DIVISION 16000 – ELECTRICAL

16010 – GENERAL REQUIREMENTS

A. GENERAL EXTENT OF WORK

(1) The General Conditions, General Requirements, and Special Conditions shall be and are hereby made a part of this section. The Electrical Contractor shall furnish all labor, materials, tools, transportation, equipment, services and facilities required for the complete, proper and substantial installation of all electrical work shown on the plans and/or outlined in these specifications. The installation shall include all materials, appliances and apparatus not specifically mentioned herein or noted on the drawings, but which are necessary to make a complete working installation of all electrical systems.

(2) The Contractor shall consult and be guided by the General Conditions and all other divisions referred to herein and receive therefrom a thorough understanding of the work covered under this division of the specification.

(3) All of the electrical related work required for this project (unless specified otherwise) is a part of the electrical contract price and is not necessarily specified under this division of the specifications or shown on the drawings. Therefore, all divisions of the specifications and all drawings shall be consulted.

(4) The drawings showing the layout of the work indicate the approximate locations of outlets, apparatus and equipment. The drawings are schematic only and are not intended to show the exact routing of conduits, etc. The final determination as to the routing shall be governed by structural conditions and other obstructions. This shall not be construed to mean the design of the system may be changed. It merely refers to the exact run of a raceway between given points. The Contractor shall consult all contract drawings which may affect the location of any outlets, apparatus or equipment to avoid possible interference and permit full coordination of all work. The right to necessary or reasonable change in the location of apparatus, outlets and equipment up to the time of roughing-in is reserved by the Architect without involving any additional expense to the Owner.

(5) The approval by the Architect or his representative of materials, drawings, etc., submitted by the Contractor will be considered as general only and to aid the Contractor in carrying out his work. Such approval as may be given does not relieve the Contractor from the necessity of furnishing the materials and performing all the work as required by the drawings and the specifications.

(6) The work specified under this division of the specifications shall include the furnishing of all labor, materials, apparatus and tools necessary for the complete installation of all conduit and wiring, devices for lighting, power and control systems, and such other work and equipment as are indicated on the drawings or as noted herein.

(7) The entire installation shall be made in a workmanlike manner, completely connected, and ready to give proper and continuous service.

(8) All materials and work in connection with the foregoing shall be as specified herein, or called for on the drawings.

(9) The complete installation shall be in accordance with the latest rules and regulations of the National Board of Fire Underwriters and all other Boards and Departments having jurisdiction. Any items or requirements noted herein or shown on the drawings in excess of code requirements, but permitted under the code, shall take preference unless special permission is obtained from the Architect to the contrary.

(10) The light and power installation shall operate with the electrical energy obtained from outside sources. Such part of the system as may be regulated by rules of the local utility company shall, insofar as method of installation, workmanship and materials are concerned, be in full accordance with the latest approved practice and rules and regulations of the local utility company.

(11) This Contractor shall coordinate his work under this division of the specifications with the work of other trades wherein it may be interrelated. His work shall be done in such an order that there will be no interference in installing, nor delay in completion, of any part or parts of each respective trade, thereby permitting the construction work to proceed in its natural sequence without unnecessary delay.

(12) Before submitting his bid, the Contractor shall familiarize himself with the rules of all governing bodies having jurisdiction and shall notify the Architect in submitting his bid, if in his opinion, any work or material specified is contrary to such rules. If such notice has been given, the Contractor shall be responsible for the approval of all work and materials and, in case the use of any material specified is not permitted, a substitute shall be approved by the Architect and shall be provided at no increase in cost.

B. RULES AND REGULATIONS

(1) All work under this heading shall comply with the latest rules and regulations of the National Electrical Code Standard of the National Board of Fire Underwriters and with all laws, regulations and ordinances of the utility company, city, County and State.

(2) Drawings and specifications indicate the minimum standards of construction. Should any work indicated be substandard to any ordinance, law, code, rule or regulation bearing on work, the Contractor shall execute work accordingly, without increased cost to the Owner, but not until he has referred such variances to the Architect for his approval.

(3) This Contractor shall provide and install only the brands of materials and equipment specified herein, or equipment approved by the Architect-Engineer as equal. All material and equipment shall be listed and labeled by Underwriter's Laboratories, Inc., indicating compliance with nationally recognized standards and/or tests.

C. PERMITS, FEES AND INSPECTIONS

(1) Secure and pay for all necessary and usual permits, fees, inspections and certificates required for this work and deliver permits and certificates to the Architect for transmittal to the Owner before final acceptance of the project.

D. SERVICES

(1) This Contractor shall pay for all expenses, deposits, reimbursements, etc., required by the local rules and codes for the service to the building, complete and ready for use.

(2) He shall bear all expenses involved for the complete installation of the electrical service (both temporary and permanent) to the building ready for operation, except as specifically excluded on the plans. This shall include guard posts around transformers and pedestals per utility company standards.

(3) He shall consult all local departments to verify requirements and bid installation of service in accordance with local codes and utility company standards.

