DIVISION 16 – ELECTRICAL

SECTION 16010 – GENERAL PROVISIONS

1. GENERAL

1.01 The following are minimum requirements and shall govern, except that building laws and/or drawings shall govern when their requirements are in excess thereof.

2. DRAWINGS AND SPECIFICATIONS

2.01 The architectural, mechanical, electrical and equipment drawings and specifications are hereby incorporated into and become a part of this Division. This Contractor shall examine all such drawings and specifications and become thoroughly familiar with project contained herein and the submission of his bid shall be construed as indicating such knowledge.

2.02 Electrical drawings are diagrammatic and are intended to show the approximate locations of equipment and piping. Dimensions given on the plans shall be verified in the field. Drawings may not be scaled to obtain exact dimensions.

2.03 The exact locations of apparatus, fixtures, equipment and conduits shall be ascertained from the Owner's representative in the field, and the work shall be laid out accordingly. Should the Contractor fail to ascertain such locations, the work shall be changed at his own expense when so ordered by the Owner. The Owner reserves the right to make minor changes in the location of conduit and equipment up to the time of installation, without additional cost.

2.04 The electrical drawings and specifications are intended to supplement each other and any material or labor called for in one shall be furnished and supplied even though not specifically mentioned in both. Labor and/or materials neither shown nor specified, but necessary for the completion and proper functioning of the system, shall be provided by this Contractor.

2.05 The work required under these specifications includes all labor, materials, equipment and services necessary to provide lighting and power systems, service entrances, motor controls and connections, branch circuiting, feeders, panels, fixtures, wiring devices, and other items shown on the plans or specified.

2.06 When the specification of an item is not identified with a particular area, the item shall pertain to all areas.

2.07 This Contractor shall furnish such labor and materials as hereinafter specified and as required to complete all electrical connections in accordance with the manufacturer's requirements for all mechanical equipment and Owner's equipment as shown and/or specified.

3. EXAMINATION OF SITE

3.01 Bidder is to visit the site and familiarize himself with existing conditions and satisfy himself as to the nature and scope of work. The submission of a bid will be evidence that such an examination has been made. Later claims for labor, equipment or materials required, or for difficulties encountered which could have been foreseen had an examination been made, will not be allowed.

4. DEFINITIONS

4.01 "Install" shall mean to place, fix in position, secure, anchor, wire, etc., including necessary appurtenances and labor so that equipment or installation will function as specified and intended.

4.02 "Furnish" shall mean to purchase and supply equipment or components.

4.03 "Provide" shall mean to "furnish and install".

4.04 "Or approved equal" shall mean equal in type, design, quality, style, color, etc., as determined by the Engineer/Architect.

5. INTERFERENCES

5.01 It shall be the duty of this Contractor to report any interferences between his work and that of any other Contractor to the Owner or Architect as soon as they are discovered. The Owner or Architect will determine which equipment shall be relocated regardless of which was first installed, and his decision shall be final.

6. MATERIALS AND WORKMANSHIP

6.01 All work shall be installed in a practical and workmanlike manner by competent workmen, skilled in their branch of the trade.

6.02 Unless otherwise specified or indicated on the drawings, all materials shall be new and free from defects and shall be the best of their several kinds.

6.03 All material and equipment shall meet or exceed standards specified by UL, NEMA, ANSI and IEEE wherever such standards have been established.

6.04 From time–to–time during the operation and at the completion thereof, this Contractor shall remove all debris and excess materials caused by his work and he shall leave the area of the operation broom clean.

6.05 All electrical equipment and material shall bear the Underwriter's Laboratories label.

7. SUPPORTS

7.01 This Contractor shall furnish and install all angle iron, channel iron, rods, supports or hangers required to install or mount panelboards, switchboards, or any electrical equipment called for on the plans, in these specifications, or as necessary to mount any piece of electrical equipment, material, or device. Conduit, fixtures, or any electrical devices shall not be supported from steel deck, bridging, ceiling, or ceiling support wires.

8. TEMPORARY CONSTRUCTION POWER AND LIGHTING

8.01 Sufficient temporary power, during construction, for heating, lighting, appliances, or motorized portable equipment shall be provided by the Electrical Contractor.

