SECTION 260500 BASIC ELECTRICAL REQUIREMENTS

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 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.

1.3 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.

1.4 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 Jurisdictionprior 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.

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

1.6 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

1.7 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.

1.8 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.

B. 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. lighting fixtures, valves, plumbing fixtures, etc.). Submittals shall include all required documentation for each product listed in the specification section at the same time as a complete package. Number each submittal by trade. Indicate deviations from contract requirements on Letter of Transmittal. Submittals will be given a general review only.

C. 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 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 meBuff-RFI-Sub-Clerk@meengineering.com

D. Refer to Division 01 for additional requirements.

1.9 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.

1.10 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.

1.11 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.

B. Refer to Division 01 for additional requirements.

1.12 UTILITY COMPANY SERVICES

A. Division 26 shall make arrangements with New York State Electric and Gas 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 New York State Electric and Gas 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.

1.13 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.

1.14 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 23 shall 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.

1.15 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. All electrical equipment and systems, as a whole, shall be tested and listed by an OSHA approved Nationally Recognized Testing Laboratory (NRTL) for the intended use in accordance with the applicable standards and have a physical label indicating such.
6. 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.

1.16 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. 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.

E. 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 their 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.

D. Refer to manufacturer drawings and specifications for requirements of special equipment. Verify connection requirements before bidding.

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 water, waste, vent, gas, , and/or diesel 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.

G. Refer to Manufacturer drawings and specifications for requirements of special equipment. Verify connection requirements before bidding.

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.

C. Refer to Manufacturer's drawings/specifications for requirements of special equipment. Verify connection requirements before bidding.

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.

C. Division 23 shall provide airtight plastic covers over all supply and return air openings prior to the start of construction by any trade. The plastic shall be maintained airtight throughout the project construction and removed only with the approval of the Owner's Representative.

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 LUBRICATION CHART

A. Provide lubrication chart, 8-1/2 in. x 11 in. minimum size, typed in capital letters, mounted under clear laminated plastic; secure to wall in area of equipment. List all motors and equipment in contract. Obtain and list necessary information by name/location of equipment, manufacturer recommended types of lubrication and schedule. Lubricate motors as soon as installed and perform lubrication maintenance until final acceptance. Divisions 22 and 26 shall add contract items to the chart provided by Division 23 or provide separate charts.

1.30 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.

1.31 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. Each item listed in the table of contents shall include a hyperlink to the associated section of the O&M Manual, in addition to the bookmarking.

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 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 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 will return copy with review comments.

1. Correct or revise O&M manual to comply with Engineer'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.

1.32 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".

1.33 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.

1.34 COMMISSIONING

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

1.35 TEMPORARY HEATING AND COOLING

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

1.36 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.

1.37 TEMPORARY FACILITIES

A. Refer to the Division 01 Sections, General Conditions and Supplemental General Conditions.

1.38 TEMPORARY LIGHT AND POWER

A. Refer to the Division 01 Sections, General Conditions and Supplemental General Conditions.

1.39 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.

1.40 SYSTEM START-UP AND TESTING

A. All new heating and ventilating systems shall be started up and operated at normal operating temperature for a period of 24 hours to "bake-off" the equipment. The associated ventilation system shall run on 100% outside air during the bake-off for an additional eight hours to purge the building. This work shall be completed prior to fall school occupancy or on a Saturday, with the Contractor responsible for being on site during the entire purge and bake-off operation.

1.41 TRANSFER OF ELECTRONIC FILES

A. M/E Engineering, P.C. will provide electronic files for the Contractor's use in the preparation of sheet metal shop drawings, coordination drawings, or record drawings related to the project, subject to a potential $50.00 charge per drawing file 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 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.

1.42 VIDEO RECORDING OF TRAINING SESSIONS

A. The contractor shall video record all training sessions required by their discipline. Video shall be in Windows Media Player video format saved on flash drives. Two (2) copies on flash drives are to be provided as a formal submittal. . Flash drives are to be tagged with project name, training session name(s), installing Contractor and date of training. The flash drive shall include a scanned version of the training session sign in list(s), including the presenter and the owner's participants.

1.43 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.

1.44 INFECTION CONTROL

A. Construction procedures, temporary partitions, negative air systems, cleaning procedures, HVAC system isolation, dust control, etc. shall be in accordance with the infection control standards set forth by the Facility. A copy of the facilities standards are available from the Owner upon request.