(4) He shall bear all expenses involved for the complete telephone service conduit installation and steel or nylon pull wire ready for cable installation. Verify complete installation with the local telephone company and bid installation to comply with their requirements.

E. MATERIALS OF APPROVED EQUAL

(1) Where items of equipment and/or materials are specifically identified herein by a manufacturer's name, model or catalog number, any such specific items may be used in the base bid, except as hereinafter provided.

(2) Unless requests for changes in base bid specifications are received and approved and noted by written addendum prior to the opening of bids, the successful contractor will be held to furnish specified items.

(3) After contract is awarded, changes in specifications shall be made only as defined under "Substitution of Equipment".

F. SUBSTITUTION OF EQUIPMENT

(1) After execution of the contract, substitution of equipment of makes other than those specifically named in the contract documents may be approved by the Engineer only if the equipment named in the specifications cannot be delivered to the job in time to complete the work in proper sequence to work of other contractors, due to conditions beyond control of the contractor.

(2) Requests for substitutions must be accompanied by documentary proof of equality of difference in price and delivery. If any, in form of certified quotations from suppliers of both specified and proposed equipment.

(3) The Owner shall receive all benefits of the difference in cost involved in any substitution, and the contract altered by change order to credit Owner with any savings so obtained.

G. SUBMITTALS

Contractor shall, within 15 days after award of contracts, begin sending to the General Contractor for review submittals containing the following:

(1) Shop Drawings:

a. Submit three master sets of "Shop Drawings" in the form of bond paper 8 1/2" x 11" or 11" x 17" size. Data shall be reduced on drawings as required to have a 7" x 9" clear on each drawing for engineer's stamp.

b. Architect and consultants will retain copies of the master set for their records and return one approved or disapproved master set to the contractor.

c. Contractor(s) shall, upon receipt of reviewed shop drawings, obtain and distribute copies of reviewed master set as necessary to coordinate work. (Contractor's file, job site file, record document file, other prime contractors, subcontractors and suppliers).

d. Shop Drawings are custom prepared data and shall show and identify item(s) to be furnished and give location, arrangement, scale, details, sizes, dimensions, performance characteristics, capacities, wiring diagrams, finish and other pertinent information. Each individual item shall have its own separate sheet provided for approval. (Example: Separate sheets for each panelboard.)

e. All shop drawings shall be checked and signed by the contractor and shall be submitted prior to submittal to the Architect/Engineer. "SHOP DRAWINGS SUBMITTED WITHOUT THE CONTRACTOR'S STAMP OF APPROVAL AND VERIFICATION WILL BE RETURNED BEFORE THE ENGINEER WILL REVIEW SAME. Equipment, materials, etc., not meeting specifications and/or drawing requirements shall be returned to the supplier for corrections before they are submitted to the Architect-Engineer. This Contractor is reminded that only those materials specified, approved or otherwise indicated by the project specifications, drawings, or addenda will be permitted to be used in constructing the electrical work for this project. The first review of submittals (shop drawings) will be provided as indicated at no charge to the Contractor. However, subsequent review(s) of resubmittals required by "Rejected" status from the original review will necessitate the Electrical Contractor being charged by the electrical consultant a fee of $65 per man-hour, with a minimum charge of $100 for each item resubmitted. It is intended that all electrical submittals be made in a complete and timely fashion such as to permit a comprehensive and thorough review of same.

f. Each shop drawing sheet shall indicate job name.

g. Shop drawings submitted without contractor's signature or approval and verification will not be reviewed.

h. Shop drawings shall be submitted on wire, devices,

fixtures (including distribution curves), gear, systems, conduit, etc.

(2) Product Data: Product Data includes manufacturer's printed specifications, instructions, recommendations, pertinent catalog pages and similar information. Such data shall be marked to identify the data applicable to the Project. Submit three copies. Architect and consultants will review, note and record action and make copies for their files. One submitted copy then will be returned to the Contractor who shall reproduce and distribute copies needed for Project Work.

(3) Quantities of materials will not be verified by the Architect or Engineer. Submittal Review stamp on shop drawings does not constitute review of quantities listed on shop drawings.

Engineer's review of Compliance Submittals will not relieve Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless Contractor, has in writing, called Engineer's attention to such deviation at the time of submission and Engineer has given written approval to the specific deviation, nor shall any review by Engineer relieve Contractor from responsibility for errors and/or omissions in Compliance Submittals. No work shall be fabricated until the contract review has been obtained. Any time delay caused by correcting and resubmitting shop drawings will be the responsibility of the Contractor.

