. Cable shall meet all requirements of FCC 68, the latest revision of the TIA/EIA 568B and Addendums.

8. Cable shall have blue colored thermoplastic jacket with overall diameter not to exceed .365" x .165".

9. The cable pulling tension shall be rated for 25 pounds minimum.

10. Cable shall be able to withstand a minimum bend radius of 1.0 inches at -20ºC without insulation cracking.

11. Cable shall be color coded in accordance with the latest revision of the TIA/EIA T568B polarization sequence.

12. Cable shall not exceed maximum length of 90 meters.

13. Performance:

    a. Less than 9.000 ohm per 100 m DC resistance.

    b. Less than 15 pF/ft. at 1 KHz, mutual capacitance.

    c. Characteristic impedance shall be 100 ohm ±22% from 1 MHz to 350 MHz.

    d. Return loss > 17.3dB at 250 MHz.

e. Insertion Loss < 32.8 dB/100M at 250 MHz.

f. Near end cross talk (NEXT)> 38.3 dB at 250 MHz.

g. Power Sum - near end cross talk (PS-NEXT)> 36.3 dB at 250 MHz.

h. Equal level far end cross talk (ELfEXT) > 19.8 dB at 250 MHz.

i. Power Sum - equal level far end cross talk (PS-ELfEXT) > 16,8 dB at 250 MHz.

j. DC resistance unbalance between any two conductors of any pair shall not exceed 3%.

k. The capacitance unbalance of any pair to ground shall not exceed 33.0pF per 100 meters.

l. Delay < 538 ns at 100MHz.

m. Delay skew < 45 ns at 100MHz.

n. Cable shall be ANSI/TIA/EIA-568.B.2 Category 6 compliant. The cable shall be tested and characterized by the manufacturer to 500 MHz.

14. Acceptable Manufacturers:

a. Belden

b. Berk-Tek

B. UTP Telecommunications Outlets/Connectors:

1. Physical Specifications:

a. Shall be 8-pin connector compatible with the latest revisions to match the cable characteristics.

b. Shall be modular and snap-in to user configurable faceplates for future retrofits meeting durability requirements specified in the latest revision of the CEI/IEC standard.

c. Shall be IDC type suitable for eight 22-24 AWG wires with a gas-tight connection.

d. Each contact surface shall have at a minimum, copper alloy with 50 micro-inches gold over nickel and a minimum contact force of 100g.

e. Conductors shall be separated and aligned internally by jack comb.

f. Shall have easy to read 568A/B color scheme to prevent termination errors.

g. Wired in accordance with TIA/EIA polarization sequence specified in Patch Panel section of this specification.

h. Transmission characteristics shall meet the requirements for the UTP cabling specified.

i. Minimum durability shall be 1000 mating cycles.

2. Acceptable Manufacturers:

a. Ortronics

b. Panduit

c. Belden

C. Color Coding:

1. Cable outer jacket shall follow the color coding scheme as follows. Jacket color shall be continuous. Patch cords shall also follow this.

2. Copper Cable:

a. Data Communication:

1) Category 6 - Blue

b. Voice Communication:

1) Category 6 - Blue

c. WiFi - Green / Purple

d. CCTV - Green / Mauve

e. Data - Blue / Yellow

f. Voice - Beige / Gray

g. Paging - White

2.2 LABELING

A. Copper Data:

1. Cabling

a. Specifically label cables at each termination point indicating the destination room, rack number and port number.

2. Field Outlets:

   a. Each data port shall have an identical label to the opposite end port.

   b. The Contractor shall utilize Interlink-Label for Windows 2 or approved equal; Network Labeling System to label all patch panel ports. Labels shall be installed in a workman-like manner and fit completely in the recessed area of the labeled location.

   c. Contractor shall utilize Interlink Icon labels at Poke-thru locations and any other locations that do not have a label location.

3. Each label shall contain the Telecommunication Room designated, the room number and the port number in the room. Verify color of label and size of font prior to completion. Provide samples as required.

4. Labels shall correspond to the room/names/numbers upon completion of the project. Contractor shall not necessarily utilize existing room/names/numbers or those indicated on the blueprints.

B. Contractor shall record each data port label on all record drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cable:

1. Provide a minimum of one (1) UTP cable to each RJ45 jack from respective equipment/telecommunications room as called for. Quantity of data jacks equals minimum quantity of UTP cables (typical).

2. All risers, and wiring concealed in walls or soffits, shall be installed in metal conduits.

3. All cable above accessible ceilings shall be installed in cable tray or J-hook style cable rings 3 ft. O.C. Refer to Specification Section 260501.

4. Provide wire management and Velcro cable wraps every 6 inches throughout closets. Provide Velcro cable wraps every 36 inches elsewhere.

5. Verify all wiring requirements with the Manufacturer. If the manufacturer recommends larger wire sizes, they shall be provided. However, smaller sizes or lower cable categories are not acceptable.

6. Install UTP cable in accordance with latest revision of TIA/EIA 568 standards.

7. The Contractor shall be responsible for replacing all cables that do not pass required bandwidth and throughput tests.

8. All raceways and closets shall be installed in accordance with latest revision of TIA/EIA-569.

9. All cables shall be labeled in accordance with latest revision of TIA/EIA 606.

10. All horizontal cables shall be terminated in patch panels at the distribution frames, and at the UTP jack at the telecommunications outlet.

11. Maximum length shall be 90 meters.

B. Terminations:

1. All terminations shall be made by a manufacturer's authorized representative.

2. Use termination kits for fiber and UTP that are approved by manufacturer of the cable.

3. All backbone cable shall be terminated in a patch panel and all connections between horizontal and backbone cables shall be via cross connect cable.

C. Equipment and Devices:

1. Install all devices where shown on drawings. Provide all necessary conduit outlet boxes, junction boxes, supports, etc. Verify all required box sizes with the system supplier. All devices shall be modular for future moves and changes.

2. Install all equipment in specified 19 in. racks/cabinets leaving minimum 30 in. of access space on sides and back of rack and 36 in. in front of rack.

3. Provide all power outlets and plug strips required for system operation but not shown on plans.

D. Raceways:

1. Minimum size raceway shall be 1 inch.

2. Minimum back box size for telecommunications outlet locations shall be two-gang; no single-gang boxes allowed.

E. Data Network Ground System:

1. Provide grounding system for all equipment rooms and telecommunication rooms as called for in Specification Section 260526.