9. CODES, LAWS, PERMITS AND INSPECTIONS

9.01 Install all work in full accordance with codes, rules and regulations of municipal, city, county, state and public utility, and all other authorities having jurisdiction over the premises. This shall include all requirements of the City Building Code, regulations of the State Department of Industrial Relations, OSHA, ADA (Americans with Disabilities Act), and the requirements of the National Electrical Code, as interpreted by the Local Inspection Division. All these codes, rules, and regulations are hereby incorporated into this specification.

9.02 Comply with specification requirements which are in excess of code requirements and not in conflict with same.

9.03 The Contractor shall secure all permits and certificates of inspection incidental to the work, required by foregoing authorities. All such certificates shall be delivered to the Owner's representative, in duplicate, before final payment on contract will be allowed. The Contractor shall pay all fees, charges and other expenses in connection therewith.

10. FIELD CHANGES (AS BUILT DRAWINGS)

10.01 Keep one (1) set of working drawings and shop drawings at the job site for sole purpose of recording all changes made during construction. After completion of the work and before requesting final payment, the above mentioned drawings shall be delivered to the Owner.

11. LABELING AND NAMEPLATES

11.01 Permanently label transformers, switchboards, panelboards, time switches and safety switches indicating equipment or panels and areas which they serve.

11.02 Lighting and appliance panels shall be labeled as shown on drawings.

11.03 Electrical Contractor shall furnish and install identification for pull or junction boxes furnished by him.

11.04 Identify each use or source of equipment by means of laminated black and white phenolic label with 3/8" letters engraved through black to white.

11.05 Materials

A. Nameplates: Engraved three–layer laminated plastic, white letters on a black background.

11.06 Installation

A. Degrease and clean surfaces to receive nameplates and tape labels.

B. Install nameplates and tape labels parallel to equipment lines.

C. Secure nameplates to equipment fronts using screws, rivets or adhesive. Secure nameplates to inside face of recessed panelboard doors in finished locations.

D. Mark every junction or pull box cover plates with the circuit number(s) of all wires contained therein.

11.07 Wire Identification:

A. Provide wire markers on each conductor at terminal strips and at final line and load connections. Identify with branch circuit or feeder number of power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring or as drawings indicate.

B. All wires shall be color coded. Color code branch circuit wiring as follows:

1. Three Phase System:

	120/208V
Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green

2. Switched Wires: Other than colors listed above

3. Travelers Between 3–Way Switches: Purple

4. Isolated Ground: Green with Yellow Stripe

12. GUARANTEE

12.01 In addition to guarantees of equipment by manufacturer of same, this Contractor shall also guarantee equipment provided by him and shall be held for a period of one (1) year to make good any defects in material and workmanship occurring during this period, at his sole expense. This one (1) year period shall start from the date of final acceptance by Owner.

13. SCOPE OF WORK

13.01 Furnish all labor and material necessary to complete the electrical work shown on the drawings, specified herein or required to complete the construction of the building as shown.

13.02 The listing herein of article or material, operation or method, required to be provided and installed by the Contractor (unless noted to be supplied by others) shall be of quality or subject to qualifications as noted. Each operation shall be performed according to standard practice, manufacturer's instructions, and conditions stated, providing, therefore, all necessary labor, equipment and incidentals.

13.03 The electrical Contractor shall schedule his work to conform to the progress of the other trades and Contractors employed on this project.

13.04 The electrical work shall include but is not limited to the following:

A. Complete power and lighting distribution systems including panels, as shown on plans.

B. Complete branch circuit wiring system.

C. Temporary electric service as required for construction.

D. Testing of all electrical equipment.

14. MANDATORY SHOP DRAWINGS

14.01 Submit a minimum of five (5) copies of all required electrical shop drawings.

14.02 Shop Drawings shall be submitted for:

Switchgear and surge suppressers

All Lighting Fixtures

All Wiring Devices

END OF SECTION 16010

SECTION 16100 – BASIC MATERIALS AND METHODS

1. CONDUIT

1.01 All wire shall be run in accordance with the applicable codes in corrosion resistant rigid threaded metal conduit or electrical metallic tubing (E.M.T.), unless otherwise specifically stated herein.

A. Conduit below first floor slab, exposed to weather, or underground shall be rigid, threaded, galvanized, heavy wall type.

