DIVISION - 26 ELECTRICAL WORK

SECTION - 26 10 00 BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

a. Coordination with other trades:

1. Examine drawings and specifications. Visit site to determine work to be performed by Electrical, Mechanical, HVAC and other trades.

2. Provide electrical materials and equipment to put work into operation, completely wired, tested, an ready for use including raceways, conductors, disconnects, starters/contactors, or other devices for proper operation and sequences of electrical, mechanical or other system or equipment.

3. Unless otherwise noted, conduit, wire for controls, and devices, both line and low voltage, shall be provided and installed as described in this or other parts of the Construction Documents.

   a) Install boxes or housings necessary for conduit and wire to controls, excluding items to be installed in piping, ducts, tanks, machinery, solenoid valves, pressure switches, aquastats, or similar devices.

   b) These items are specified for installation in other sections. Connecting wiring is specified in this Division.

4. Control wiring in separate conduit between HVAC sensing devices and control panels or motors, shall be installed under this Division after verification from approved shop drawings of the required locations and connections.

5. Seal penetrations through fire rated floors or walls with fire resistant compound as specified in other sections.

6. Connect electrical equipment and devices as parts of the equipment or furniture furnished under other sections.

7. Comply with provisions of Instructions to bidders and General Conditions of this contract.

1.2 TRADESPERSON QUALIFICATIONS

a. Contractor shall provide appropriate subcontractors in the electrical trade for all work required by this Division 16, and other pertinent sections of these specifications, licensed master and journeyman at all times. No other workers shall be allowed.

b. Where the work of these trades is subcontracted the Contractor shall include this requirement in subcontracts.

c. The subcontractor shall demonstrate capacity to bond the subcontracted work. The decision to require such bond to be issued remains with the General Contractor.

d. To ensure compliance with the above tradesperson qualifications requirement, the General Contractor shall require the trade subcontractor to submit with each draw request, and shall in turn submit with the General Contractor's draw request, a certified payroll identifying each tradesperson employed for the work of this section during the payroll period, the qualifications level of each tradesperson, and where licensed as a Master or Journeyman the license number of each individual.

1.3 SUBMITTALS

a. Manufacturer's Data:

1. Complete list of materials to be furnished under this section

2. Manufacturer's specifications and other data required to assure specifications compliance.

3. Catalog literature, clearly marked for identification of items to be provided, including disconnects, breakers, fuses, starters, lighting fixtures, transformers, or other materials not requiring specifically prepared Shop drawings.

b. Shop Drawings for nonstandard items, including but not limited to panelboards, switchboards, control centers, anchoring layouts and details, lighting fixtures, or similar products.

c. Contract Closeout submittals:

1. Record Drawings

2. Warranties

3. Operating instructions, maintenance manuals, and parts lists

4. Point-to-point wiring diagrams

1.4 DELIVERY, STORAGE AND HANDLING

a. Delivery and Storage:

1. Deliver materials to jobsite in their original unopened containers with labels and certifications intact and clearly legible at time of use.

2. Store materials according to manufacturer's recommendations and as approved by Owner's Representative.

b. Replacement:

1. In case of damage, pilferage, or other loss, make immediate repair or replacement of materials necessary to obtain approvals of Owner's Representative , without additional cost to the Owner.

c. Protection:

1. Use necessary means to protect materials of this section before, during, and after installation, including protection of installed work and materials of other trades.

PART 2 - PRODUCTS

2.1 CONDUIT WORK AND WIRING METHODS

a. All wiring, except where otherwise shown or noted, shall be installed in rigid galvanized conduit. Steel conduit shall be zinc coated. Conduit shall comply with corresponding Federal Specifications for Rigid Conduit. Sizes of conduits used for various feeders, circuits, etc., shall be as noted in the drawings or in accordance with the NEC latest edition and/or PREPA standards. Minimum size of all conduit shall be 3/4 inch for electrical and signaling systems, unless otherwise noted on the drawings. Rigid metallic conduit shall be used where embedded in slabs or walls or where otherwise noted in the drawings. Rigid galvanized conduit shall not be used in direct contact with the ground. When the use of PVC (Schedule 40) conduit is permitted these shall be approved types in the market and concrete and water-tight fittings shall be used. Samples shall be submitted prior to the use of these items and approval shall be obtained from the Owner's Representative.