2. Provide 3/4" x 4' high continuous plywood backboard with two coats of medium gray fireproof paint in telecommunications room.

3.2 TESTING

A. Copper Cable: System supplier shall channel test end-to-end each permanent link connection using latest 500 MHz for Cat 6a 1000 Mbps IEEE testing procedure. (Tester must conform to the latest standards at the time of testing not time of bid). Provide a full test using Fluke DTX-1800 with latest software version, or approved equivalent. Testing shall be performed by a technician trained with the specific testing equipment. Testing shall be witnessed by the Owner's Representative.

B. Replace any cables and connectors that do not meet or exceed standards referenced and stated herein and then tested. Testing shall be end-to-end / port-to-port for each cable.

C. Test equipment shall be in good condition and working order, calibrated within one year of its use and utilize leads without twisting and kinks. Unit calibration shall be in accordance with Level III Field Tester per ANSI/TIA 1152.

D. Test Reporting

1. The field testing shall be accurately documented for submission, inclusion in O&M Manuals and for Owner future use.

2. Test reports shall include data directory table cross-referencing room numbers and cable numbers with the test report. Post copies of directory at telecommunications room location.

3. Report shall utilize electronic Windows based documenting with a hard and electronic copy provided to the Owner.

4. The report documentation for each cable test shall include the following as a minimum:

a. Project name.

b. Test equipment manufacturer and model number, and last calibration date.

c. Date and time of the test.

d. Patch panel identification.

e. Cable identification.

f. Cable type.

g. Pass/Fail: Pass indicating meeting or exceeding the identified criteria or standard (whichever more stringent) for all parameters. Fail indicating test not meeting identified criteria for one or more parameters.

h. Cable length.

i. Propogation delay and attainable bandwidth.

j. List of tested parameters with test and allowable values. Any failed parameters shall be noted or highlighted.

3.3 WARRANTY

A. All cable plant parts shall be warranted to the owner for a period of 15 years as a complete end-to-end system.

B. All network equipment shall be warranted to the owner for a period of one (1) year two (2) years. Provide technical support at no charge to the customer for a period of one (1) year after system has been commissioned.

C. Make available an extended warranty to the customer.

D. Warranties shall commence upon final acceptance of the system.

END OF SECTION

SECTION 283102 - ANALOG ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation of a fully operational analog addressable fire alarm system and related Work as described in the Contract Documents.

B. Provide system as approved by local Fire Marshal and the Authority Having Jurisdiction (AHJ). System materials and installation shall be in accordance with the manufacturer's recommendations.

1.2 QUALITY ASSURANCE

A. All methods of construction, details of workmanship that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions, etc. correspond to the nomenclature dictated by those manufacturers. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

B. Installation shall be in accordance with NFPA-70 (National Electrical Code), NFPA-72 (National Fire Alarm Code), AHJ, state codes, local codes, requirements of authority having jurisdiction and the contract documents. Installer shall be certified in the State of New York for fire alarm installation.

C. Equipment shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published UL, NFPA, ANSI, NEMA and IEEE Standards. All system equipment shall be compatible and of the same manufacturer.

D. Each item of the fire alarm system shall be listed as a product of a single fire alarm system manufacturer and shall bear the UL Label.

E. System installation shall be under the supervision of an accredited factory representative. Final connections to the FACP, annunciator panel and any other panels shall be by the factory representative.

F. The system provider must:

1. Provide equipment from a single manufacturer for which they maintain a contract, distributorship, are an agent, or other formal arrangement for which documentation can be produced showing authority to sell and service the equipment in this territory.

2. Demonstrate that they have successfully installed these systems, utilizing their standard products, for a period of five (5) years minimum.

3. Maintain a service organization to provide both normal and emergency service. Emergency service must be available 24 hours per day, 365 days per year and staff must be adequate to respond within 2 hours of an emergency call.

4. Have a service location not more than 50 miles from the project location.

5. Maintain adequate spare parts inventory to provide both normal and emergency service.

6. Employ service technicians who are trained in accordance with the systems manufacturer's recommendations.

7. Own and demonstrate proficiency in the use of the required test equipment, tools, etc. for the proper installation, set-up, testing and maintenance of the system. If requested, provide a listing of tools and/or equipment and where appropriate, certifications in the proper training and use of the tools and/or equipment.

8. Provide all system programming to deliver a customized system to the Owner ready for use.

9. All system programming is to be completed to the satisfaction of the Owner. If after preliminary use of the system, and/or training, the increased understanding of the system's features and capabilities necessitates reprogramming to any extent, it is to be performed at no additional cost.

10. Provide a minimum of two system inspections/tests each year during the warranty period as described in NFPA 72. Needed and requested system programming changes shall be provided at these times.

11. Warranty period shall be as described elsewhere with two years being minimum. Provide a service contract for the Owner review for two years beyond the warranty period. Warranty shall include all parts, materials, labor, transportation, etc.

1.3 SYSTEM DESCRIPTION

A. The system shall constantly monitor all initiation devices and notification circuits for any abnormalities or alarm conditions. System shall sample/poll each addressable device no less than every 10 seconds.

B. The system operation subsequent to the alarm activation by any initiating device (manual station, automatic detector, sensor, sprinkler flow switch, etc.) shall be as follows:

1. All audible alarm notification appliances within corresponding building or designated area shall provide a common audible fire alarm signal until the System Reset Key or the Signal Silence Key is depressed.

2. All visual alarm notification appliances shall flash continuously and synchronized until the system is reset or silenced.

3. The remote central monitoring station shall be notified automatically until the System Reset Key or the Signal Silence Key is depressed.

4. Shutdown of the corresponding HVAC system equipment shall occur with a supervisory alarm until the system is reset. All fans over 2000 cfm shall be shut down.

5. Activation of all programmed outputs assigned to the initiating device shall occur until the system is reset or the silence key is depressed.

6. The alarm shall be displayed at the local Fire Alarm Control Panel (FACP) and the fire alarm annunciator panel.

7. The system alarm LED shall flash on the control panel and the fire alarm annunciator panel until the alarm has been acknowledged/reset. Once acknowledged, this same LED shall latch on. A subsequent alarm received shall flash the system alarm LED on the control panel and annunciator. The LCD display shall show the new alarm information.

8. A pulsing audible alarm tone shall occur within the local building control panel and, where applicable, the fire alarm annunciator panel until the event has been acknowledged.