END OF SECTION 260500

SECTION 260501 BASIC MATERIALS AND METHODS

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. 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.

1.3 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.

1.4 SUBMITTALS

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

1. Wiring Devices
2. Underground Pullboxes (Handholes) and Covers

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

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. Channel Support Systems:

1. Channel Support Systems shall be provided for racking of conduit, trapeze suspensions, equipment support, cable racks and panel racks. 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

D. 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. 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	**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

E. 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

F. 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. 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

G. 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. Receptacles connected to the emergency power system shall have a red colored face. 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.

4. 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.

1) = the system name.

5. 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 - 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

c. Wall Mounted - Dual Technology - Dual Switching:

1) Unit shall fit into a standard single gang electrical box, have two on/off buttons 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. To have two contacts each fully rated, electrically separate and be commonly controlled. 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 20-300fc) 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 AD2000X2 (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.

H. 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. 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", "Medium Voltage Electric", etc. to designate type of service. Unit shall be rated to AASHTO HS20-44 loading. Provide 18 in. drywell of #2 crushed stone under pullbox and 18" beyond. Refer to drawings per details and locations.

a. Manufacturers:

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

I. Ductbanks:

1. Ductbanks shall be rigid non-metallic conduit encased in 3000 psi concrete 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.

J. 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.

K. 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 Above 600 Volts in Indoor Dry Locations or Outdoors, Above Grade Locations: Rigid metal conduit conduit.
2. Wiring Above 600 Volts, Below Grade: Rigid non-metallic conduit encased in concrete with rigid metal conduit bends and penetrations through building floors and walls.
3. Wiring 600 Volts or Less in Dry Locations: Electrical metallic tubing or type MC cable.

4. Wiring 600 Volts or Less in Outdoors, Above Grade Locations: Rigid metal conduit.
5. Wiring 600 Volts or Less Installed Below Grade, in Concrete Floor Slabs or Below Ground Floor Slab: Rigid non-metallic conduit encased in concrete with rigid metal conduit bends and penetrations through building floors and walls.
6. All Wiring Installed in Hazardous Locations: Galvanized rigid metal conduit.
7. 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.
8. Where EMT is allowed, branch circuits may be type MC cable concealed.

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.
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 "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. 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.

23. 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 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.

24. 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. Provide conduit seals and explosion proof devices as indicated on the plans and as dictated by the NEC for all hazardous locations indicated on the drawings.

16. 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.
17. Provide cable/conductor vertical support in accordance with the NEC.
18. Manholes/Handholes:

    a. Provide cable racks, and securely fasten all cables. Support stanchions shall be spaced 3 ft. apart maximum.
    b. Provide separation of conductors of different systems per NEC requirements.
    c. Pitch all raceways toward the manhole/handhole.
    d. 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. 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, hazardous areas; also 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, 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 main service disconnects 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. Nameplates shall be engraved black, with white core, with Helvetica medium 3/16 in. lettering. 1/8 in. lettering is acceptable where space of 3/16 in. is not available.
6. 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.
7. Provide signage at each electrical service room indicating "DANGER - HIGH VOLTAGE - KEEP OUT". Utilize adhesive backed, yellow background, block lettering signage at door.

8. 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 260501

SECTION 260526 GROUNDING

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 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, wire ways, 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 nonload 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.

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. 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.

1.4 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.

1.5 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

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 conductors 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, starter 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.

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. Clamps to pipes or raised floor systems shall be of suitable size and type for the intended system.
4. 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.
5. 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. 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. Provide equipment grounding conductor, green colored insulation, with phase conductors, to primary side of all transformers rated 600 volts or less circuited to the enclosure and secondary neutral bushing, to all electrical utilization and distribution equipment; insulation shall be same type as phase conductors. Transformer enclosures shall be bonded to the primary and secondary circuit grounding conductor.
3. Equipment grounding conductors shall extend from the point of termination back to the ground bus of the source panelboard, switchboard, transformer, or switchgear.

G. 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.
2. Surge Protection Device (SPD) Ground Conductor Installations: Extend SPD dissipation ground conductors to local equipment ground bus and to common grounding electrode conductors. Size conductors per SPD manufacturer recommendations and the NEC.

H. 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.

I. 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 nonshrinking 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 260526

SECTION 262000 ELECTRIC DISTRIBUTION

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 a complete distribution system as indicated on the Contract Documents and as specified herein.

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. 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.

1.4 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. Dry type transformers.
2. Branch circuit panelboards.
3. Disconnect switches.
4. Surge Protective Devices.