b. All conduits, outlets and fittings shall run in a concealed manner except where otherwise noted in the drawings or hereinafter specified. In rooms and spaces having low partitions, conduit shall run in such a manner as not to be exposed between the top of the partition and the ceiling in any way. For location of all low partitions refer to Architectural Drawings. When the partition is to the ceiling, the conduit shall pass above the ceiling in the furred space.

c. Where conduits, boxes and fittings are to be run exposed or inside furred spaces as indicated, they shall be run in a neat workmanlike manner at right angles (leveled) and parallel to the walls and partitions. Suitable approved conduit fittings shall be used in place of outlet boxes in all such cases.

1) Exposed conduit work shall be used where indicated and in mechanical areas. Junction and pull boxes shall be used above the ceiling as indicated or as and where required (not necessarily all the junction and pull boxes have been indicated).

2) Conduits thru covered walkways or above roofs, shall run above the roof with appropriate watertight fittings, pull boxes, conduit supports and fittings as indicated.

d. Where conduits cannot be run in furred ceiling space or floor fill, they shall be installed in the neutral axis of concrete beams or concrete floor construction.

1) The Electrical Contractor shall coordinate his conduit runs and work with other trades so as to avoid interference.

2) Where conduits cannot be run as indicated or interfere due to architectural limitations, changes, mechanical piping, ductwork, etc., this Contractor shall obtain an immediate decision from the Owner's Representative.

e. All conduits shall be rigidly and securely fastened to outlet boxes and panels with lock nuts and bushings of an approved type, in the case of rigid conduit, special care shall be exercised that the full number of threads project thru to allow the bushing to butt up tight against the end of threads after which the locknut shall be screwed up to bring the bushing into firm contact with the box. All joints shall be made with approved conduit couplings and in such a manner that ends of conduits shall butt together so as to make all joints watertight throughout the system. Use of set screw fittings is not permitted.

f. All conduit terminations at panels and cabinets shall be made so that the conduit enters perpendicular to the corresponding side and, if necessary, a drilling template shall be constructed to assure proper positioning.

g. Circuit runs to all panels shall be installed with as few crossings as possible and in straight line between outlets. Bends shall be avoided whenever possible.

h. All bends and offsets for 3/4" conduits can be made in the field, provided they are made with an approved hickey or conduit bending machine. In the case of large size conduit, 1" or larger, standard manufactured elbows or offsets shall be used unless the Contractor is authorized by the Owner's Representative to make them at the site, using a properly designed conduit bending machine that will not deform, crush, or damage the conduit. The inside and outside of all bends and offsets shall be smooth and free from irregularities. Minimum bending radius shall be as per NEC requirements.

i. All conduits shall be cut with a hacksaw, ends reamed and squared. Rigid steel conduit shall be thread cut and cleaned before reaming.

j. The maximum length of any conduit run shall not exceed 100 ft. including two (2) 90 degree bends. Pull and junction boxes shall be used as required.

k. All bushings for conduits larger than 1" shall be of the metal and plastic type, with an insulating ring where the conductors touch the bushings (OZ Mfg. Co. Type B, IBC or SB as applicable, T & B, G.E. or approved equal).

l. The use of all plastic bushings is strictly prohibited. Provide an approved flexible material grounding jumper across all joints in the electrical conduit system throughout as required by the Owner or his Representative.

m. All installed conduits buried directly in the ground or ground slabs shall be embedded in a concrete envelope at least 3" thick.

n. All installed conduits shall be suitably plugged with a cork, wooden plug or other approved means to prevent the accumulation of foreign matter within the conduit. Pulling shall be delayed until the project has progressed to a point where general construction procedures are not liable to damage wire and cables, and when moisture and dirt have been excluded and removed from boxes and raceways. Only approved pulling lubricants shall be used. Approval for this shall be obtained from the Owner's Representative.

o. At all motor terminals, step-down transformers and other electrical devices where so required or indicated specifically in the drawings, the Contractor shall furnish and install suitable fittings and approved flexible metallic conduit.