B. Carlon PVC, Type 40 heavy wall conduit with ground wire may be used underground below floor slab or pavement in lieu of rigid threaded metal conduit. PVC schedule 40 conduit shall not be run in or above first floor slab. Conduit risers that shall terminate above floor slab with rigid, threaded metal conduit adapter. Conduit above slab shall be metal.

C. A ground conductor shall be supplied in all conduits and raceways. The ground conductor shall be copper, and sized per the NEC, or as shown on drawing, whichever is more stringent.

D. PVC conduit run beneath areas subject to heavy vehicular traffic such as commercial parking areas, drive throughs, etc. shall be concrete encased. This conduit shall comply with NEMA TC–6 and –8 (Power), TC–10 (Telephone), and NFPA F512 (Concrete Encasement Applications) and UL–651 (Standard).

E. PVC conduit used between lighting standards shall be Carlon Type 40 min. and comply with NEMA TC–2, TC–3, and UL–651 (Standard).

1.02 Conduits and E.M.T. shall be delivered to the building in 10–foot lengths and each length shall have the Underwriter's Laboratories label.

1.03 Conduit and E.M.T. shall be run concealed in all finished areas of the building.

1.04 E.M.T. connectors and couplers shall be set screw type made of die cast as manufactured by Thomas & Betts, Steel City, or Appleton. Bends and offsets shall be made with a hickey or power bender without kinking or destroying the smooth bore of the conduit. Paralleled conduits shall run straight and true with offsets uniform and symmetrical. Conduit terminals at boxes and cabinets shall be rigidly secured with locknuts and bushings as required by the National Electrical Code and local electrical code. Insulated bushings shall be used on all conduit 1–1/4" trade size and larger.

1.05 Conduit shall be securely fastened in place at no more than 8–foot centers, and hangers, supports or fastenings shall be provided at each conduit, elbow and at the end of each straight run, terminating at a box or cabinet. Conduit shall not be suspended from the ceiling or ceiling suspension wires.

1.06 Horizontal and vertical conduit runs shall be supported by one–hole malleable straps or other approved metal device with suitable bolts, expansion shield or beam clamp for mounting to building structure or special brackets. Conduit shall be supported from structural steel or joist and independent of other piping. Do not support conduit from metal roof deck or any other support device of another trade.

1.07 Armored cable (BX) or nonmetallic sheathed cable (Romex) shall not be used.

1.08 No aluminum conduit shall be used.

1.09 Only short runs of flexible metal conduit not over 6' in length and having a ground conductor, shall be used for terminal connections to motors and also for electrical equipment where it is not practical to make final connection with rigid conduit. Flexible conduit exposed to weather shall be Sealtite.

1.10 Exposed conduit and conduit in ceiling space shall be run parallel to the building structure.

1.11 Conduit system shall conform to all the requirements of the National Electrical Code (N.E.C./N.F.P.A.–70) and local codes.

1.12 Metal Clad (MC) cable may be used where allowed by these drawings and conform to notes shown on sheet E0.0.

2. CONDUCTORS

2.01 Sizes of conductors for feeders are given on the drawings and no wire smaller than #12 gauge shall be used for branch lighting or power circuits. All wiring shall have the U.L. label and be of 98% conductivity copper. Aluminum wire or aluminum cable is not acceptable.

A. The gauge of all wire shall be in accordance with B&S standard.

2.02 All wire and cable for branch lighting or small power circuits shall have "NEC" Type "THHN/THWN" 600–volt insulation.

2.03 Wire and cable #10 gauge and above shall be stranded Type "THWN" insulated for 600–volts.

2.04 For special conditions, as provided by the National Electrical Code, Type "R.H.H., A.V.A." or other required insulation shall be used.

2.05 Where lighting fixtures are used as raceways, 90 degree C. minimum insulated wire shall be used.

3. GROUNDING

3.01 This Contractor shall provide, install and connect a complete system of grounding for all equipment and structures. A good mechanical and electrical connection shall be made with approved grounding connectors.

3.02 Electrical system and equipment grounds shall comply with the N.E.C. as well as all local and state codes and regulations.

3.03 Panels, conduit systems, motor frames, lighting fixtures and other equipment that are part of this installation shall be securely grounded both mechanically and electrically in accordance with all codes.