9. Alarms shall be entered into the system event log history.

10. Refer to Appendix A for operational/sequence matrix.

C. Any subsequent alarm shall follow the operation described above.

D. The activation by any system smoke detector or sensor shall initiate an alarm verification operation whereby the panel will reset the activated detector and wait for a second alarm activation. If, within a preset time after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within the prescribed time, the system shall resume normal operation. The alarm verification shall operate only on smoke detector alarms. Other activated initiating devices shall be processed immediately. The alarm verification operation shall be selectable by device.

E. A manual evacuation (drill) switch shall be provided to operate the alarm notification appliances without causing other control circuits to be activated. However, should an actual alarm occur, all alarm functions shall occur as described previously.

F. The system shall have a password(s) to allow the operator to display all alarms, troubles, and supervisory service conditions log history including the time of each occurrence. This shall be able to be viewed from the front of the control panel, annunciator panel or from a computer connected to the FACP.

G. The actuation of the " walk test" program at the control panel shall activate the "Walk Test" mode of the system which shall cause the following to occur:

1. The remote central monitoring station connection shall be bypassed.

2. Only audible and visual appliances shall be operated. Other alarm functions (elevator recall, HVAC shutdown, etc.) shall not be affected.

3. Walk test shall be selectable by circuit or circuits.

4. Actual alarms received during a "Walk Test" shall cause the control panel to go into alarm and override the walk test mode.

5. The control panel shall show trouble conditions.

6. The walk test activation of any initiation device shall cause the audible signals to activate for two seconds or a distinguishable audible.

7. The panel shall automatically reset itself after signaling is complete.

8. The control panel shall automatically return to normal condition if there is no activity on a walk test circuit for a period of 30 minutes.

H. Any momentary opening of an initiating or notification appliance circuit wiring shall cause an audible signal to sound at the Fire Alarm Control Panel and, where applicable, the annunciator panel for four seconds indicating a trouble condition.

I. Elevator Operation:

1. Provide the following equipment as a minimum and as indicated on the drawings:

a. Smoke detection in the elevator equipment room.

b. Smoke detection at each elevator lobby.

c. Smoke detection in the elevator shaft if a smoke hatch.

d. Heat detection in the equipment room and shaft (high and low) if a sprinkler system is in the area. Detectors shall be within 2 ft. of the individual sprinkler heads.

e. Detection devices located in elevator lobbies, elevator hoistways and elevator machine rooms shall be used for elevator recall. Hoistway and equipment room heat detection shall initiate power shut down prior to water flow. Operation shall be in accordance with ASME A17.1, Safety Code for Elevators and Escalators. Signals shall be provided to the elevator controls for main level lobby alarm, any lobby alarm, elevator equipment room alarm and elevator hoistway alarm as a minimum. Provide addressable control modules for the signals to the elevator controls.

J. Alarm initiation of a detector associated with a smoke hatch or fire barrier shall initiate a system alarm. Also, provide connections between the auxiliary contacts on the detectors or addressable control module and the associated smoke hatches and fire barriers such that the smoke hatch or fire barriers will be operated upon its respective detector activation. Provide power supplies, wiring and accessories for fire alarm system and all supervisory functions required for proper smoke hatch and fire barriers operation.

K. Duct mounted smoke detectors associated with duct dampers shall have an addressable control module to operate the duct damper. In the event of an alarm initiation by the duct mounted smoke detector or the associated air handling unit/fan shut down the duct damper shall be closed. Control wiring shall be provided to shut the damper(s) when the associated air handling unit is not operational. Provide power supplies, wiring and accessories as needed for this operation.

L. Provide wiring and equipment such that alarm initiation of a heat detector located in the elevator machine room and/or the elevator shaft shall provide suitable voltage from the fire alarm control panel to be applied to the shunt trip coil of the elevator's supply circuit breaker. No fire alarm devices except the heat detectors in the elevator machine rooms and shaft shall cause this. Also, alarm initiation of these heat detectors shall initiate the system alarm functions described above. Provide an addressable control module with a Form C contact at the elevator controllers, which shall be normally closed and shall open upon alarm initiation of any of these heat detectors; this contact shall be used to disconnect the battery-powered emergency return unit if so equipped with the use of a relay suitable for the emergency power circuit. Also, provide an auxiliary contact on the main line disconnect switch (four pole unit) and two (2) #12 in conduit to the elevator controller from this contact for the same purpose.

M. Provide a minimum of two Form C contacts at the building's fire alarm control panel. This contact shall activate upon activation of any fire alarm initiating device.

1.4 SUPERVISION

A. The system shall utilize independently supervised initiation device circuits. The alarm activation of any initiation device shall not prevent the subsequent alarm operation of any other initiation device.

B. Notification appliance circuits shall be supervised to indicate an open or short circuit condition.

C. The incoming power to the system shall be supervised so that any power failure must be audible and visually indicated at the control panel and the remote annunciator. A green "power on" LED shall be displayed continuously while incoming power is present. This shall be a trouble alarm.

D. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control panel and the remote annunciator. This shall be a trouble alarm.

E. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

1.5 SUBMITTALS

A. Provide a complete system submittal prior to ordering of equipment and installation including but not limited to:

1. Complete equipment list.

2. Catalog descriptive literature for all equipment. This shall include a description of the unit, ratings, functions, capability, materials and compatibility with other components.

3. Riser Wiring Diagram showing all equipment, devices, device addresses, connections, control connections, remote notification connection(s), wire quantities and sizes.

4. Floor plan indicating equipment and device locations, addresses, power circuit information with power panel location, notification circuiting, initiation circuiting, control circuiting and any system applicable building characteristics (ceiling heights, structural members impeding detection, etc.). Contact the Engineer for an electronic copy of the project floor plans. Engineer logo shall be included in final drawing.

5. Typical Terminal Wiring Diagram for each type of device.

6. Terminal wiring Diagram for all Fire Alarm equipment.

7. Calculations including:

   a. Battery sizing calculations indicating total number of power devices, load associated with each type device, backup period and recommended battery capacity (AH).

   b. Voltage drop calculations with actual equipment loads used to derive battery back-up ampere-hour rating and individual circuit voltage drop (indicate the wire size to be used and the associated voltage drop with the allowed voltage drop) for each circuit.

8. Complete console enclosure and equipment configuration.

B. Submittal package, calculations and system wiring shall be performed/collected/signed by a NICET Level III technician.

C. If required by the Authority Having Jurisdiction (AHJ) provide a submission of all requested information for review and comment by the AHJ. All AHJ comments shall be incorporated and resubmitted until approved.

