DIVISION 16 ELECTRICAL

SECTION 16010

GENERAL REQUIREMENTS

PART 1 – GENERAL EXTENT OF WORK

1.01 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 drawings 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.

1.02 The Contractor shall consult and be guided by the General Conditions and all other divisions referred to herein and relative thereto in performing the work covered under this division of the specification.

1.03 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.

1.04 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 outlet, apparatus or equipment to avoid possible interference and permit full coordination of all work. The right to make any reasonable change in the location of apparatus, outlets or equipment up to the time of roughing-in is reserved by the Architect without involving any additional expense to the Owner.

1.05 The approval by the Architect or his representative of any materials, drawings, etc., submitted by the Contractor will be considered as general and only 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.

1.06 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.

1.07 The entire installation shall be made in a workman like manner, left completely connected, and ready to give proper and continuous service.

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

1.09 The complete installation shall be in accordance with the latest rules and regulations of the National Fire Protection Association 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.

1.10 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 construction, workmanship and materials are concerned, be in full accordance with the standard practice and rules and regulations of the local utility company.

1.11 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 all construction work to proceed in its natural sequence without unnecessary delay.

1.12 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. Otherwise, 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.

1.13 Unless noted otherwise on the Drawings, or elsewhere in these Specifications, the singular words 'Provide', 'Furnish', or 'Install' noted on the drawings or in these Specifications shall mean to completely furnish, install, and connect each item, and if such is a part or component of a system the entire system shall be functional with all items and components provided.

PART 2 – RULES AND REGULATIONS

2.01 All work under this heading shall comply with the latest rules and regulations of the National Electrical Code Standard of the National Fire Protection Association and with all laws, regulations and ordinances of the utility company, City, County and State.

2.02 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.

2.03 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 Underwriters Laboratories, Inc., indicating compliance with nationally recognized standards and/or tests.

PART 3 – PERMITS, FEES AND INSPECTIONS

3.01 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.

PART 4 – SERVICES

4.01 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.

4.02 This Contractor 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 drawings. All temporary wiring shall be installed per the National Electrical Code. This shall include guard posts around transformers and pedestals per utility company standards. Verify complete installation and locations of pad mount or pole mount transformers with the local electric utility company and bid installation to comply with their requirements.

4.03 This Contractor shall consult all local departments to verify requirements and bid installation of service in accordance with local codes and utility company standards.

4.04 This Contractor 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.

PART 5 – NOT USED

PART 6 – MATERIALS OF APPROVED EQUAL

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

6.02 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.

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

PART 7 – SUBSTITUTION OF EQUIPMENT

7.01 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 requirements set forth in the specifications cannot be delivered to the job in time to completethe work in proper sequence to work of other contractors, due to conditions beyond control of the contractor.

7.02 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.

7.03 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.

PART 8 – SUBMITTALS

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

8.02 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 leave 5" x 3" 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 reviewed 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 this contractor and General Contractor 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 signatures 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.

8.03 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.

8.04 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.

8.05 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 Architect's review has been obtained. Any time delay caused by correcting and resubmitting shop drawings will be the responsibility of the Contractor.

PART 9 – OPERATING INSTRUCTIONS:

9.01 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.

9.02 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.

9.03 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.

9.04 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.

9.05 The Contractor shall prepare (5) complete brochures covering all systems and equipment furnished and installed under his contract. Brochures shall be submitted to the Architect–Engineer for review prior to delivery to the Owner. The Engineer will retain (1) copy. The cost of these brochures shall be included in the contract cost. Brochures shall contain the following:

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

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

C. Complete parts list for each equipment item.

D. 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.

E. Riser diagrams on special systems.

9.06 Brochures shall be bound in hard fiberboard covers or loose-leaf 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:

A. Project name and address.

B. Section of work covered "Electrical Work".

C. Name and address of Architect.

D. Name and address of Engineer.

E. Name and address of Contractor.

F. Telephone number of Contractor, including night or emergency number.

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

PART 10 – COORDINATION AND BUILDING CONDITIONS

10.01 The Contractor shall visit the site and determine all existing local conditions affecting work in his contract. 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.