H. Operating Instructions:

a. The Contractor shall submit along with the shop drawings of the equipment, three (3) copies of operating instructions for all items. Instructions shall be prepared by the manufacturer of the equipment.

b. After the operating instructions have been approved by the Engineer, the Contractor shall frame one (1) set under plastic and mount near the equipment described.

c. The Contractor shall also obtain all manufacturer's instruction manuals and provide one complete set of "as built" drawings and turn these over to the Architect upon completion of the project.

d. The Contractor shall keep in a safe place all keys and special wrenches furnished with equipment under this contract and shall give same to the Architect at the completion of the project.

e. The Contractor shall prepare a complete brochure, in triplicate, covering all systems and equipment furnished and installed under his contract. Brochures shall be submitted to the Architect-Engineer for review and delivery to the Owner. The cost of this brochure shall be included in the contract price. Each brochure shall contain the following:

1. Certified equipment drawings and/or catalog data clearly marked for equipment furnished as required for approval submission under previously detailed section of these specifications.

2. Complete operating and maintenance instructions for each item of equipment.

3. Complete parts list for each equipment item.

4. Any special emergency operating instructions and a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to the various parts of the system.

5. Wiring diagrams on special systems.

f. Brochures shall be bound in hard fiberboard covers or loose-leaved binders. If loose-leaf binding is used, each sheet shall be reinforced to prevent tearing from continued usage. Each brochure shall have the following information clearly printed on its front cover:

1. Project name and address.
2. Section of work covered: "Electrical Work".
3. Name and address of Architect.
4. Name and address of Engineer.
5. Name and address of Contractor.
6. Telephone number of Contractor, including night or emergency number.

g. In addition to these written instructions, each respective Contractor shall fully and carefully instruct the Owner, or his representative, as to the proper operation, care and maintenance of each system and its equipment.

I. COORDINATION AND BUILDING CONDITIONS

(1) The Contractor shall visit the site and determine all existing local conditions affecting work to be contracted. He shall examine architectural drawings and specifications to familiarize himself with the type of construction to be used for all work and how it will affect the installation of work in his contract.

(2) Failure to determine existing conditions or the nature of existing or new construction will not be considered as a basis for the granting of additional compensation.

(3) The drawings have been prepared to cover all electrical work under this contract. The Contractor is referred to all other contract drawings to guide him in the proper installation of his work.

(4) The Contractor shall fully familiarize himself with the floor plans, elevations, details of construction, feeders, fixtures, conduit, wiring, service, etc., insofar as it may affect the installation of the work under this specification in order that all necessary materials and labor may be provided even though not specifically referred to on the drawings or called for in the specifications.

(5) As the drawings are generally diagrammatic, the final layout of the work shall be subject to the approval of the Architect but the Contractor shall be responsible without increase in contract price for the coordination of all work under various divisions of the specifications.

(6) This Contractor shall confer with other Contractors installing work which may affect his work and must arrange his conduit, etc., in proper relation to such work. Any damage resulting from his neglect to do so must be paid for by the contractor.

(7) Where necessary to fit and confer with paneling of ceilings and wall spaces, the Contractor must, at his own expense, shift the lighting outlets or other outlets as required by the Architect.

(8) All outlets shall be set in such a manner as to finish flush with wall and ceiling lines unless marked to be exposed or surface mounted. Verify all details of brackets, switches, outlets, etc., are to be as directed.

(9) The Contractor shall obtain from the Architectural and Structural drawings the location of all openings and supports available for his apparatus and material and shall install them accordingly. In case the opening provided is not sufficient, or an obstruction interferes with placing items as shown or specified, the Contractor shall obtain instructions from the Architect and shall install them as directed without extra charge.

(10) The above provisions refer only to the exactness of positions that cannot be determined from the drawings and do not permit placing another distinctly different from that shown on the drawings.

(11) This Contractor shall do all cutting and patching of building materials required for the installation of work herein specified. Holes shall be made in walls and floors only with the approval of the Architect and all such cutting shall be done in a manner directed by him.

(12) All patching shall be done in a neat and workman-like manner, meeting with the approval of the Architect, by mechanics of the particular trade involved. Any penetrations through roof shall be made with "Standard" flashing connections as manufactured by Thermoset Engineering and Manufacturing Co., Inglewood, Calif., and any penetrations made in exterior or interior fire resistive walls shall be sealed with Thunderline "Link-Seal" connections, as manufactured by Thunderline Corporation, Wayne, Illinois.

(13) All drilling of holes through concrete shall be accurately and carefully done by using a "Concrete Termite" drill. The use of a star drill or air hammer for this work shall not be permitted.

(14) This Contractor shall do all painting and finishing of all electrical equipment installed in finished areas. All work shall be performed in accordance with the Architectural specification section on "Painting and Finishing". All colors and finish applications will be as directed by the Architect. (Painting is not required of receptacles, switches, electric outlets, etc., unless specifically so noted on the plans.)

(15) The Electrical Contractor shall confirm the exact electrical requirements for all equipment supplied by others and installed or connected by the Electrical Contractor. The specific work performed in the installation of any equipment shall be in conformance with the requirements established by the shop drawings of the equipment supplied. In the event the shop drawings establish requirements distinctly different from the requirements shown in the contract documents, the Contractor shall be entitled only to an adjustment of the difference between the work shown and the work required with full credit for labor and materials shown on the original plans.