D. Test reports at the completion of the project. Testing shall be of all system devices, equipment, circuits, features and functions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The project fire alarm system shall comply with and be in accordance with the drawings and specifications. All system equipment and materials shall be of the same manufacturer unless otherwise indicated. System and component acceptable manufacturers include the following unless otherwise indicated:

1. Notifier (Basis of Design)

2. Simplex

3. Pyrotronics - Siemens

4. EST - GE

2.2 FIRE ALARM SYSTEM

A. The fire alarm system shall be comprised of the components specified as a minimum and also include components not indicated but required for a complete and operable system as described herein.

B. The system and all its components shall be UL listed and in accordance with NFPA 72, local and state codes.

C. The system shall have 25% spare capacity. This shall include all individual notification circuits, initiation circuits, initiating modules, alarm modules, power supplies, batteries, central processing unit memory and printed circuit card space. System initiation device and control device capacity shall be a minimum of the indicated percentage over the shown quantity or 250 whichever is greater.

D. Each initiating device shall have an individual address for system communication. The system addresses shall not exceed seven digits. Each address, initiation circuit, notification circuit and control point shall have an individual identification description.

E. System shall shut down all air handlers more than 1,000 cfm upon an alarm.

2.3 FIRE ALARM CONTROL PANEL (FACP)

A. The system shall be entirely solid state, microprocessor based, use digital transmission and shall be field programmable. All system programming including field modifications shall be stored in non-volatile memory. Field modifications shall be automatically stored without special actions. The panel shall be designed and manufactured expressly for the intent to detect the presence of fire and to provide indication of such detection. Panel shall contain as a minimum power supply(s), control module, main control printed circuit board, initiation modules, notification modules, terminals and back up battery(s). Control module shall have 80 character backlit LCD display and twelve control buttons (four being field assignable), minimum. Display shall indicate the battery voltage at all times.

B. The system shall be modular in design to allow for future expansion with a minimum of hardware additions.

C. The FACP shall be located where shown on the drawings. Enclosures shall accept all system items for an aesthetically suitable operator's console. Enclosures shall be of modular size to allow surface mounting of multiple boxes adjacent to each other, shall have hinged solid metal doors and contain a lock with a key common to all system devices. Enclosure shall have a red finish.

D. The FACP shall operate its integral LCD Display through an RS-232C port operating up to 9600 baud to indicate all operator transactions, alarms, trouble reports and any other conditions specified by system programming.

E. Conditions of the system shall be indicated at the operator interface by LED's. These conditions shall be alarm, supervisory, trouble and alarm silenced. An LCD 2 line, 40 character per line display shall also be included. It shall display "SYSTEM IS NORMAL" with the date and time under normal circumstances. The LCD display shall also indicate type of alarm, point status, number of alarms and location. Through the use of function keys, historical data can also be displayed.

F. The FACP shall include a password (three (3) levels of protection with individual passwords, minimum) protected key pad for access to programming, special functions and all system features.

G. Any event initiated by the FACP due to an alarm input shall be retained in nonvolatile EPROM memory. The FACP shall also have sufficient memory for 1200 individual alarm/trouble events.

H. The FACP shall have the following user connection types:

1. Ethernet connection for a computer, personal data device or printer. Connection shall allow for programming changes, history download, setting review/changes, etc.

2. RS 232 port for connection of a serial printer.

I. Battery and charger shall be as specified within this section.

J. Design Equipment: Notifier FireWarden-100

2.4 VENTILATION FAN SHUTDOWN CONTROL

A. Provide supervised normally closed relays and contactors for connection into the fan motor control circuits ahead of all automatic devices.

B. Sequence fan shutdown for every air distribution system over 1000 cfm. Provide duct detectors in return of systems over 2,000 cfm and in return at each floor of systems over 15,000 cfm.

C. Provide drill bypass feature, locate switch on Fire Alarm Control Panel and label "DRILL-FAN SHUTDOWN BYPASS". Buzzer shall sound continuously while in bypass mode.

D. Provide fan reset feature, locate switch on Fire Alarm Control Panel and label "FAN RESET".

2.5 INITIATION DEVICES

A. General:

1. Provide analog addressable smoke and thermal sensors as shown. All detectors, control modules, monitor modules and all other initiation devices shall communicate with twisted pair cable and have an individual address. Peripheral devices shall be of the some manufacturer as the FACP.

2. Spot type detectors shall utilize the same interchangeable bases.

3. If a device is removed or taken out of service a trouble signal shall be initiated.

B. Photo-Obscuration Type Smoke Detector:

1. The photo-obscuration detector shall operate on the photo electronic principle and provide an analog signal to the system indicating the amount of smoke. Detector shall be an analog addressable type.

2. The detector shall incorporate a built in type identification so the system can identify the type of detector. The sensor shall be continually monitored to measure any change in their sensitivity because of the environment (dirt, smoke, temperature, humidity, etc.). Unit shall not be affected by exterior light or EMF.

3. The detector shall be designed and arranged to prevent interference from exterior electromagnetic fields and light.

4. The detector shall provide advance indication of the analog value of the products of combustion to the FACP indicating that maintenance is required in order to insure normal operation. The detector sensitivity shall be adjustable per device (within UL limits) and be set at the FACP for continuous or variable based on time of day. There shall be a minimum of six (6) selectable sensitivity levels. The individual detector sensitivity setting shall be adjusted to meet the building/space characteristics and operation. The detector shall monitor the obscuration continuously and raise the obscuration level to compensate for a dirty sensor to maintain the set sensitivity.

5. Detectors shall be designed for twistlock mounting to a separate base assembly. Provide manufacturer's recommended back box suitable for surface mounting where required.

6. The detector base shall have terminals for making all connections; no soldering shall be required. It shall be possible to secure the detector to the base with a concealed socket headscrew to prevent unauthorized tampering.

7. Smoke detectors shall be UL 268 listed and FM approved.

8. All smoke detectors shall be field checked and set to meet the prevailing conditions of the premise and any Owner requests. All such work shall be performed by an authorized representative of the manufacturer trained in such procedures.

9. Photo-obscuration type smoke detection shall be used for smoke detection unless indicated otherwise indicated.

C. Heat Detector:

1. The heat detector shall be a thermal sensor and shall constantly monitor the space temperature and constantly report this to the system. The unit shall be analog addressable.