10.02 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.

10.03 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.

10.04 The Contractor shall fully familiarize himself with the floor drawings, 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.

10.05 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.

10.06 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.

PART 11 – PERFORMANCE

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

PART 12 – SYSTEM

12.01 System Distribution characteristics shall be as indicated on drawings.

PART 13 – GROUNDING

13.01 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 ground clamps. 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 ground rods (when required) shall not be less than 6 feet apart.

PART 14 – ADJUSTING, ALIGNING AND TESTING

14.01 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. A complete record of all such adjustments shall be made. 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.

14.02 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.

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

14.04 The Contractor shall maintain service and equipment for the testing of electrical equipment and apparatus until all work is approved and accepted by the Owner. A first class voltmeter 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.

14.05 Before final acceptance is made, this Contractor shall, at his own expense, frame under plastic the sequence of operations of the sound system, controls, fire alarm, etc., for each and every item requiring such functions. These instructions shall be mounted as directed. He shall cover same with Architect and/or his selected parties, and shall adjust all apparatus and place same in satisfactory operating service as approved by the Architect.

14.06 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 his work fully complies with the purpose and intent of the drawings and specifications. All labor, services, and all instruments or tools necessary for such demonstration and tests shall be provided by the Contractor.

PART 15 – NOT USED

PART 16 – GUARANTEE

16.01 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.

16.02 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. He guarantees that all wiring and conduit to be used in construction of this project will be new and unused.

16.03He 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 certification of completion and acceptance. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to the Page 16010-Owner's satisfaction, advise Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Architect will then suggest course of action. The Electrical Contractor shall replace material and equipment that requires excessive service during guarantee period and as directed by the Architect. This guarantee does not include ordinary lamp failure.

16.04 Use of systems provided under the Specification for temporary services and facilities shall not constitute Final Acceptance of the work nor beneficial use by the Owner, and shall not institute guarantee period.

PART 17 – SUPPLEMENTARY CONDITIONS

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

17.02 Materials and equipment installed on this project shall be first class in quality and shall be new and unused.

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

17.04 Work under this contract shall be adequately protected at all times. Temporary raceways shall be kept closed and all raceways shall be installed clean and free from dirt and grease.

17.05 Storage, parking, signs, advertisement, fires and smoking shall conform to all applicable regulations and/or directions of the Architect.

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

17.07 Contractor shall furnish all holes, scaffolds, staging, runways and equipment necessary for the completion of this work.

17.08 Obtain and pay for all required electrical permits and licenses.

17.09 Maintain lights and guards required for safety.

17.10 Remove temporary service after use.

PART 18 – CONTRACT CHANGES

18.01 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.

PART 19 – RUBBISH/CLEANUP

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

19.02 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.

PART 20 – PROPOSALS

20.01 The Contractor shall consult the General Conditions and the Proposal Form for proposals and subdivisions of the work required.

PART 21 – EXTENT OF WORK

21.01 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, complete, and operative installation throughout.

PART 22 – TAXES

22.01 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.

PART 23 – "AS–BUILT DRAWINGS"

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

23.02 Drawings shall clearly indicate any and all approved deviations (i.e. addendum items, change order data, etc.) from the Project Bid Documents.

23.03 These drawings will become the property of the Owner and will be for his future reference file, record document.

DIVISION 16 ELECTRICAL

SECTION 16020

BASIC MATERIALS AND METHODS

PART 1 – CONDUIT

1.01 Materials:

A. All conduits and raceways shall be as listed below. No other wiring or raceway systems will be allowed.

B. Rigid conduit (G.R.S.) and intermediate metal conduits (IMC) shall be standard size, hot dip galvanized steel conduit, minimum 1/2" trade size, as manufactured by Triangle PNC, Inc., Allied, or equal. Rigid conduit and IMC shall be provided with threaded fittings and couplings. In trade sizes 2–1/2" to 4", contractor may use Allied 'KwikCouple' fittings in lieu of individual steel couplings. Where 'KwikCouple' fittings are used exterior for vertical risers, install fitting with taper end up. A "green" ground wire, sized per NEC 250–95, shall be installed in all conduits containing phase conductors.