J. PERFORMANCE

(1) Provide as part of the work of this contract, in addition to the first year guarantee on equipment and materials, the labor described routine maintenance and inspection. (The one year time period will not start until each and every item is complete in accordance with plans and specifications and accepted by the Owner). Check all emergency systems, controls, fire alarm, transformers, etc., correct and adjust same. This service to be provided during the guarantee period.

K. SYSTEM

(1) System Distribution characteristics shall be as indicated on plans.

L. GROUNDING

(1) All conductors, motor frames, etc., that require grounding shall be grounded in accordance with the requirements of the National Electrical Code, local power company and local electrical codes. All ground connections to ground rods shall be with U.L. approved groundclamps. Provide additional ground rods as required to achieve a resistance of 25 ohms or less per N.E.C. 250-84, at the request of the Engineer provide a copy of the ground test results. Multiple grounds (when required) shall not be less than 6 feet apart.

M. ADJUSTING, ALIGNING AND TESTING

(1) All equipment shall be checked for proper adjustment and balance. All panelboards, distribution panels, switchboards, and transformers shall be balanced to provide a balanced load on each phase before the equipment is put into service. Final readings shall be submitted to the Architect/Engineer for records. The Contractor shall provide all equipment, instruments, gauges, meters, etc., as required for the complete checking of these systems.

(2) Mechanisms of all electrical equipment shall be checked, adjusted, and tested for proper operation. Adjustable parts of all lighting fixtures and other electrical equipment shall be checked, adjusted, and tested as required to produce the intended performance.

(3) Completed wiring system shall be free from open or shorted circuits. After completion, this Contractor shall perform insulation tests for insulation resistance in accordance with the requirements of the National Electrical Code.

(4) The Contractor shall maintain service and equipment for the testing of electrical equipment and apparatus until all work is completed and accepted by the Owner. A first class watmeter and ammeter shall be kept available at all times and this Contractor shall provide service for test readings when and as required. All test readings shall be recorded on an approved form and submitted to the Architect.

(5) Before final acceptance is made, this Contractor shall, at his own expense, frame under plastic the sequence of operations of the special systems (including jackets) or for each and every item requiring instructions. These instructions shall be mounted as directed. He shall cover same with Architect and/or his selected parties, and shall adjust and operate and place same in satisfactory operating service as approved by the Architect.

(6) Final observation will be made upon written request from the Contractor after the project is complete. At the time of final observation, the Contractor shall be present or shall be represented by a person of authority. The Contractor shall demonstrate, as directed by the Architect-Engineer, that he has fully complied with the purpose and intent of the plans and specifications. All labor, services, and all instruments or tools necessary for such demonstration and tests shall be provided by the Contractor.

N. MOTOR CONTROL AND SPECIAL CONNECTIONS

(1) The Electrical Contractor shall furnish, install and connect all wiring, conduit, fusing, starting switches, thermal switches, disconnect switches, remote pushbutton stations not included in arrangement specifications, etc., for all equipment requiring electrical power that is furnished by other contractors under this or other divisions on the drawings or listed below. The Electrical Contractor shall receive, install and connect all motors, starters and controllers, capacitors, power factor correction devices, transformers, alarms, bells, horns, relays, remote switches, etc. for equipment supplied by others. (i.e. starters, capacitors or power factor correction devices in mechanical equipment, etc.) In general all major equipment will be specified to be factory provided with only service and interlocking required at the site by the Electrical Contractor, however he shall check all equipment specifications and drawings to verify if the equipment is specified factory provided and if not, then it shall be his sole responsibility of the Electrical Contractor to provide the complete wiring of the equipment in accordance with wiring diagrams and temperature control drawings provided by the other contractors and/or the Owner, to the Electrical Contractor. All wiring/cabling of equipment shall be by the Electrical Contractor.

(2) All control equipment requiring piping connections to air, water, steam, etc., lines such as pneumatic electrical relays, remote bulb thermostats, controls, solenoid valves, aquastats, pressure control, etc., will be furnished and installed under "Mechanical Work".

(3) All line and low voltage wiring, conduit and connections required to control the equipment are a part of this section.

All low voltage connections and/or terminations are by the Mechanical Contractor.

(4) It shall be assumed the Contractor has familiarized himself with the equipment to be furnished by the other contractors and/or the Owner in connection with this work and that provisions for such connections and work have been included in the Contractor's bid. In no case will extra remuneration be allowed for such work.

O. GUARANTEE

(1) This Contractor, by the acceptance of this specification and the signing of his contract, acknowledges his acquaintance with the requirements and guarantees that every part used in constructing the system as herein described will be of the best of its respective kind that can be obtained and will be erected in a most thorough and substantial manner by none but experienced workmen.

(2) He guarantees that all conduit as provided within and by this specification will be free from all obstructions of every description and will be free from holes or broken places and be well bonded together, without exposed ends that will wing and conduit to be used in construction of this project will be new and unused.

