

SECTION 16010ELECTRICAL - GENERALPART 1 - GENERAL1.1 DESCRIPTION

- A. Provide all labor, materials, equipment, operations, methods and procedures as indicated in the Contract Documents, together with all items necessary for or incidental to the completion of the work.
- B. All systems or additions to existing systems indicated in the Contract Documents shall mean all necessary supervision, labor, equipment and materials required to provide complete, properly functioning systems.
- C. All systems shall be adjusted, tested, inspected and turned over to the Owner in perfect working order.
- D. The words "provide", "supply", "supply and install", "install", "furnish" or "furnish and install", as used in DIVISION 16 or as indicated on the Drawings related to DIVISION 16 shall mean a complete and properly functioning Electrical installation performed by the Contractor.
- E. References:
  - 1. Refer to Architectural, Structural, Heating and Ventilating, Plumbing, Process Piping and Instrumentation Drawings to coordinate material and equipment locations and electrical requirements.
  - 2. Applicable portions of DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS together with DIVISION 1 - "GENERAL REQUIREMENTS", are part of DIVISION 16.
  - 3. Refer to "SECTION 01630 - SUBSTITUTION AND PRODUCT OPTIONS", for work affecting DIVISION 16. Refer to SECTION 00100 - INSTRUCTIONS TO BIDDERS; SECTION 00700 - GENERAL CONDITIONS; SECTION 00800 - SUPPLEMENTARY CONDITIONS; and as specified herein regarding substitutions of materials and equipment.
- F. Work Specified Herein:
  - 1. Visit and examine the project site and become familiar with all existing conditions pertinent to the work to be performed thereon. No additional compensation will be allowed for failure to be so informed.
  - 2. The following scope of work is a brief generalization of the type and extent of the work specified under DIVISION 16. Detailed requirements are indicated on the Drawings and in related sections of the Specifications. The work specified under DIVISION 16 includes, but is not necessarily limited to the following:
    - a. Provide Electrical Distribution Systems as indicated on the "Single-Line Diagrams", related drawings and schedules, and as specified herein.
    - b. Provide complete lighting system(s), including all necessary fixtures, wiring, connections, controls and lamps.

- c. Provide complete branch circuit wiring systems including all raceways, conductors, cables, outlet and junction boxes, wiring devices and device connections.
  - d. Provide all required 480 Volt, 208 Volt and 120 Volt Power and Control wiring and connections and provide all required and supplemental motor starters and control systems for equipment specified under DIVISIONS 11, 13, 14 and 15 except as indicated on the Drawings. Starter sizes, protective device sizes, wire and conduit sizes, holding coil voltages and control voltages shall match the requirements of equipment, systems and devices specified under DIVISIONS 11, 13, 14 and 15. No additional compensation will be allowed for modifications required due to equipment and device sizes, ratings, etc. which differ from those of specified equipment.
  - e. Provide all required interconnecting conduit and wiring for Instrumentation and Control Systems and operations specified under DIVISION 13. Electrical subcontractor is responsible to review the Instrumentation Drawings and Specifications 13440, 13441 and 13442 to determine the instrumentation and control conduit and wiring requirements. Electrical subcontractor is responsible to implement conduit and wiring needs to match the functional descriptions in 13440.
  - f. Provide all required interconnecting conduit and wiring for HVAC, ATC Power and Control Systems and operations specified under Division 15. Electrical subcontractor is responsible to review the HVAC/ ATC Drawings and Specifications to Division 15 to determine the ATC control conduit and wiring requirements. Electrical subcontractor is responsible to implement conduit and wiring needs to match the functional descriptions in Division 15.
  - g. Coordinate the work of other trades which will affect the work under DIVISION 16 and direct such trades as required to accomplish all necessary cutting, patching, excavation, trenching, backfill, and concrete work necessary for the completion of the work under DIVISION 16.
3. Coordination with Division 15
- a. Provide all required interconnecting power and control [480V, 208V and 120V] conduit and wiring for HVAC Systems and operations specified under DIVISION 15. Electrical subcontractor is responsible to review the HVAC Drawings and Specifications to determine the power conduit and wiring requirements. Electrical subcontractor is responsible to implement conduit and wiring needs to match the functional descriptions in Div 15 except that specifically identified as provided by the HVAC subcontractor. HVAC subcontractor shall be responsible for all control [low voltage 24VDC / 24VAC] conduit and wiring. This shall include, but is not necessarily limited to, wiring for automatic temperature control, boiler and control wiring for plumbing systems. The HVAC subcontractor shall provide all miscellaneous 120VAC control from HVAC control