C. E.M.T. (thinwall conduit) shall be minimum 1/2" trade size, as manufactured by Triangle PNC, Inc., Allied, or equal. Provide EMT with Thomas and Betts, or equal, U.L. listed steel or die–cast type fittings. Indenter type fittings shall not be used. Contractor may use Allied 'Kwik–Fit' fittings in lieu of individual fittings. A "green" ground wire, sized per NEC 250–95, shall be installed in all conduits containing phase conductors. E.M.T. conduit shall not be installed in earth or below grade.

D. All conduit installed in wet locations, 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.). All conduit installed in earth or below grade shall be rigid steel conduit (G.R.S.), intermediate metal conduit (I.M.C.), or U.L. approved schedule 40 P.V.C. conduit.

E. Thin wall conduit (E.M.T.) may be used where code permits except as outlined above.

F. Short runs of galvanized or liquid tight steel flexible conduit may be used when approved by the Engineer. (Minimum 1/2" trade size.) A separate "green" ground conductor (sized per N.E.C.) shall be installed in all flexible conduits. Type AC "Armored Cable", Type MC "Metal–clad Cable", or "Zip" cable shall not be used in any manor unless supplied as part of a manufactured flexible wiring system for lighting and approved by the Engineer.

G. U.L. approved schedule 40 P.V.C. conduit may only be used where conduits are to be run in earth or below slabs. P.V.C. conduits shall not be used above grade inside or outside of the building, unless specifically noted otherwise on the drawings. Use G.R.S. ells and risers, both horizontal and vertical. Use conduit adapters when converting from P.V.C. to steel conduit. Branch circuit and feeder P.V.C. conduit to be 3/4" min. Concrete encase all conduit installed below grade where so noted on the drawings. (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.

1.02 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.

1.03 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. Coordinate installation with Structural Engineer for conduits rising up from floor slabs into bottom of panelboards. Minimum distance between conduits shall be 6". 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, boxes and cabinets with a minimum possible number of bends and not more than the equivalent of 4–90 degree bends between J–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 elbow. Long radius elbows shall be used where necessary.

E. Conduits shall be securely fastened in place with approved straps, hangers, and steel supports as required by the National Electrical Code. All surface mounted conduits on walls below eight foot above grade shall be secured with conduit straps, no clamps. The use of wire, plumbers 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 is approved by the Architect. All boxes shall be code gauge construction with screw type covers and shall be installed in accessible locations.

G. Conduit shall be reamed and thoroughly cleaned before installation and kept clean after installation. Openings shall be plugged and boxes shall be covered or required to keep conduit clean during construction. All conduit shall be flished clear of obstructions before the pulling of wires. All conduit shall be as sized above and shall not be smaller than N.E.C. listed minimum requirements.

H. All work shall be protected against damage during construction and any work damaged or moved out of line after roughing–in shall be repaired and reset to the approval of the Architect without additional cost to the Owner.

I. Conduit terminations at panelboards, switchboards, motor control equipment, junction boxes, etc., shall be aligned and installed true and plumb. Wood or steel backs or templates shall be used where required. This work shall also include all steel supports as required for mounting of electrical equipment excepting where steel supports are specified to be furnished under another specification heading.

J. Where conduits cross construction expansion joints, Contractor shall provide Appleton XJ or equal expansion couplings with copper bonding jumpers.

K. Where conduits are installed in concrete, all connectors and couplings shall be water tight or rated for direct burial in concrete.