p. For the connection of the wall or roof exhaust fans from the junction box immediately at its side, a flexible liquid-tight with PVC extruded cover conduit shall be used ("Seal-tite" or approved equal). A green grounding wire with appropriate terminals shall also be installed when indicated.

q. Expansion and deflection fittings shall be used at all expansion joints at embedded and/or exposed conduit where required and/or indicated in the drawings. Fittings shall be OZ Mfg. Co., Type "DX", T & B, G.E., or approved equal.

r. Sealing fittings, when indicated, shall be acceptable with removable inspection covers and close up plug, Crouse Hinds EYS, EYD, Appleton, or approved equal.

s. Running threads for the connection of rigid metal conduit is absolutely prohibited.

t. In the case of PVC, all conduit terminations at boxes or panels should be well reamed to avoid damage to conductor insulation. A ground conductor (same size as phase conductor - unless otherwise specified) shall be provided throughout.

u. Conductors in vertical run raceways shall be supported at intervals not greater than:

Up to 100 ft. for No. 12 to 1/0 copper

Up to 70 ft. for 2/0 to 4/0 copper

Up to 40 ft. for 250 MCM to 500 MCM copper

Up to 30 ft. for conductors above 500 MCM

1) The cable supports shall be OZ Mfg. Co., Type "R" Thomas & Betts, General Electric, or approved equal, installed in an appropriate size, junction box. At main switchboards, power centers, junction and pull boxes and all wires shall be properly laced, supported and fireproofed (asbestos tape or sleeving) and such method shall be submitted to and approved by the Owner's Representative.

v. For the wiring of lighting fixtures see Lighting Fixtures General Section of these specifications.

w. Conduits shall be National Electric, Triangle, Republic, or approved equal.

2.2 BOXES

a. All outlets, junction, pull boxes and fittings shall be galvanized metal (non metallic as indicated in special cases), and shall be installed plumb, rigidly and securely in a satisfactory manner with an alignment tolerance of 1/16 inch unless otherwise specified.

b. All NEMA-4 specified boxes shall be made of heavy gauge stainless steel.

c. Ceiling outlets in slab shall be 4" octagonal outlet boxes, 2-1/2" minimum depth and with K.O. to fit conduit, except that when so advisable 4" square or larger, 2-1/8" minimum depth outlet boxes equipped with a canopy cover may be used in lieu of octagonal boxes. Ceiling outlets shall be provided with 3/8" fixture stud when necessary to support fixtures. Outer boxes shall be flush with the ceiling surface or as indicated in plans. For size and type of boxes for recessed ceiling fixtures see Lighting Fixtures - General Section.

d. Wall outlets for lighting fixtures shall be 4" octagonal by 2-1/8" deep with 3/8" fixture studs, and with K.O. to fit conduit. Boxes shall be flush with the finished wall surfaces, or if necessary raised covers used for this purpose.

e. Wall outlet boxes for convenience outlets, switches, and other outlets shall be 4" square minimum by 2 1/8" deep minimum with K.O. to fit conduit, and equipped with raised covers of the required height and gang, so as to bring them flush with the finished wall surface. The installation of raised covers on the boxes prior to the pouring of the concrete is strictly prohibited. In all cases the raised cover shall be installed after the forms are removed and shall be of the same depth as the plaster thickness. All wall outlets shall be located at the height indicated in the plans, and shall be horizontally mounted unless otherwise approved.

f. Boxes for other outlets like ranges, special purpose outlets, signaling devices, etc., shall be of the size and type recommended by the manufacturer of the device. When located on columns or over doors they shall be set symmetrical with columns or door.

g. Standard depth type concrete outlet boxes shall be used wherever possible in order to avoid conflict with steel reinforcement.

h. Suitable approved junction or pull boxes shall be installed when deemed desirable for the inspection of conductors as required by the length of the run, or as indicated. Junction or pull boxes not over 150 cubic inches in size shall be constructed same as outlet boxes, of not less than No. 20 gauge sheet steel. Junction or pull boxes over 150 cubic inches in size shall be constructed same as panelboard cabinets, except that covers may be of the same thickness as boxes. Minimum size of junction boxes: 4" x 4" x 2 1/8" deep. Other pull boxes shall be as indicated in drawings.