1.5 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. Dry-Type Transformers:

1. Transformers to be self-cooled ventilated dry type. Transformers that require internal or external fan assisted forced air cooling to obtain ambient air (AA) rated kVA are not acceptable. Transformers 15 kVA and less shall have 185°C insulation system and shall be designed not-to-exceed 115°C rise above 40°C ambient. Transformers 30 kVA and higher shall have 220°C insulation system and shall be designed not-to-exceed 150°C rise above 40°C ambient. Insulation systems shall be U.L. listed. Cores shall be manufactured from a high-grade, non-aging, silicon steel with high magnetic permeability, low hysteresis and eddy current losses, and shall be clamped with structural angles and bolted to the enclosure to prevent damage during shipment or rough handling. Remove clamping after installation. Coils shall be aluminum, vacuum impregnated with non-hydroscopic thermosetting varnish and shall have a final wrap of electrical insulating material designed to prevent injury to the magnet wire. Transformers having coils with magnet wire visible will not be acceptable. 30 KVA, and larger, floor mounted. Under 30 KVA, wall mounted. Provide Mason type ND, Korfund or Vibrex vibration isolation devices for each transformer.
2. Ratings: Shall be as indicated on the drawings. IEEE #C57, NEMA and US Government requirements shall apply. The transformer efficiencies shall meet or exceed the requirements of New York State and the US Department of Energy.
3. For transformers up to 300 kVA, provide with 6-2-1/2% full capacity taps, 2-FCAN (for connections above nameplate) and 4-FCBN (for connections below nameplate). For transformers above 300 kVA, provide 4-2-1/2% fully rated taps, 2-FCAN and 2-FCBN.
4. Manufacturers: Subject to compliance with contract documents, the following manufacturers are acceptable:

a. Square D

b. Eaton Corporation
c. General Electric by ABB
d. Acme
e. Heavy-Duty
f. Howard

B. Branch Circuit Panelboards:

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. Shall be NRTL listed for use as service entrance equipment where used at the service entrance.
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 full length piano-hinged trim allowing access to wiring gutters without removal of trim.
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:

        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 short time, short time delay, long time, long time delay, front adjustable, and instantaneous trip functions as indicated.
3. Lugs shall be mechanical, rated for 60/75° AL/Cu.
4. 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.
5. Ratings shall be as indicated in the Contract Documents.
6. 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.

D. 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, for indoor use, NEMA 4 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. Eaton
    c. General Electric
    d. Siemens

E. 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.

F. Surge Protective Device:

1. Device shall be rated for location as shown on drawings.
2. Seven Mode Protection: Line-to-neutral (three), line-to-ground (three) and neutral-to-ground.
3. Provide test report from a recognized independent testing laboratory verifying the Surge Protective Devices (SPD) can survive published surge current rating on both a per mode and per phase basis. ANSI/UL 1449, latest edition.
4. Surge Current Capacity - The minimum total surge current tested with the ANSI/IEEE C42.41, 20 kA-8/20 microsecond waveform that the device is capable of withstanding shall be as shown in the following table:

	Application	Peak Surge Current Per Phase	Nominal Discharge Current - In Per Mode
a.	Type 1 - Service Entrance	250 kA	20 kA

5. Unit shall comply with ANSI/UL-1449, latest edition. Voltage Protection Rating (VPR) per Mode must not exceed the following for Type 1 SPD:

    a. 208Y/120, L-N 700 volts, L-G 700 volts, N-G 800 volts, L-L 1000 volts.
    b. 480Y/277, L-N 1200 volts, L-G 1200 volts, N-G 1200 volts, L-L 2000 volts.

6. Unit shall comply with ANSI/UL-1449, latest edition. Voltage Protection Rating (VPR) per Mode must not exceed the following for Type 2 SPD:

    a. 208Y/120, L-N 800 volts, L-G 700 volts, N-G 800 volts, L-L 1000 volts.
    b. 480Y/277, L-N 1000 volts, L-G 1200 volts, N-G 900 volts, L-L 1800 volts.

7. UL-1283 bi-directional high frequency noise attenuation for electric line noise shall be 50 dB at 10 kHz-100 MHz.
8. Short Circuit Current Rating: 200 KAIC.

9. Indication system:

    a. A green/red LED indicator for each phase.
    b. Flashing trouble light.
    c. Shall alarm open circuit damage, thermal conditions and overcurrent.
    d. Transient surge counter.
    e. Provide dry contact for remote monitoring.