L. Mechanical equipment service clearances and electrical apparatus service clearances as specified in their respective manufacturer's product data shall be maintained free from conduit obstructions.

M. All conduits routed below grade shall be minimum 30" below grade unless noted otherwise on the drawings. All conduits routed below floor slabs shall be installed a minimum of 4" below the slab.

PART 2 – WIRES AND WIRING

2.01 American, Southwire, Essex, or equal code gauge wire, rated 600V, finished with fadeless color coding and bearing Underwriters' label. Wire shall be soft annealed copper with properties conforming to the National Electrical Code requirements. No. 8 gauge and larger shall be stranded and No. 10 gauge and smaller may be solid or stranded, unless noted otherwise on the drawings. Stranded conductors shall only be used on devices and circuits that are U.L. listed for use with stranded conductors.

2.02 Wire smaller than No. 12 gauge shall not be used unless specifically called for on the drawings.

2.03 Unless noted otherwise on the Electrical drawings or herein, all wiring for all systems shall be routed within conduit, shall be of the same insulation type and shall be continuous between outlets and boxes (with no splices or taps into conduit). Splices and taps in outlet boxes shall be twisted joints. U.L. approved pre–insulated spring pressure connectors shall be used for branch circuit connections. Connectors shall be installed so that all conductors are properly insulated.

2.04 All control wiring shall be copper, solid or stranded, #14 Ga. or larger depending upon current requirements, with insulation type for 90 C. rating. Where stranded conductors are used, provide with spade type insulated copper terminals. Unless noted otherwise on the Mechanical drawings or herein, all mechanical control wiring for all systems shall be routed within conduit, shall be of the same insulation type and shall be continuous between outlets and boxes (with no splices or taps into conduit).

2.05 See riser diagrams and/or other sections of the Specifications for types and ratings for sound, fire alarm, control and other special cables.

2.06 Wires for general use within the building shall be type THHN or type THWN, 90 degree rated except where called for otherwise on the drawings. Type THHN or type THWN shall be used at the temperature rating of equipment termination lugs, environmental conditions, and as Code allows. Wires for other than general use shall be as hereinafter specified for specific services.

2.07 A "green" insulated ground conductor, sized per N.E.C. 250–95 and/or as shown on the drawings, shall be installed in each conduit containing phase conductors.

2.08 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.

2.09 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	240/120 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 "high leg" per N.E.C.)

2.10 All conductors size #8 AWG and smaller shall have colored insulation. Where conductors with black insulation are used for the larger wire sizes (#4 AWG and larger), color coding shall be provided with two (2) layers, one–half lapped, of No.35 colored Scotch Vinyl electrical tape. Where any conductor is or can be supplied from an emergency system the Contractor shall mark each conductor with an additional two layers, one–half lapped, of Purple colored Scotch Vinyl Electrical tape.

2.11 Isolated Ground conductors shall be green with one yellow stripe. All isolated ground circuits shall be provided with separate phase, neutral, and ground conductors (no shared neutrals or grounds).

2.12 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.

2.13 Splices and taps for #6 and larger conductors shall be made with block 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 taps having irregular surfaces shall be properly padded with Scotchfil putty before application of insulating plastic tape. Scotchlok electrical pre–insulated spring pressure connectors or equal may be used for up to #8 conductors.

PART 3 – NOT USED

PART 4 – NOT USED

PART 5 – SUPPORTS AND HANGERS

5.01 Provide supports and hangers as necessary and as required to insure a good and substantial installation. Support raceways, fixtures, cabinets, boxes, etc., on approved type of trapeze hangers or wall brackets, as manufactured by Unistrut, Anvilstrut, Electric, Kline, Globe, or approved equal. Provide steel hanger rods securely fastened to or through the building structure for all trapezes, etc. Do not suspend from mechanical piping or ductwork. Perforated plumber's straps or wire will not be permitted.