2. The sensor shall use dual solid state thermistors and shall monitor the ambient temperature from 32 degrees F, to 155 degrees F and provide a fast response to rapid increase in temperature. The sensor shall send data to the FACP representing the analog value of the ambient temperature. The FACP shall be suitable to monitor for set temperature (selectable by detector for 135 or 155 degrees F) and rate of rise (selectable by detector for 15 or 20 degrees F per minute). Individual detector thermal settings shall be adjusted for the building/space characteristics and operation but shall initially be set to 135 degrees F set temperature and 15 degrees F per minute rate of rise.

3. Detectors shall be designed for twistlock mounting to a separate base assembly. Provide back box suitable for surface mounting where required.

4. The detector base shall have terminals for making all connections; no soldering shall be required. It shall be possible to secure the detector in the base with a concealed socket headscrew to prevent unauthorized tampering.

5. Smoke detectors shall be UL 268 listed and FM approved.

6. All thermal sensors shall be field checked and set to meet the prevailing conditions of the premise. All such work shall be performed by an authorized representative of the manufacturer trained in such procedures.

D. Single Station Smoke Detector:

1. Detectors shall operate on the photoelectronic principle. Upon activation, the detector shall sound its integral alarm horn in accordance with ANSI S34.1 and operate its associated alarm circuit and illuminate the built-in alarm light. Integral alarm horn shall be rated 90 dB at 10 ft. Built-in alarm light shall be 177 candela, 60 flashes/minute strobe. Provide LED power-on/alarm indicator. Detectors shall operate on 120 volts AC. Provide an integral 9 VDC battery backup with low/missing battery alarm signal. Provide with 9 VDC long life battery. Provide backbox suitable for surface mounting where required. unit shall have single pole double throw dry contacts rated 1 amp resistive at 24 VDC. Contacts shall operate when the detector is in the alarm condition. Detector shall be U.L. listed and F.M. approved. Detector shall operate from 40°F to 120°F and up to 93% relative humidity. Provide tandem operation capability.

2. Interconnect all detectors inside a dwelling unit such that any detector in alarm will activate the notification appliances in all the other connected detectors.

3. Design Equipment: Gentex 7139CS C.

4. Make:

   a. Simplex

   b. Gentex

   c. Approved equal.

E. Addressable Initiation Module:

1. The addressable initiation module shall be used to connect supervised conventional initiating device or zone of supervised conventional initiating devices (water flow switches, tamper switches, manual pull stations, (4) wire smoke detectors, conventional (4) wire duct detectors, fire pump alarms, dry chemical fire extinguisher control panels, etc.) to one of the system's addressable circuits.

2. The module shall provide address setting means using rotary decimal switches and also store an internal identifying code which the control panel shall use to identify the type of device.

3. The module shall contain an integral LED that flashes each time the unit is polled.

F. Manual Pull Stations:

1. Noncoded pull-down type, double action (push then pull down) manual addressable units with front keyed test/reset. Units shall be semi-flush where installed in construction with hollow or block walls. Where construction does not allow semi-flush mounting then unit shall be surface mounted utilizing the manufacturers back box. Each unit shall have a distinct address. Units shall be key reset.

2. Units installed outdoors or in potentially wet locations shall be rated for such conditions.

3. Bright red finish with white lettering "FIRE ALARM".

G. Duct-Type Smoke Detector:

1. Detector shall be a photoelectric type that shall be activated by the presence of combustion products.

2. The detector head shall be a plug-in unit. The unit shall contain no moving parts. One chamber shall be for fire detection and the second chamber shall function as a reference, to stabilize the detector for changes in environmental temperature, humidity and pressure. It shall be possible to electrically check detectors sensitivity, using a sensitivity test set, or equivalent, and readjust the detectors sensitivity as required.

3. The detector base shall have terminals for making all connections; no soldering shall be required. It shall be possible to secure the detector in the base with a concealed socket-head screw to prevent unauthorized tampering.

4. Smoke detectors shall be listed by Underwriter's Laboratories, Inc. and approved by Factory Mutual Insurance Company.

5. Provide complete with sampling tubes. Size sampling tubes for 80% of the width of the duct. Locate in ductwork for the indicated system and in accordance with the manufacturer's recommendations. Unit shall be rated for air velocities of 300 to 4000 fpm as a minimum.

6. Provide addressable control module and 120V power for smoke damper operation.

7. Provide a remote indicating light/key test switch for each duct detector and mount in a local utility room with a sign indicating the system and location of the duct detector (i.e. AHU-2, Second Floor East End).

8. Provide addressable base.

H. Carbon Monoxide (CO) Detector:

1. Detector shall sense the level of CO concentration within a space and provide analog addressable signal to the system and be UL 2075 listed. Unit shall have a minimum life span of 10 years without replacement/recalibration.

2. Provide with audible notification base unit for local unique notification. Alarm and notification initiation shall be from the control panel.

3. Detector shall connect to the system addressable circuiting.

4. Alarm level shall be adjusted at the control panel. Upon an alarm the local notification shall sound and a trouble alarm initiated.

I. Single Station Carbon Monoxide (CO) Detector:

1. Detector shall sense the level of CO concentration within a space, provide local notification and be UL 2034 listed. Unit shall have a minimum life span of 10 years without replacement/recalibration.

2. Provide with audible notification base unit for local unique notification. Audible shall be 85dB minimum output at 10 ft.

3. Unit shall be 120V with 9V battery backup.

J. Single Station Combination Smoke/Carbon Monoxide Detector:

1. Detector shall be photoelectronic type and have carbon monoxide (CO) sensing. Upon activation, the detector shall sound its integral alarm horn in accordance with ANSI S34.1 and operate its associated alarm circuit and illuminate the built-

in alarm light. Integral alarm horn shall be rated 85 dB at 10 ft. Built-in alarm light shall be 177 candela, 60 flashes/minute strobe. Provide LED power-on/alarm indicator.

2. Detectors shall operate on 120 volts AC. Provide an integral 9 VDC battery backup with low/missing battery alarm signal. Provide backbox suitable for surface mounting where required. Unit shall have single pole double throw dry contacts rated 1 amp resistive at 24 VDC. Contacts shall operate when the detector is in the alarm condition. Detector shall be U.L. listed and F.M. approved. Detector shall operate from 40°F to 120°F and up to 93% relative humidity. Provide tandem operation capability.

3. Interconnect all detectors inside a dwelling unit such that any detector in alarm will activate the notification appliances in all the other connected detectors.