i. For exposed conduit work, appropriate fittings, cast steel and gray iron conduit fittings of the appropriate size and type with adequate plate cover shall be used.

j. All junction and pull boxes with appropriate cover plate shall be accessible after completion of the building. The connecting nipple of back to back mounted boxes shall be sealed with an approved type of sealing compound.

k. Fittings and flexible couplings shall be Crouse Hinds, Appleton, Killark, or approved equal.

l. Boxes shall be Crouse Hinds, Appleton, Raco, Steel City.

2.3 SUPPORTS

a. Support all electrical work in accordance with the best industry practice and, as approved by the Owner's Representative and the following recommendations:

1. Supporting elements of wood, perforated metal strap or wire shall not be used.

2. Include supporting racks for work indicated as being supported from walls where the walls are found to be incapable of supporting the weight.

3. Include supporting racks for equipment, intended for vertical surface mounting, which is required in a free position.

4. Supporting racks shall be of angle steel or channel steel members. They shall be rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.

5. Where they are not embedded in concrete, support conduits less than 2" trade size, vertically run, at intervals no greater than 8 feet. Support such conduits, 2" trade size or larger, at intervals no greater than the story height, or 15 feet, whichever is smaller.

6. Where they are not embedded in concrete, support conduits less than 1" trade size, horizontally run, at intervals no greater than 7 feet. Support such conduits, 1" trade size or larger, at intervals no greater than 10 feet.

7. Nothing shall depend on circuitry for support, except that threaded hub type fittings having a gross volume not in excess of 100 cubic inches may be supported from heavy wall conduit, where the conduit in turn is securely supported from the structure within five inches of the box on two opposite sides.

8. Nothing shall rest on, or depend for support on, suspended ceiling media (i.e., tiles, tile holding splines or bars, lathe, plaster and the like). Vertical members which suspend the ceiling (together with their horizontal bracing which occurs above the ceiling), however, may be used for support where indicated.

9. As a minimum procedure, support surface or pendant mounted lighting fixtures:

    a) From its outlet box by means of an interposed metal strap where weight is less than 5 pounds.

    b) Directly from structural slab, deck or framing member, where weight exceeds more than 5 pounds.

    c) As described in Lighting Fixtures Supporting System.

10. As a minimum procedure, in suspended ceilings, support small runs of circuitry (e.g., conduit not in excess of 1" trade size) from ceiling suspension members, as described above. Support large runs of circuitry directly from structural slabs, decks, or framing members.

2.4 SWITCHES

a. All switches shall be installed in accordance with the swing of the doors and located on the strike side of the door, with the exception of Automatic Door Switches which shall be installed on the other side.

b. In those cases where two or more switches are located at one point, they may be grouped together in an outlet box of the proper gang and only one switch plate provided.

c. Switches shall be installed at the height indicated and as specified hereinafter or approved equal.

1. Flush Tumbler Type, 20 amp., AC-Quiet, 120/277 V, AC, specification grade, Ivory Color.

d. Approved manufacturers for switches:

1. Pass & Seymour
2. Bryant
3. Arrow Hart
4. Hubbel

2.5 WALL RECEPTACLES

a. All wall receptacles shall be installed at the height indicated.

b. All receptacles shall be as specified hereinafter or approved equal.

c. Convenience outlets:

1. Grounding type - Parallel slots, side wiring terminals 20 amps., 125 v., duplex, NEMA configuration 5-20R - specification grade, Ivory Color.

d. Special purpose outlets (see legend in drawings).

e. Weatherproof - Same as c. above, with aluminum plate and quick clamp spring door cover, stainless steel springs, Hubbell No. 5205/5206.

f. Approved manufacturers for NEMA Standard configuration receptacles:

1. Pass & Seymour
2. Bryant
3. Hubbell

g. Telephone - 4" x 4" x 1 1/2" box (min. size) with raised cover and plate with 1" bushed hole or special box supplied by equipment manufacturer when flush equipment is indicated.

h. Plates - Stainless Steel - non-magnetic, rust proof, to meet Federal Specifications W-C-596, latest edition, satin finish specification grade, Hubbell, General Electric or approved equal. Oversize plates to be used when required to cover plastering defects.

i. Miscellaneous Receptacles - for electric and signaling systems. As specified hereinafter, and as approved by the Owner's Representative.

j. Junction Outlet Boxes - shall be provided with blank stainless steel plates.