10. Integrated model.
11. Manufacturers: Subject to compliance with contract documents, the following manufacturers are acceptable:

    a. Eaton SPD - Design Make
    b. L.E.A./Dynatech
    c. Liebert
    d. Square D
    e. Current Technology

G. Manual Motor Starter:

1. Provide all starters with thermal overload(s); and pilot light(s), and handle lock-out provisions. Gang starter with selector switch for multi-speed applications. Provide single or 2-pole as required.

    a. 120 volt, single-pole, surface mounted: Square D FG-5P and handle guard.

2.2 SHORT CIRCUIT PROTECTION, COORDINATION AND ARC FLASH STUDY

A. The contractor shall provide an electrical power systems study as described below and submitted for approval prior to final equipment submission. Submit documents/drawings of complete short circuit, coordination and arc flash study for the electric distribution system for this project including the service entrance to all branch circuit panelboards and branch circuits 50A and over. Documents shall be prepared by a licensed Professional Engineer in New York State with at least 5 years' experience in similar studies, using the most current software version of SKM Power Tools. Study documentation shall include:

1. Software used to prepare study with a description of the software philosophy.
2. Quantities, ratings and characteristics of all system components.
3. Impedance data for each piece of equipment.
4. Calculation methods and tabulations.
5. One-line diagrams and impedance diagrams.
6. Service entrance characteristics (available short circuit, X/R ratio, voltage, etc).
7. Available short circuit at each node in the system with associated required equipment ratings.
8. Coordination verification with equipment settings and time current graphs.
9. Arc flash energy level at each piece of equipment with adhesive labels.
10. Conclusions and recommendations.

B. Short Circuit Current:

1. Perform short circuit current calculations to determine the available short circuit current at each piece of distribution equipment.
2. Calculations shall take into account the following:

    a. Available utility short circuit current.
    b. System impedances (transformers, conductors, etc.).
    c. Conduit types.
    d. Motor contribution for motors.

C. Coordination:

1. Electrical distribution system shall be fully coordinated from the service entrance to branch circuit over current protection.
2. Emergency electric distribution system shall be fully coordinated from the service entrance to the branch circuit over current protection.
3. The coordination shall meet the current edition of ANSI/IEEE Standard 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems. The study shall indicate that this standard was used as the basis for the study.
4. Field settings, adjustments and minor modifications necessary for conformance with the recommendations shall be accomplished without additional expense to Owner. Provide documentation that all applicable over current protective devices have the recommended settings and have been suitably calibrated.
5. Coordination graphs shall indicate coordination proposed for systems indicated on log-log graph forms. Coordination graphs shall include:

    a. Complete descriptive titles.
    b. Graph for all over current devices.
    c. Thermal damage curves (conductors, transformers, etc.), available short circuit current limits, rated current levels and over current protective device operation bands. Over current protective device operation bands shall be for the recommended settings.
    d. Indication that applicable devices are inherently selectively coordinated with associated back up list from the manufacturer.
    e. Listing of all project over current devices with manufacturer and model number.
    f. Recommended settings for all adjustable over current protective devices.

6. Equipment design discrepancies and proposed corrective modifications if required shall be submitted with studies with variations clearly note.

D. Arc Flash:

1. Arc flash evaluation shall be provided to determine the arc flash energy at each piece of distribution equipment. Calculation shall be in accordance with IEEE 1584 and NFPA 70E.

2. Two separate arc flash energy levels shall be calculated and displayed on separate labels in locations that an arc flash energy reduction maintenance switch is utilized to indicate the energy with and without the switch engaged.
3. Arc flash calculations shall utilize finalized and approved over current protective device settings.
4. Arc Flash labels shall be furnished and installed on the appropriate equipment after the Short Circuit, Coordination and Arc Flash Study has been completed and approved. Layout and information on the label shall be approved by the engineer of record.

E. Once competed and approved, provide the Owner and Engineer an electronic copy of the full calculations, inputs and outputs.

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. Install dry-type transformers with adequate clearances for proper ventilation. Bolt floor mounted transformer to pad.

D. Floor mounted dry-type transformers 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.

E. 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.

F. Identification:

1. Identify all items of equipment as described in Section 260501-3.1, Identification. Identification shall be provided for panelboards, transformers, motor starters, disconnect switches, enclosed circuit breakers, switchboard main/distribution breakers, surge suppression devices, control panels, etc.

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.

END OF SECTION 262000