4. Design Equipment: Gentex 7139CS C.

2.6 NOTIFICATION APPLIANCES

A. Horns:

1. 24 volts DC.

2. Basic grille type with powder coated red finish paint.

3. Horn shall be rated 94 dBA (anechoic chamber) at 10 feet. Output shall be selectable steady tone or coded. Provide dampening devices to reduce unit output by 5dBA for a minimum of 40% of the system horn units and install as needed to meet the Owner's needs.

4. Units shall be semi-flush where installed in construction with hollow or block walls. Where construction does not allow semi-flush mounting then unit shall be surface mounted utilizing the manufacturers back box.

5. Units installed outdoors or in potentially wet locations shall be rated for such conditions.

6. Provide directional projector where noted on the Drawings.

7. Provide backbox and grille for fully recessed installations; 4 in. deep box maximum.

8. Sleeping locations shall utilize 520 Hz horns.

9. Horn for carbon monoxide alarm notification shall meet the requirements above but have a white finish color, have the word "ALERT" imprinted on the device and have a temporal Code 4 alarm.

B. Strobe Unit:

1. 24 volts DC with built-in Xenon Flasher; two watts maximum. Pulse duration shall be 0.2 seconds with maximum duty cycle of 40%. Illumination intensity shall be field selectable for 15/30/75/110 candela or 135/177/185 candela as applicable for the location. Output setting shall be 15 candela in corridors, 75 candela in general areas, 177 candela in sleeping areas or as indicated. Flash rate minimum 1 Hz, maximum 2 Hz. Units within building shall flash in synchronization.

2. Protruding pyramid shaped lexan lens with reflector and the word "FIRE" imprinted on the lens.

3. Rated life shall be a minimum of 500 hours of continuous operation.

4. Units installed outdoors or in potentially wet locations shall be rated for such conditions.

5. Units shall be semi-flush where installed in construction with hollow or block walls. Where construction does not allow semi-flush mounting then unit shall be surface mounted utilizing the manufacturers back box. Wall or ceiling mounted as noted on the Drawings.

6. Provide surface backbox for surface installation; 4 in. deep maximum.

7. Strobe for carbon monoxide alarm notification shall meet the requirements above but have a white finish color and have the word "ALERT" imprinted on the device.

C. Combination Horn-Strobe Units:

1. Unit shall be a combination of the horn and strobe units specified above in a single manufactured unit.

2.7 ADDRESSABLE CONTROL MODULE

A. The addressable control module shall have an individual system address, be supervised and control an output dry contact from indication from the FACP. This can be used to control or have an input to elevator controls, notification appliances, door holder circuits, fans systems, etc. as indicated. Modules shall be connected to the addressable loop(s).

B. The unit shall control an output relay (dry contact form C). The module shall mount in a 4 in. square, 2-1/8 in. deep electrical box.

C. The module shall contain an integral LED that shall flash each time the module is polled.

D. The module shall provide address setting means using rotary decimal switches and also store an internal identifying code which the control panel shall use to identify the type of device. Each unit shall have a separate address and be connected to the system addressable signaling circuit.

2.8 REMOTE ANNUNCIATOR

A. Wall mount within a flush box. Maximum depth of 4 in., stainless steel trim. Nominal dimensions of 4 in. x 12 in.

B. Annunciation shall be by two line by 40 character LCD display to provide system information and alarm/trouble description.

C. Unit power and control shall be from the FACP. Unit circuiting shall be supervised.

D. Provide trouble signal with audible buzzer, silencing switch and system reset. All pushbuttons shall be inoperable without keyswitch activated. Pushbuttons for alarm acknowledge, silence and alarm reset shall be standard on the front with a description. Shall include a minimum of four auxiliary switches/pushbuttons to be programmed as coordinated with the owner (possible options are door holder release override, manual alarm initiation, elevator capture bypass, etc.).

E. Tamper-resistant front panel screws.

2.9 MAGNETIC DOOR HOLDERS

A. Rated 115 volts AC.

B. Holders shall be wall or floor mounted adjacent to the doors as dictated by the building conditions. Floor mounted units shall only be used where wall mounted are not possible.

C. Door holders shall be aluminum construction, have 25 pound holding force and shall have all necessary mounting hardware. Provide door plate for each and extender chain (chromed and 1 in. links) where needed.

D. At each door holder location (or pair of door holders where two doors occupy the same opening), provide a flush mounted keyswitch to disable or enable the door holders. (Keyswitches not indicated on drawings). The keyswitch shall be maintained contact, with key removable in the vertical position. Keyswitch shall be tamper resistant, factory prewired brushed stainless steel finish. Provide all wiring to connect to local door holders. Make: DynaLock 2800 Series to meet the conditions or equivalent.

2.10 MUNICIPAL TIE EQUIPMENT - LEASED TELEPHONE LINE SYSTEM

A. Provide complete system consisting of sending and receiving equipment.

B. Transmission shall be provided over telephone lines arranged by the Owner.

C. Sending reversing relay and associated equipment shall be contained within the Fire Alarm Central Processing Unit enclosure.

D. Sending equipment shall transmit telephone line trouble as well as fire alarm condition signal.

2.11 AUTOMATIC DIALER

A. Provide automatic tie to telephone line upon activation of the fire alarm system and transmission of prerecorded message. Provide two telephone lines from the building service individually routed to the FACP and terminated.

B. Ten minute digitally stored message capacity.

C. Provide automatic line seizure.

D. Provide automatic telephone dialing to a prearranged telephone line. System shall have standard pre-recorded message stored in the memory. Record and store custom message as indicated by the Owner or call station.

2.12 DIGITAL COMMUNICATOR

A. The digital fire communicator shall be installed in the FACP or mounted in a separate enclosure. The communicator shall be powered by 24 VDC from the FACP and shall report four (4) conditions - (2) alarm, (1) trouble and (1) supervisory. The unit shall have a built in auxiliary relay output which is programmable for alarm or trouble conditions, and shall be capable of sending a distinctive AC power failure report.

B. Install all wiring in accordance with manufacturer's recommendations. All wiring shall be completely tested as directed by the manufacturer, and a written test report submitted to them for approval. Their approval shall be obtained before connecting any devices. The system manufacturer, by their approval of the test report, shall assume all responsibility for all installed wiring.

C. The communicator shall have the following features: visual and audible trouble indications; supervised or unsupervised input channels, dual phone line interface with line seizure; local and remote programming and automatic 24-hour test.

D. The communicator shall be UL 864 listed and meet the requirements of NFPA 72 Chapter 4 for supervising station fire alarm systems.