(3) He further guarantees to hold himself responsible for any defects which may develop in any part of the entire system, including apparatus and appliances provided under this section of the specification, and to replace and make good without cost to the Owner any such faulty parts of construction which develop defects at any time within one year from date of final certificate of completion and acceptance. This guarantee does not include normal lamp failure.

P. SUPPLEMENTARY CONDITIONS

(1) Supplementary to all other terms of the contract, this work shall be performed subject to the following conditions.

(2) Materials and equipment installed on this project shall be first class in quality and shall be new in all respects.

(3) Workmanship on this project shall be first class work performed by the experienced licensed mechanics of the proper trade.

(4) Work under this contract shall be adequately protected at all times. Temporary pipe and conduit shall be kept closed and all pipe and conduit shall be installed clean and free from dirt and grease.

(5) Storage, parking, signs, advertisement, fires and smoking shall conform to all applicable regulations and/or ordinances.

(6) Measurements on job and shop layouts required for installation of work shall be the responsibility of the contractor and acceptance of work to be subject to approval of shop drawings by the Architect.

(7) Contractor shall furnish all hoists, scaffolds, staging, runways and equipment necessary for the completion of this work.

(8) Obtain and pay for all required electrical permits and licenses.

(9) Maintain lights and guards required for safety.

(10) Remove temporary service after use.

Q. CONTRACT CHANGES

(1) All changes or deviations from the contract, including those for extra or additional work, must be submitted in writing for the approval of the Architect/Engineer. No verbal orders will be recognized.

R. RUBBISH/CLEANUP

(1) All rubbish resulting from the work herein specified shall be periodically removed by this Contractor.

(2) Clean all electrical equipment and materials of all foreign matter (both inside and out). Clean all light fixtures using only methods and materials as recommended by the manufacturer.

S. PROPOSALS

(1) The Contractor shall consult the instructions to Bidders and the Proposal Form for proposals and sub-divisions of the work required.

T. EXTENT OF WORK

(1) The extent of the work under this heading of the contract shall be the furnishing of all plant, labor, materials, and equipment as required to complete work as shown on the drawings and as specified under this heading, and all plant, labor, materials, and equipment not shown on the drawings or specified, but necessary to make installation complete in accordance with the intent of the contract, to provide first class and complete installation throughout.

U. TAXES

(1) Contractor shall include all applicable local, state and federal taxes in his bid. Consult the Supplementary Conditions of these specifications relative to any and all tax exemptions permitted for this project.

V. "AS-BUILT DRAWINGS"

(1) E.C. shall prepare and submit to the Engineer, upon completion of this project, one complete set of reproducible "As-Built" drawings for the electrical portion of the project.

(2) Drawings shall clearly indicate any and all approved deviations (i.e. addendum items, change order data, etc.) from the original contract drawings.

(3) These drawings will become the property of the Owner and will be for his future reference.

DIVISION 16000 – ELECTRICAL

16020 – BASIC MATERIALS AND METHODS

A. CONDUIT

(1) Materials:

a. Rigid conduit (G.R.S.) shall be standard size, hot dip galvanized steel conduit as manufactured by Triangle PWC, Inc. or equal. A "green" ground wire, sized per NEC 250-95, shall be installed in all conduits containing phase conductors.

b. E.M.T. tubing (thinwall conduit) shall be as manufactured by, or be equal to, Triangle PWC, Inc. with Thomas and Betts, Inc. listed steel set-screw type fittings. Die cast fittings and/or indenter type fittings shall not be used. A "green" ground wire, sized per NEC 250-95, shall be installed in all conduits containing phase conductors.

c. All conduit installed in wet locations or exposed exterior to the building, or subjected to physical abuse (i.e. industrial locations), shall be rigid steel conduit (G.R.S.) or intermediate metal conduit (I.M.C.).

d. Thin wall conduit may be used where code permits except as outlined above.

e. Short runs of galvanized or liquid tight flexible conduit may be used when approved by the Engineer. A separate "green" ground conductor (sized per N.E.C.) shall be installed in all flexible conduits.

f. U.L. approved schedule 40 P.V.C. conduit shall be used where feeders or branch circuits are to be run in earth or below slabs. Use G.R.S. ells and risers, both horizontal and vertical. Use conduit adapters when converting from P.V.C. to steel conduit. Brands: conduit P.V.C. conduit to be 3/4" min. Concrete encase all conduit installed below grade where so noted on the plans. (U.L. approved schedule 40 P.V.C. with plastic spacers). All P.V.C. conduit shall be provided with a separate "green" ground conductor, sized per N.E.C.

(2) Bushings and Locknuts:

a. Where conduits enter boxes, they shall be rigidly clamped to the box by double locknuts and bushings. Conduit shall enter the box squarely. Bushings and locknuts shall be made of malleable iron and shall have sharp clean-cut threads.