PART 6 – JUNCTION, PULL AND SUPPORT BOXES

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

6.02 Conductors shall not be spliced within pull boxes.

PART 7 – NOT USED

PART 8 – NAMEPLATES AND IDENTIFICATION

8.01 General: The following shall be equipped with nameplates:

A. All distribution equipment (disconnect switches (fused or nonfused), switchboards, panelboards, transformers, motor control centers, separately mounted circuit breakers, contactors, motor starters and relays etc.).

8.02 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 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 motor controller shall be the same as the name 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.

8.03 Construction: Nameplates shall be laminated phenolic plastic, black front and black with white core. Nameplates for emergency system panelboards and transfer switches shall be red front and back with white core letters. Lettering shall be engraved through front layer to form 1/4" white characters (1/2" white letters for distribution panels and switchboards). Each switch label shall be 1/4" letters. Nameplates shall be securely fastened to the equipment to be identified, with double sided adhesive backed tape. Metal nameplates may be non–ferrous metal not less than 0.03" thick, die stamped. All nameplates and their installation are part of this work. Free hand lettering or adhesive tape type label markers will not be accepted.

8.04 Special Electrical Systems (fire alarm, sound system, emergency systems, etc.) shall be so identified at junction and pull boxes, terminal cabinets and equipment racks with a permanent, waterproof means of identification. (Example – FIRE ALARM). Free hand lettering or adhesive tape type label markers will not be accepted.

8.05 Wall switches or other control devices controlling equipment or special lighting control configurations shall have either engraved wall plates or shall be provided with engraved nameplates.

DIVISION 16 ELECTRICAL

SECTION 16030

SERVICE AND DISTRIBUTION

PART 1 – MAIN SERVICE

1.01 Primary: See the plans.

1.02 Secondary: See the plans. Voltage will be, 277/480–volt, 3–phase, 4–wire, WYE, 120/208–volt, 3–phase, 4–wire, WYE, 240–volt, 3–phase, 3 wire Delta, or 120/240–volt, 1–phase, 3 wire.

1.03 Consult power company for their requirements and for coordinating with their installation. Contractor shall provide any work thus required beyond that indicated by drawings and/or specifications and pay for costs incurred for Utility Company to install both temporary and permanent service to the project. Verify costs with Utility Company prior to bidding. Contractor shall provide guard posts around electrical transformers and electrical pedestals per Utility Company standards.

PART 2 – DISTRIBUTION EQUIPMENT

2.01 Part 2 applies to all distribution equipment supplied on the Project.

2.02 All electrical distribution equipment (switchboards, panelboards, disconnect switches, transformers, starters, etc.) shall be of one manufacturer, unless specifically noted on the drawings, in the specifications, or approved by the Engineer. Intermixing of distribution equipment by different manufacturers will not be permitted.

2.03 If shown on the plans, provide surge arrester for lightning protection on main service entrance. Refer to drawings for voltage and phasing of service. Arrester shall be located within, or adjacent to, the main switch enclosure as indicated on the plans.

2.04 Equipment layouts on the drawings are based upon one manufacturer. Verify all actual equipment sizes with equipment manufacturer prior to bidding.

2.05 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 working clearances must be maintained at all times. In no case will extra remuneration be allowed for layout changes that differ from those shown.

FHWA REGION NO.	STATE	PROJECT NUMBER	FISCAL YEAR	SHEET NUMBER	TOTAL SHEETS
X	KANSAS	X	X	X	X

2.06 Shop drawings shall be furnished for all distribution equipment indicating the following information:

A. Switchboard voltage/current rating.

B. Overall outline 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.

G. Coordination of any ground fault system settings shall be as per the manufacturers requirements.

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

2.07 All items of distribution equipment required to be floor mounted shall be mounted on a minimum 3 1/2" concrete base above floor. Concrete base to be by Electrical Contractor.

2.08 All phase and neutral busing and all ground bars in panelboards and switchboards shall be copper only. All lugs shall be AL/CU rated. All panelboards supplied by "K" factor transformers shall have 200% rated neutrals.