3.04 System ground shall not exceed a maximum of ten (10) OHMS resistance. Verify existing grounding system and add additional grounding as required to meet the above specified value.

3.05 A ground conductor shall be supplied in ALL conduit. It shall be insulated, stranded, annealed copper conductor.

4. TOGGLE SWITCHES AND RECEPTACLES

4.01 Color for all general purpose switches and receptacles shall be selected by architect/owner.

4.02 Acceptable device manufacturers are Hubbell, Leviton, or Pass & Seymour. The basis of design is Leviton.

4.03 Wall Switches:

A. Single poles #1221, double pole #1222 and three (3) way switches #1223 shall be rated 20–ampere, 120/277 volts.

B. Switches shall be mounted 4'–0" above finished floor to centerline.

4.04 Duplex receptacles shall be 20–ampere at 120 volts, Leviton catalogue #5362 or approved equal, mount at 18" above floor to centerline or as noted on plans.

4.05 Outdoor receptacles shall be weatherproof with spring loaded doors (Intermatic #4926 plates).

5. WALL PLATES

5.01 Unless otherwise noted, all plates for wall switches, receptacles and telephone outlets shall be stainless steel.

5.02 All plates shall have full contact with the wall and boxes. Edges shall be parallel to the finished walls and ceilings.

6. OUTLETS

6.01 Locations of outlets are shown approximately on the drawings. Contractor shall refer to the shop drawings of the manufacturers of the equipment for the exact location of outlets for fixtures, motors, heaters and their respective control devices. Approximate locations of light fixtures are shown on the drawings.

6.02 Outlet boxes for concealed work shall be pressed steel boxes, galvanized and not less than #12 gauge, except floor boxes which shall be cast iron. Each ceiling outlet designated for a lighting fixture shall have a fixture support secured in place with nuts and bolts. Ceiling boxes shall be four inches (4") round and octagonal with lugs and screws for back plates. Wall outlets shall be four inches (4") square by 1–1/2" deep, single or double cover, except gang boxes of similar depth shall be used at locations requiring more than 2–gang.

6.03 Outlets on the exterior of the building shall be flush weatherproof type.

6.04 All outlets shall be firmly secured in place. Outlets in finished areas shall be flush with finished ceiling or walls.

6.05 All outlet locations in floor shall be verified with Owner's Representative before pouring of concrete floor.

7. BRANCH CIRCUIT WIRING

7.01 The Electrical Contractor shall provide and connect a complete system of panels, conduits, wire fittings, boxes, supports and all other miscellaneous materials required for equipment as indicated on the plans and ready for operation by the Owner.

7.02 All circuits shall be color coded.

END OF SECTION 16100

SECTION 16400 – ELECTRICAL SERVICE AND DISTRIBUTION

1. SECONDARY SERVICE

1.01 Electrical service shall be as shown on plans. Provide all necessary equipment and material and install the service and distribution equipment accordingly.

1.02 Electrical Contractor shall provide feeders from the existing service equipment to main panel in Shop as indicated on drawings.

1.03 Site electrical shall be coordinated with Owner by Electrical Contractor.

1.04 Provide coordination, via the General Contractor, for the final locations, penetrations, and service tie–ins associated with service conduits.

2. SAFETY SWITCHES

2.01 General

A. Switch shall be type as indicated on plans, with visible, quick make, quick break blades. Swiches hall be U.L. listed and conform to NEMA Standards.

2.02 Enclosures

A. Steel enclosures with operating handle at side. NEMA 1 for general indoor use, NEMA 3R for general outdoor use and NEMA 4 (stainless steel) where indicated on the drawings. Manufacturer's standard enamel finish.

B. The enclosure shall be interlocked with the switch handle such that the enclosure door cannot be opened with switch in the "on" position. Switch handle shall be capable of being padlocked in the "off" position.

2.03 Ratings

A. Safety switches shall be rated for the continuous current and voltage indicated on the drawings. Where used in conjunction with motor circuits, units shall be horsepower rated for the size motor indicated.

B. Switches used as service entrance equipment shall be U.L. listed for use as service equipment.

2.04 Poles

A. Safety switches shall have the number of poles indicated on the drawings, but not fewer than one (1) pole for each ungrounded conductor to be opened.