(3) Conduit Installation:

a. Where conduit sizes are not specifically indicated, provide sizes in accordance with the requirements of the N.E.C.

b. Conduit work in general shall be installed concealed in walls, floor and roof construction or concealed within furred spaces. Exposed work shall include only feeders and short connections to equipment in equipment room unless noted otherwise. All exposed conduits (where approved by the Engineer) shall be routed parallel and/or perpendicular to building elements.

c. Conduit to be installed to the requirements of structure and to the requirements of all other work on the project. Conduit shall be installed to clear all openings, depressions, pipes, ducts, reinforcing steel, etc. Conduit set in forms for concrete structure shall be installed in such a manner that installation will not affect the strength of the structure. Maximum size of conduit permitted in concrete slabs, if so approved by the Architect, is 1" trade size.

d. Conduit shall be installed continuous between connections to outlets and boxes and shall allow a minimum possible number of bends and not more than the equivalent of 4-90 degree bends between 2-box connections. Bends shall be smooth and even and shall be made without flattening conduit or flaking enamel. Radius of bends shall be as long as possible and never shorter than the corresponding trade above. Long radius elbows shall be used where necessary.

e. Conduits shall be securely fastened in place with approved straps, hangers, or clamps at least as required by the National Electrical Code. The use of wire, plumber's straps, etc. will not be permitted.

f. Junction and pull boxes shall be installed where shown on drawings and additional boxes shall be installed if required for pulling of wire, provided location and installation are approved by the Architect. All boxes shall be code gauge construction with screw covers in areas of walls or partitions shall be separated by a horizontal distance of not less than 24 inches. Installation shall be per UBC and fire stopping pads manufactured by International Protective Coating Corp. Outlet boxes larger than 4" square shall not be installed in fire rated walls or partitions. Verify location of fire rated walls or partitions with Architectural drawings prior to rough-in.

(13) Provide blank cover plates for all outlet boxes not used. Blank cover plates for junction boxes supplied from the emergency system shall be painted red.

D. INSTALLATION OF SWITCH PLATES, ESCUTCHEONS, ETC.

(1) It shall be the duty of this Contractor to examine the plaster, paneling and other finishes before making his installation to make sure that those accessories, when installed, will fit properly and will not leave an open or unfinished surface showing. He shall refuse to complete his installation when faulty work on the part of others is found, and he shall promptly report the trouble to the Architect.

E. SUPPORTS AND HANGERS

(1) Provide supports and hangers as necessary and as required to insure a good and substantial installation. Support channels, conduit clamps, conduit clamps, etc., an approved type of trapeze hangers or wall brackets as manufactured by Unistrut, or Stirkley. Provide steel hanger rods securely fastened to an approved building structure for all trapeze hangers. Do not suspend from mechanical piping or ductwork. Perforated plumber's straps or wire will not be permitted.

F. JUNCTION, PULL AND SUPPORT BOXES

(1) Pull and junction boxes shall be code gauge galvanized steel boxes with screwed covers. Recessed covers. Boxes shall be flush or surface mounted as shown or required by N.E.C. and job conditions. Install in accessible locations.

G. PAINTING AND FINISHES

(1) Preparation of the material and the materials used for priming and finish painting shall be in accordance with the "Painting" section. Priming shall be performed under "Painting" section. Priming shall be performed under this section. (Galvanized, cadmium, zinc, phosphate or chromate coated shall be the work of this section and materials and workmanship shall be as specified in "Painting" section.

H. NAMEPLATES

(1) General: The following shall be equipped with nameplates:

a. Disconnect Switches (fused or nonfused), switchboards, panelboards, separately mounted circuit breakers, contactors, motor starters and relays.

b. Special Electrical Systems (fire alarm, sound system, etc.) shall be so identified in junction and pull boxes, terminal cabinets and equipment racks.

c. Wall switches or other control devices controlling equipment or special lighting control configurations.

(2) Inscription: Nameplates shall adequately describe the function or use of the particular equipment involved. Nameplates for panelboards and switchboards shall include the panel designation, voltage, phase and A.I.C. rating required (See Schedules). For example, "Panel – A", 120/208 V, 3-Phase, 4-wire, 10,000 A.I.C. The name used for a machine's nameplate shall be the same as the one used on the machine's motor starter, disconnect and P.B. station nameplates. Nameplates for fused switches and panels shall also indicate fuse type and size.

(3) Construction: Nameplates shall be laminated phenolic plastic, black front and black with white core. Nameplates for emergency power circuits shall be black with plastic shall be red front and back with white core letters. Lettering shall be engraved through first layer to form 1/4" minimum characters (1" white letters for distribution panels and switchboards). Provide a minimum label size of 1" letters. Nameplates shall be securely fastened to the equipment to be identified, with double sided adhesive. Isolated type Motor nameplates may be non-ferrous metal not less than 0.03" thick, die stamped. In lieu of plastic nameplates, engraving directly on device plates is acceptable. Letters engraved thus, shall be filled with contrasting enamel. All nameplates and their installation are part of this work. Use hand lettering or adhesive tape type label markers will not be accepted.