2.09 Panel schedules are not shown on the drawings, however, copies of these schedules are available to the Contractor after bids are let, upon request to the Engineer.

PART 3 – BRANCH CIRCUIT AND DISTRIBUTION PANELBOARDS

3.01 General:

A. All panels shall be provided with key locking door.

B. Panels shall have hinged covers with concealed trim clamps, doors shall have laser cut trim with concealed hinges, and flush lock, master keyed. Hinged cover shall have continuous piano hinge down one side with door opening by a single latch. 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. Doors over 48" high and double doors shall have 3–point latching per U.L. 50. Consult drawings for flush or surface mounting.

D. After wiring, label each circuit and provide under plastic in door of panel a typewritten schedule indicating load description of all circuits in panel. Mark spare breakers and provisions for future breakers in pencil on schedule for future circuit marking.

E. Breakers shall have individual plastic cases sized as scheduled on the plans. Two and three pole breakers shall have common trip (single pole units with tie bars are not acceptable). Main circuit breakers shall be vertically mounted. Back–let main circuit breakers above 100 amps will not be acceptable. Where spaces are noted in the panel summary, provide all necessary bussing, device support, and connections for future circuit breakers. Provide blank cover for all spaces.

F. All panelboards shall have copper ground buses installed and grounded per the requirements of the N.E.C. All panelboards serving devices having isolated ground circuits shall be provided with an additional insulated copper ground bus for connection of isolated ground conductors. All neutral and ground bars shall have a minimum number of lugs equal to 66% of number of pole spaces in panel. In computer rated or isolated ground panelboards, all neutral, ground and isolated ground bars shall have a minimum number of lugs equal to 100% of number of pole spaces in panel.

G. Where flush mounted panels occur on drawings Contractor shall stub into ceiling void for future use, (1) 1" empty conduit for every four spare 20A. breakers or unused panel spaces. On multi–story buildings, Contractor shall stub into ceiling void above panel and into ceiling void of floor below for future use, (1) 1" empty conduit for every four spare 20A. breakers or unused panel spaces. Conduits stubbed into ceiling void below panel shall be provided with conduit cap and labeled "To Panel Above".

H. All panelboards supplied from an emergency source shall have breakers provided with handle lock–offs for each breaker. Breaker handles to be set in the "ON" position.

I. All phase and neutral busing and all ground bars in branch circuit panelboards and circuit breaker distribution panelboards shall be copper only. All lugs shall be AL/CU rated. All panelboards supplied by "K" factor transformers shall have 200% rated neutrals.

3.02 Branch Circuit Panelboards:

A. Panelboards rated up to 240V (400A. max) shall have a short circuit current rating tested to U.L. Standards for a minimum rating of 10,000 A.I.C. unless noted otherwise. Breaker rating with–in panel shall be equal to or greater than minimum integrated equipment rating. Series ratings will not be accepted, unless specifically noted otherwise on the drawings. All breakers shall be of either the plug–in type or bolt–on type.

B. Panelboards rated over 240V and up to 480V (400A max) shall have a short circuit current rating tested to U.L. Standards for a minimum rating of 14,000 A.I.C. unless noted otherwise. Breaker rating with–in panel shall be equal to or greater than minimum integrated equipment rating. Series ratings will not be accepted, unless specifically noted otherwise on the drawings. All breakers shall be of the bolt–on type only.

C. Branch Circuit Breaker Panelboards:

Panel Rating Square D Siemens G.E. Cutler–Hammer

240V (400A max)	NQOD	SI/S3	AL	PRL1
480V (400A max)	NF	S2/S3	AE	PRL2

3.03 Circuit Breaker Distribution Panelboards:

A. Panelboards rated up to 240V (600A. and above) shall have a short circuit current rating tested to U.L. Standards for a minimum rating of 10,000 A.I.C. unless noted otherwise on the drawings. Brea