2.13 CENTRAL STATION MONITORING

A. Make all arrangements for, and pay all costs for a UL listed central station monitoring service to monitor the fire alarm system through the digital communicator for a period of one (1) year.

2.14 BATTERY AND CHARGER

A. Standby power shall be provided through 24 volt DC battery and automatic charger.

B. Provide sealed lead-calcium batteries suitable for a minimum of 24 hours of battery standby. When the system is operating on the battery supply, a trouble condition shall be generated. When utility power is restored, the system shall revert back to 120 VAC supply without any operator action.

C. Provide cell reversal protection.

D. Battery life expectancy shall be ten (10) years minimum.

E. Charger shall be self-regulating, solid state, type, automatic with capability to fully charge the discharged battery within 48 hours.

F. Locate charger within the FACP enclosure. Locate batteries in FACP enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION, EQUIPMENT

A. All installations shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of Work. Fire alarm installation shall be directed by a person who possesses a state license for installation of fire alarm systems. All equipment and components shall be installed in accordance with the manufacturer's recommendations.

B. System junction boxes and surface mounted device boxes shall be painted red.

C. All notification circuits shall originate from the FACP. Signal expander units shall not be used.

D. Provide all wiring to sprinkler flow switches, pressure switches, and alarm check valves, installed by others. Maintain supervisory circuitry to the switches. Use liquidtight conduit for the last 2 ft. - 0 in. of raceway at the switch.

E. Provide all wiring to post indicator valves, OS&Y valves and dry pipe sprinkler system maintenance air pressure switches, provided by others. Wire into the supervisory alarm portion of the fire alarm system.

F. Provide all wiring to the smoke dampers installed by others. Provide an addressable control module for each. Wire to the damper junction box with flexible conduit and wire; provide box or boxes as required. Install according to NEC. Smoke dampers shall close when its associated smoke duct detector is in alarm, upon direction from the FACP or if the associated fan unit is not operating.

G. Provide all power supplies and wiring to smoke relief hatches and fire barriers provided by others. Smoke relief hatch or fire barrier shall operate only when its associated smoke detector is in alarm.

H. Provide all wiring to duct smoke detectors. Duct smoke detectors shall be mounted on the ventilating ductwork by others. All mounting arrangements, holes cut into ductwork, sealing of openings along with ceiling and access doors for the duct type detectors shall be provided by others. Provide duct detectors along with sampling tubes with end caps. Sequence smoke damper operation thirty seconds after its associated fan has been shut down.

I. Provide all wiring required for fan shutdown. Wire from the addressable control module for each fan to be shut down and provide wiring from the module to the fan control unit (starter, adjustable speed drive, etc.) Dry contact shall be wired ahead of all control

functions for starters. Provide intermediate relay for control circuits beyond the rating of the control module.

J. Coordinate the municipal tie with the local Fire Department and comply with Fire Department requirements and regulations. Coordinate leased telephone line tie with Owner and Telephone Company.

K. Install all door holders in accordance with installation detail on the drawings and coordinate with the General Construction trade. Connect door holders to nearest 120 volt corridor receptacle circuit.

L. Provide 120 volt AC supervisory relays in the Fire Alarm Control Panel enclosure for each magnetic door holder power circuit to insure their associated circuit breakers are in the "ON" position. In the event a circuit breaker is in the "OFF" position, its associated supervisory relay shall transmit a trouble signal.

M. All single-station smoke detectors shall be directly connected to the lighting circuit of the dwelling unit or sleeping room with no intervening wall switch. Cord-connected installation shall not be permitted.

N. Provide all elevator capture control wiring. Installation shall be in accordance with manufacturer's recommendations.

O. Elevator machine room and shaft heat detectors shall be mounted within two feet of the sprinkler head where applicable.

P. Detection and initiating equipment shall be listed by NRTL and approved by FM.

Q. All surface mounted devices shall be mounted on a special box furnished by fire alarm equipment manufacturer. Total assembly shall be secure, smooth contour and have no protrusions.

R. Where detectors are installed on wood or masonry surfaces, attach brackets directly to the surface with tamperproof fasteners. Where detectors are installed on suspended ceilings, provide additional supports in the ceiling, such as channel support system, angle iron or additional runner bars. Fasten the additional supports rigidly to the ceiling runner bar system. Attach bracket to the supports with tamperproof fasteners. Install metal spacers between the bracket and supports so that the ceiling tiles will not be a part of the support system.

S. Install wall mounted audio/visual signal devices at 80 in. AFF to center line. Where ceiling types are called for, verify ceiling type and mounting height in the field. Provide pendant-mounted devices as required for specified mounting height.

T. An auxiliary fire alarm relay used to control an emergency control device that provides control functions described in this specification shall be located within 3 ft. of the emergency control device and all wiring shall be supervised.

U. All smoke detectors shall be field checked and set to meet the prevailing conditions of the premise. All such Work shall be performed by an authorized representative of the manufacturer trained in such procedures.

V. Provide circuiting from all indicated motor controls for indication if not operational and close any associated smoke dampers.

W. Provide a weather proof combination horn/strobe unit to indicate fire protection system water flow located near the fire department connection at a location coordinated with the local fire marshal.

3.2 SYSTEM CIRCUITING

A. All wiring shall conform to the NEC and to NFPA-72, National Fire Alarm Code.

B. Install all wiring in accordance with manufacturer's recommendations taking into account loading, intended location, circuit length, spare capacity and voltage drop.

C. All wiring shall be copper and installed in a dedicated/segregated EMT conduit system.

D. Power circuits:

1. Provide the required quantity of 20 ampere, 120 volt circuits to the system with a minimum of one (1) for the FACP**.**

2. Circuit breakers serving fire alarm system equipment shall have a red handle lock to prevent from manual off operation. Directory shall be marked for the specific equipment served.

E. Provide minimum #18 AWG twisted shielded pair for addressable signal line circuits. Notification appliance circuits shall be#14AWG minimum.

F. Addressable signal line circuits shall be NFPA 72 - 2010 Class A (redundant, single open operation).

G. Notification appliance circuits shall be NFPA 72 - 2010 Class A (redundant, single open operation).

H. Notification circuits shall be segregated as indicated on the drawings and by individual floors as a minimum.

3.3 PROGRAMMING

A. Include in bid the cost to cover all system programming, including items particular to this project (such as custom zone descriptions, time delay settings, sensitivity settings, etc.) such that entire system is 100% complete and operating to the Owner's satisfaction. Coordinate all system programming with the Owner. Also, provide programming of the system a minimum of once during the warranty period to provide changes requested by the Owner.