2.6. CONTACTOR AND CONTACTOR BANKS

a. Contactors shall be for installation in enclosing cabinets identical to those used for the Electric Panels, properly sound proofed with bonded acoustical 1" Fiberglass. Cabinets shall be purchased from Panelboard manufacturer.

b. Contactor shall be of the type and size indicated, with the proper number of poles, 250 or 600 volts as applicable.

c. Contacts shall be rugged of massive construction designed for long life and high interrupting capacity. Operating coils shall be vacuum impregnated for protection against dirt and moisture. Coils shall be for 120 volt operation. Hold-in contact for 3-wire momentary control switch shall be included for electrically-held contactors.

d. Contactors shall be as follows:

1. Electrically Held - Allen Bradley, G.E., Square D, or approved equal.

2. Mechanically Held - Allen Bradley, G.E., Square D, or approved equal.

e. All contactors shall be mounted on vibration isolators on all four corners. Isolators shall be Vibration Mountings, Inc., Barry Controls, G.E., or approved equal, size as recommended by contactor manufacturer, and as approved by the Owner's Representative.

f. Contactor Banks shall be interconnected with nearest 120/208 v. panel in order to obtain 120 volt control power. A toggle switch shall be provided inside contactor panel to disconnect control voltage for maintenance purposes.

2.7 LOW VOLTAGE WIRE AND CABLE

a. All low voltage wire and cable, except where otherwise indicated, shall be copper, heat-resistant, thermoplastic insulated, moisture and oil resistant type (Type THHN/THWN), 600 volt insulation. White colored insulation shall be used for neutral; black, red and blue for service lines and branches; green for grounding conductor, and other colors for special service as directed or as required by the NEC.

b. Wires and cables shall be not over six (6) months old and shall be delivered to the job in new coils. They shall be suitably protected from weather or damage during storage and handling and shall be in first class condition when insulated.

c. In those special cases where the ambient temperature, as the result of nearby equipment, is considered to be excessive for thermoplastic or rubber insulated wire (Rockbestos Type SR-E or approved equal) shall be used.

d. All conductors shall be continuous from outlet to outlet and no splices shall be made except at outlet boxes. Conductor shall be of sufficient length at outlets to make future connection to device without strain.

e. Taps and splices shall be both mechanically and electrically perfect, properly cleaned and tightened, and sufficient insulating tape shall be applied in a manner that will make the insulation of the joints equal to the insulation of the conductor.

f. All taps and splices in wires shall be made by solderless connectors of an approved type and size.

g. Approved manufacturers:

1. CONNECTORS:

#10 or smaller	Scotch, Thomas and Betts
#8 or larger	OZ Mfg. Co. Type ST, Thomas & Betts , Compression 53,000 or 54,000 Series, Scotch
Tape	Scotch, T & B

2.8 MANUAL AND MAGNETIC MOTOR STARTERS

a. Manual Motor Starters shall be for 125, 250 or 600 volts, as applicable, full voltage, non-reversing, 1, 2 or 3 pole, with thermal overload relays at all poles and as required for the motor to be served, start-stop and reset pushbuttons and pilot light on the cover where indicated. Enclosures shall be NEMA 1 when located indoors and NEMA 4 when located outdoors except where otherwise indicated. All covers shall have provision for padlocking with stainless steel plates or key operated. Starter shall be for flush mounting unless noted and all shall be from the same manufacturer unless approved otherwise.