I. WALL SWITCHES

(1) Wall switches in general, used to control lighting, shall be quiet operating, AC only, rated for operation to NEMA standards as well as the latest Federal Specification W-S-896d. Specification grade shall meet the specification shall be submitted to the Engineer for approval.

(2) Switches shall be single pole, two-pole, three-way, or four-way, as shown on the drawings. Four-way wall switches shall be under one gangplate. Where switches are in fire rated walls groups of switches shall be maximum of 2 gangs under one cover plate.

(3) All Switches shall be rated 20 A. at 125 V. – 277 V. unless specified otherwise.

(4) Manuf: P & S Hubbell Leviton G.E. Bryant

Toggle	20AC1	1220	1220	GE 5950	4901
Series	series	series	series	series	series
Key	20AC1-L	1220-L	1221-L	GE 5950-	4090T-
Switches:	series	series	series	OLD series	SL series
Pilot	20AC1-ORL	1220-PILOT	1221-PILOT	1221-SG	4090T-PLR
Switches:	series	series	series	series	series

(5) Pilot light switches shall be illuminated toggle switch lighted red in the "on" position. Key switches shall be master keyed.

(6) All switches shall have High-Impact Thermoplastic, smooth surface, wall plates. Where plates are to be engraved, provide stainless steel wall plates. Plates shall be flush and parallel with the wall.

(7) Color of switches and plates shall be as selected by the Architect. Verify colors prior to ordering.

(8) Provide barriers between 277V. switches and between 277V. and 120V. switches installed in a common outlet box.

(9) Incandescent wall box dimmers shall be linear slide type with smooth face plates, no exposed cooling fins, equal to Lutron NT-600, NT-1000, or NT-1500 for loads to 1500W. For loads 1500W. Lutron NT-2000. Verify color of face plate and dimmer with Architect prior to ordering.

J. RECEPTACLES

(1) Convenience duplex receptacles shall be grounded twin outlet receptacles rated 20 amperes at 125 volts.

(2) Provide sizes in accordance with the drawings as "Hot" (weatherproof), they shall be G.F.C.I. duplex receptacles, with a Nylon industrial grade rainlight single lift coverplate.

(3) See plans for special outlet schedule.

(4) Receptacle body shall be formed of high-impact thermoplastic or urea and receptacle contacts shall be Bronze. Certification that receptacle meets or exceeds N.E.M.A. Standards shall be submitted to the Engineer for approval.

(5) Surge suppression duplex receptacles shall be 20A, 125V., NEMA 5-20R devices. Receptacles shall have a red, device verification light which is illuminated when the suppression circuit is functional. The receptacle shall meet or exceed UL Standards 1449 and 498 and be capable of suppressing 70 joules of transient energy. Receptacles shall be P & S #6362-15P or Wiremold #5371D-V.

(6) Manufacturer: P & S Hubbell Leviton G.E. Bryant

Duplex Receptacle: (20A, 125V.)	5362	5362	5362	GE 5362	5362
Duplex Receptacle: (GFCI, 20A, 125V)	2091S	GF 5362	6898-HG	GF5342	GFR-83
Duplex Receptacle: (Isolated ground)	IG6300	IG5362	5362-IG	5362-IG	5362-IG
Clock Receptacle: (15A., 125V.)	53733-SS	5235	5261-CH	GE4224-S	2828-OS

(7) Install receptacles to clear all cabinets, equipment, etc.

(8) All receptacles shall have High-Impact Thermoplastic, smooth surface, wall plates. Where plates are to be engraved, provide stainless steel wall plates. Plates shall be set plumb and parallel with the wall.

(9) Color of receptacles and plates as selected by the Architect. Verify color prior to ordering.

(10) Provide duplex receptacle on separate circuit beside each television terminal location and other communications equipment requiring 120 volt power.

K. FLOOR BOXES

(1) Flush floor boxes shall be equal to Steel City #600 Series floor box with P-90-OS cover plate for power and P-60-T/2-2 for telephone outlets. Provide with carpet flange for floors with carpet. Verify exact location with Architect prior to rough-in.

(4) If layout changes are required due to other electrical manufacturers equipment, the final location and other communications equipment requiring 120 volt power.

(5) Equipment layouts on the drawings are based upon one manufacturer. Verify actual equipment sizes with equipment manufacturer prior to bidding.

(6) If layout changes are required due to other electrical manufacturers equipment size, they must be submitted to and approved by the Engineer prior to bidding. National Electric Code wiring clearances must be maintained at all times. In no case will extra remuneration be allowed for layout changes that differ from those shown.

(7) Shop drawings shall be furnished for all distribution equipment indicating the following information:

a. Switchboard voltage/current rating.
b. Overall dimensions including weight, available conduit space.
c. Switching and protective device ampere ratings.
d. Bus ratings and material.
e. One line diagram.
f. Integrated short circuit rating.

Adequate conduit space shall be provided to meet the requirements established on the drawings.

C. BRANCH CIRCUIT PANELBOARDS

(1) General:

(a) All panels shall be provided with key locking door.