2.05 Fuses

A. Where indicated, safety switches shall be fused in each ungrounded leg in accordance with the requirements of the Section entitled "Fuses".

2.06 Acceptable

A. Acceptable manufacturers are General Electric, Eaton, Square 'D', or Siemens.

3. DISTRIBUTION PANELBOARDS (INCLUDING POWER PANELS)

3.01 Power and distribution panels shall be suitable for voltage indicated on plans and/or riser diagrams. Panels shall be 3–phase, 4–wire, with full neutral, minimum buss, dead front with lugs in the mains, fusses and heavy–duty switches in branch circuits. Size and number indicated on the plans. All lugs shall be U.L. approved aluminum type.

3.02 Panels shall be provided with spares and full provisions for future breakers as shown.

3.03 Panels shall be manufactured as a complete unit by Siemens, Square 'D', General Electric Company; Eaton, not an assembly of parts secured from a supply house.

3.04 Panelboards and switches shall be identified for "usage".

LIGHTING AND APPLIANCE PANELBOARDS

4.01 Lighting panels shall be dead front type, aluminum buss, with lugs only in the mains and branch circuits as indicated on the drawings. Panels shall have 20 amp single, double or 3–pole circuit breakers (capable of interrupting available short circuit current) as required in each branch circuit. Where breakers larger than 20 amperes are required, the sizes are noted on the drawings. Breakers shall be bolted to bus type, quick–make, quick–break and capable of interchanging 1,2 or 3–pole units. Multiple units shall be common trip. Provide spare breakers in each panel as shown. All lugs shall be U.L. approved CU/AL type.

4.02 Electrical Contractor shall arrange circuits as near as possible to circuit numbers on the drawings. At finish of job, Electrical Contractor shall take current reading checks of respective phases. A minimum of circuit connections shall be rearranged to balance (as closely as possible) the load on the panel.

4.03 Panels shall be enclosed in galvanized steel of code thickness. Cabinets shall be large enough to allow standard size wiring gutters on each side, top and bottom of panels. Mount not over 6'–6" from floor to top of panels.

5. GENERAL (FOR ALL PANELS AND PANELBOARDS)

5.01 Metal framed card holders with typewritten circuit directory must be provided for each panel. Directory shall be clear and designation shall match identification on equipment. Panelboards (switchboard, distribution, power panels and lighting panels) shall be identified by a label on the switch and/or panel door. Provide engraved laminated phenolic nameplates with 3/8" letters engraved through black to white.

5.02 All panels, safety switches, starters and in general, all equipment requiring lugs shall be equipped with solderless type U.L. approved lugs.

5.03 Provide all necessary unistrut, channel, backing and supports to mount switchboard and panelboards securely in place.

6. FUSES

6.01 This Contractor shall replace all fuses blown during construction and testing and shall provide a complete set of fuses in all fuse holders, switches, panels and all other devices requiring fuses.

6.02 Fuses shall be as specified herein and indicated on drawings. Alternate manufacturer is Littelfuse. In the event the Electrical Contractor wishes to furnish materials other than those specified, a written request, along with complete application data to assure a selectively coordinated system, shall be submitted to the Engineer for evaluation.

END OF SECTION 16400

SECTION 16500 – LIGHTING

1. LIGHTING FIXTURES

1.01 All fixtures shall be as shown on Fixture Schedules, and approved by owner.

1.02 Unless otherwise indicated, all lighting fixtures shall be furnished and installed by Electrical Contractor as indicated on the Lighting Fixture Schedules, including lamps.

1.03 All fixtures shall bear the Underwriter's Laboratories label and shall be installed according to manufacturer's instruction.

1.04 All fixtures, unless otherwise indicated, shall be new and undamaged.

1.05 Surface–mounted fluorescent fixtures shall be mounted 1–1/2" from ceiling. Mount spacers and supports on 48" centers with additional support at the end of each row of fixtures.

1.06 This Contractor shall provide and install all necessary support media for all lighting fixtures including structural steel, angles, rods, etc. In general, fixtures shall be supported in a manner acceptable to the local inspection authorities. All fixtures shall be firmly supported from beams or joists.

1.07 This Contractor shall support all fixtures from building structural members and NOT from ceiling system.

END OF SECTION 16500

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ELECTRICAL SPECIFICATIONS

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