b. Magnetic Motor Starters shall be for 125, 250 or 600 volts, as applicable, full voltage, non-reversing, 2 or 3 pole, equipped with thermal overload relays at all poles and as required for the motor to be served, under voltage protection and pilot light where indicated. Enclosures shall be NEMA 1 when located indoors and NEMA 4 when located outdoors except where otherwise indicated. Combination, circuit breaker type motor starters shall be used unless otherwise indicated. Starter shall have reset pushbutton in cover, H-O-A pushbutton as indicated. Starter shall be for flush mounting unless noted and all shall be from the same manufacturer unless otherwise approved. Starter to have 480/120V control transformer and auxiliary contacts as specified on the drawings.

c. Approved manufacturers:

1. Westinghouse
2. General Electric
3. Allen Bradley

2.9 SAFETY SWITCHES

a. All safety switches shall be 2 or 3 pole, 250 or 600 volts, fusible or non-fusible, as applicable, of the capacity shown in plans, quick-make, quick-break, for industrial heavy duty service. Enclosures shall be NEMA 12 when located indoors, NEMA 4 when located outdoors or as indicated on drawings.

b. For fusible safety switches warning stickers shall be installed on all switch fronts indicating the type and capacity of fuses to be used.

c. Approved manufacturers:

1. Westinghouse
2. General Electric
3. Square D
4. ITE

2.10 FEEDERS AND SUB-FEEDERS

a. All feeders and sub-feeders shall be THHN/THWN with TW green grounding conductors of the size indicated in the Schedules.

2.11 PANELBOARDS

a. Panelboards shall be of the dead front type.

b. Panels shall have main protection when listed. If not listed, main lugs only of the required capacity shall be supplied.

c. Lugs shall be of a sufficient size for the size of cables feeding the panels, even when indicated lug sizes and lugs usually provided for the type panel are smaller. Bus bars shall be copper.

d. Cabinets shall be of sufficient size to allow a gutter space of at least 4" on all sides. Panels having gutter taps shall have a gutter space of at least 6" on all sides. Gutter space shall be sufficient for size of cables feeding panels.

e. Fronts shall be fastened to cabinet by means of concealed trim clamps. Door shall be supported with concealed hinges and provided with chrome plated flush lock and latch.

2.12 OVER CURRENT PROTECTIVE DEVICES

a. Fuses

1. Fuses shall be of the rating and type indicated in plans, 600 or 250 volt service as applicable.

   a) Dual Element fuses shall be BUSS Fusetrons, Type FRN or FRS as applicable, rating as indicated.

   b) Low Peak Dual Element fuses shall be BUSS Low Peak, Type LPB or LPS, rating as indicated with notched blades to fit clips or fuse holders equipped with pins.

   c) Current limiting fuses shall be BUSS Limitron Type KTN or KTS, as applicable, rating as indicated.

2. Contractor shall furnish one (1) spare fuse for each fuse size installed.

   a). Molded Case Circuit Breakers

      1) Molded Case Circuit Breakers shall be of the rating and type indicated in plans, for 240 V., 480V., or 600 V service as applicable.

      2) Each pole of these breakers shall provide inverse time delay and instantaneous circuit protection. The circuit breakers shall be ambient compensated thermal magnetic.

      3) The breakers shall be operated by a toggle type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping due to overload or short circuit shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they open; close and trip simultaneously.

      4) Breakers must be completely enclosed in a molded case. Non-interchangeable trip breakers shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be of non-welding silver alloy.

      5) Circuit breakers shall be listed with Underwriter's Laboratories, Inc., conform to the applicable requirements of latest NEMA standards, and meet the appropriate classifications of Federal Specifications W-C-375a.

      6) For those breakers that combine current limiting action with thermal/magnetic trip protection in one complete assembly:

         a) The current limiters shall not be affected when the thermal and/or magnetic trip functions to clear the

circuit. Regardless of which tripping device serves to clear the circuit, all poles of the breaker shall simultaneously open automatically.

b) The breaker must not be resetable until current limiters which have functioned have been replaced and the cover refastened. The current limiters shall have a visual means to determine which one has operated and requires replacement when the cover is removed.

On breakers with interchangeable thermal, and adjustable magnetic trip, the accessibility and position of the adjustment knob shall not be changed from those on the standard breaker.

7) Approved manufacturers: Westinghouse, General Electric, Square D.

PART 3 - EXECUTION

NOT USED

END OF SECTION