(b) Panels shall have concealed trim clamps, doors with concealed hinges, and flush lock, master keyed. Where multi-section panelboards are indicated on the drawings, panel enclosures and covers shall be of the same size for each section.

(c) Key all doors alike and furnish two (2) keys for each lock. Provide over 48" high and double doors shall have 3-point latching per U.L. 50. Consult drawings for flush or surface mounting.

(d) Provide wire troughs with 2 gal. AWG & 1 gal. AWG copper ground wire, sized per N.E.C. 250-95 and/or as shown on the plans, shall be installed in each conduit containing phase conductors.

(8) Where quantities of conductors in a raceway system are not specifically indicated, provide the number as required to maintain function, control and number of circuits as indicated.

(9) All conductors shall be identified at all termination points and in all pull and junction boxes by the following method of color coding.

208Y/120 volt system	480Y/277 volt system	480Y/277 volt system
Phase A Black	Phase A Black	Phase A Brown
Phase B Red	Phase B Red	Phase B Orange
Phase C Blue	Phase C Blue	Phase C Yellow
Neutral White	Neutral White	Neutral Gray
Ground Green	Ground Green	Ground Green

*Note: Identify "hot leg" per N.E.C.)

All conductors size #8 AWG and smaller shall have colored insulation. Where conductors with black insulation are used for the larger sizes (#6 AWG or larger), color coding shall be provided with tape (2) layers, one-half lapped, of No.35 colored Scotch Vinyl electrical tape. Where any conductor is a run to the emergency system the Contractor shall mark such conductor with an additional two layers, one-half lapped, of Purple colored Scotch Vinyl Electrical tape.

(10) Provide a listing of the above described conductor color code identification scheme at all branch circuit panelboards per Article 210-4(d), National Electrical Code.

(11) Splices and taps for #8 and larger conductors shall be made with black type terminations (with insulating jacket) or with split bolt connectors, covered and completely insulated with a minimum of three half-lapped layers of Scotch No. 33+ (105 degree C) plastic electrical tape or by approved insulated fastener. All splices and tape holding irregular surfaces shall be properly padded with Scotch-fil putty before application of insulating plastic tape. Solderless electrical pre-insulated spring pressure connectors or equal may be used for up to #8 conductors.

C. OUTLET BOXES

(1) All electrical service outlets, including plug receptacles, lighting outlets, lighting fixtures and switches shall be provided with 4" square, code gauge steel knockout boxes, galvanized or sherardized and of required depth for service and application. Boxes installed in gyp board or plaster finish shall have code gauge galvanized raised covers set to not more than 1/4" behind the finish. Covers shall be selected with proper openings for devices installed in box. Manufacturers shall be Steel City, Appleton, RACO or equals approved by the Engineer.

(2) Sectional boxes shall not be used except where directed and approved by the Architect. Installation in Sectionalized tile walls and provided conduit connections are installed concealed in walls.

(3) Where lighting fixtures and appliance outlets are to be mounted on concrete or on plaster finish on concrete, outlet boxes shall be provided in forms of sectional dimensions from bench marks, columns, walls or floors. Where lighting fixtures and appliance outlets are to be mounted on masonry walls and/or plastered furring or other finish, outlet boxes shall be roughed in to general locations before installation of walls and furring and shall be reset to exact dimensions before walls and furring are completed. All outlet boxes shall be set true to horizontal and vertical lines parallel to walls, floors, and ceilings and be true to finish lines.

(4) Install all outlets in a secure and substantial manner and locate so as to be compatible with space, construction and equipment requirements and with the work of the other trades.

(5) Furnish and install plaster rings for all boxes installed in plastered (or gyp board) ceilings and walls. Verify construction with general construction plans.

(6) Boxes for exposed work (where permitted or approved) shall be Appleton or Crouse-Hinds Type FS or FSC for shallow devices and Type FD or FDC for deep devices. Boxes for ceiling mounted light fixtures shall have approved non-bolt fixture studs. Boxes used as junction boxes shall have beveled edge flat steel blank covers.

(7) Location of outlets on small drawings is approximate and exact dimensions for location of outlets shall be as taken from large scale plans and details on drawings or as directed by the Architect. Outlets shall be located generally from column centers and finished wall lines or to center of joints of wall panels. Ceiling outlets shall be installed at elevation of suspended ceilings and connected to outlets in ceiling or side above.

(8) Clock outlets shall be mounted 8'-0" above floor unless otherwise noted on the drawings. All other outlets shall be mounted at height as shown on the drawings or as directed. Bracket lights over mirrors shall be centered on mirror with fixture 2'-0" above top.

(9) Boxes for switches and receptacles installed in columns shall be located off center to allow for future partitions.

(10) Boxes for switches at or near doors shall be installed on the side opposite the hinge. Verify door swing direction prior to rough-in.

(11) Rough-in outlets for electric water coolers so as to be concealed behind cooler. Verify exact location schedulable in accordance with recommendation of equipment supplier.

(12) To prevent sound from traveling through wal