3.4 SPARE EQUIPMENT

A. Provide the following spare equipment to the Owner. Deliver the equipment to the Owner designated location on the project site in original packaging.

B. Equipment to include:

1. Smoke detectors: 5% of each type used with a minimum of five (5).

2. Heat detectors: 5% of each type used with a minimum of five (5).

3. Addressable control modules: 2% of each type used with a minimum of two (2).

3.5 TESTING AND INSTRUCTION

A. The complete fire alarm system shall be fully tested after the installation is complete. Testing shall include all devices, FACP, annunciator panel, other panels, features and functions. Testing shall be witnessed by the owners representative and be in accordance with the NFPA and herein. Provide a testing report to the authority having jurisdiction and the Engineer as a submittal.

B. Provide a minimum of four (4) hours of instruction to the operating personnel designated by the Owner's Representative with regard to use and operation of the system. Provide up to three programming modifications.

C. Provide three (3) sets of keys to all panels, manual stations, etc., to the Owner's Representative.

D. Provide a copy of the system programming to the Owner on a CD/DVD disk or flash drive.

E. Provide to the Owner system Operation Manuals as specified, that shall include as a minimum:

1. Bill of Material.

2. Catalog descriptive literature for all equipment. This shall include a description of the unit, ratings, functions, capability, materials and compatibility with other components.

3. Riser Wiring Diagram showing all equipment, devices, device addresses, connections, control connections, remote notification connection(s), wire quantities and sizes.

4. Floor plan indicating equipment and device locations, addresses, power circuit information with power panel location, notification circuiting, initiation circuiting and control circuiting. Contact the Engineer for a copy of the project floor plans.

5. Typical Terminal Wiring Diagram for each type of device.

6. Terminal wiring Diagram for all Fire Alarm equipment.

7. Calculations including:

a. Battery sizing calculations indicating total number of power devices, load associated with each type device and recommended battery capacity (AH).

b. Voltage drop calculations with actual equipment loads used to derive battery back-up ampere-hour rating and individual circuit voltage drop (indicate the wire size to be used and the associated voltage drop with the allowed voltage drop) for each circuit.

8. Instruction report starting when instruction was given and who was in attendance, signed by Owner's Representative.

9. A written test report from an authorized representative of the equipment manufacturer that each device and overall system operation has been 100% tested and approved.

10. Certificate of Completion as described in NFPA-72.

11. A two (2) year warranty in accordance with the Basic Requirements of these Specifications shall be provided for this system.

3.6 CO DETECTOR SIGNAGE

A. Coordinate with the Owner, install a permanent 8-1/2 in. and 11 in., two (2) color lamicoid sign at eye level in the vicinity of every CO alarm notification device indicating specific instructions to be followed, ex. "Do not enter room if an alarm is sounding".

END OF SECTION

APPENDIX A
FIRE ALARM SYSTEM OPERATION/SEQUENCE MATRIX

System Outputs

System Inputs	**Actuate Common Alarm Signal Indictor**	**Actuate Audible Alarm Signal**	**Actuate Common Supervisory Signal Indicator**	**Activate Audible Supervisory Signal**	**Actuate Common Trouble Signal Indicator**	**Activate Audible Trouble Signal**	**Indicate Zone or Device Description**	**Activate Notification Appliances**	**Display Change of Status on All Annunciators/Printers**	**Transmit Alarm Signal to Central Station**	**Transmit Supervisory Signal to Central Station**	**Transmit Trouble Signal to Central Station**	**Release Magnetically Held Doors**	**Recall Elevator to Recall Floor**	**Actuate Warning to Elevator Controls**	**Actuate Warning to Elevator Cabs**	**Activate Elevators Shunt Trip**	**Close All Related Smoke Dampers**	**Unlock All Exits and Control Doors**	**Shutdown Respective Air Handling Units (SA and RA)**	**Activate Floor Pressurization (High Rise Only)**	**Activate Stairwell Pressurization (High Rise Only)**	**Active Smoke Exhaust (High Rise Only)**	**Open Associated Smoke Hatch**	**Local Notification**
Fire Alarm System AC Power Failure					X	X						X														
Fire Alarm System Low Battery					X	X						X														
Open Circuit					X	X						X														
Ground Fault					X	X						X														
Circuit Short					X	X						X														
Manual Pull Station Actuation	X	X					X	X	X	X			X						X							
Area Smoke Detectors	X	X					X	X	X	X			X	X				X	X		X	X	X			
HVAC Air Duct Smoke Detector	X	X					X		X	X								X		X						
Area Heat Detectors	X	X					X	X	X	X			X	X				X	X		X	X	X			
Fire Suppression System Alarm	X	X					X	X	X	X			X	X				X	X							
Sprinkler Tamper Switch			X	X			X				X															
Sprinkler Water Flow in Building	X	X					X			X			X	X				X	X							
Sprinkler Water Flow in Elevator Equipment Room or Shaft	X	X					X	X	X	X					X	X	X	X								
Elevator Shaft Smoke Detector	X	X					X	X	X	X															X	
Elevator Equipment Room Area Smoke Detector	X	X					X	X	X	X			X	X		X		X	X							
Elevator Shaft and Equipment Room Heat Detectors	X	X	X	X			X	X	X	X			X	X		X	X	X	X							
Elevator Pit Sprinkler Flow	X	X					X			X				X	X	X	X									
Elevator Pit Heat Detector	X	X					X	X		X				X	X	X	X									
Elevator Lobby Smoke Detectors	X	X					X	X	X	X			X	X				X	X		X	X	X			
Elevator Lobby Recall Floor	X	X					X	X	X	X			X	X				X	X		X	X	X			
Fire Pump Power Failure/Phase Reversal			X	X			X		X	X	X	X														
Fire Pump Low Fuel			X	X			X		X	X	X		X	X				X	X							
Fire Pump Running	X	X					X		X	X			X	X				X	X							
Jockey Pump Running			X	X			X		X		X															
Fire Pump not in Automatic Mode	X	X					X			X																
Area of Refuge Two-Way Communication Status	X	X					X			X																
Smoke Detector Adjacent to Smoke Hatch	X	X					X	X	X	X			X	X					X						X	
AHU Off, Any Reason																		X								
CO Detection			X	X			X		X		X															X