- panels to final control devices, as required, unless specifically included in Electrical work per the Drawings and Specifications. Provide safety disconnects and receptacles required by NEC.
4. Coordination with Division 13
    - a. Electrical subcontractor shall supply terminal connection diagrams to Division 13 instrumentation subcontractor pertaining to terminations in Motor Control Centers, local control stations, VFDs and all equipment supplied by electrical subcontractor.
    - b. Instrumentation supplier shall provide point to point wiring schematics to electrical subcontractor to allow completion of all instrumentation and control conduit and wiring between all devices, system control panels, and all equipment provided by instrumentation supplier and equipment provided by electrical subcontractor.
- G. Work Specified Elsewhere:
1. The materials and methods used for all Electrical Work indicated in the Contract Documents shall meet the requirements specified in Division 16.
  2. The following Electrical Work and Work relating to the Electrical Work will be performed under other Divisions of the Contract Documents:
    - a. Substitutions, product options, cleaning up and project record documents are specified in DIVISION 1.
    - b. Site work and excavation are specified in DIVISION 2.
    - c. Concrete Work DIVISION 3.
    - d. Metals are specified in DIVISION 5.
    - e. Painting is specified in Section 09900.
    - f. Mechanical equipment is specified in DIVISION 11 and/or DIVISION 15.
    - g. Special equipment systems and instrumentation is specified in DIVISION 13.
    - h. All interconnecting 24 volt control wiring required for the specified Heating and Ventilation systems, equipment and operations indicated under DIVISION 15 will be provided under DIVISION 15, unless specifically indicated on the Drawings related to DIVISION 16.
    - i. Firestops are specified in Section 07270.
- H. Removals, Relocations and Rearrangements:
1. Examine the existing site, structure(s) and installation(s) for the work of all trades which will influence the cost of the work under DIVISION 16. This work shall include removals, relocations and rearrangements relating to the work of all trades which may interfere with, disturb or complicate the performance of the work under DIVISION 16; and relating to the work involving systems, equipment and related service lines which shall continue to be utilized as part of the finished project.
  2. When the Contract Documents indicate elimination of, or structural changes in walls, floors, ceilings, enclosures, pipe chases, etc., remove, relocate, rearrange

and reconnect as required, all existing Electrical Work such that systems to remain shall continue to function properly.

3. Provide in the Base Bid a sufficient amount to include all removals, relocations, rearrangements and reconnections herein specified, necessary or required to provide approved operation and coordination of the combined new and existing systems and equipment.
- I. Codes and Fees:
1. Comply with the following codes, standards, regulations and specifications:
    - a. National Electrical Code (N.F.P.A. No. 70 - most recent edition)
    - b. Life Safety Code (N.F.P.A. No. 101 - most recent edition)
    - c. Occupational Safety and Health Act (O.S.H.A.) - regarding construction practices.
    - d. State and local electrical codes, building codes and fire codes for the locale where the work is to be performed.
  2. Compliance with the above codes, standards, etc., does not relieve the Contractor from the requirements of the Contract Documents which may exceed these codes, standards, etc. but which are not contrary to them.
  3. If it is observed that the Contract Documents are at variance with any of the above codes, standards, etc., promptly notify the Engineer in writing, and necessary changes shall be adjusted by appropriate modification. If any work is performed which is contrary to such codes, standards, etc., the Contractor shall assume full responsibility therefor and shall bear all costs in correcting such work in order to comply with such codes, standards, etc.
  4. Secure and pay for all permits, fees and licenses necessary for the proper execution of the work under DIVISION 16.
- J. Tests and Procedures Prior To Start-up:
1. All equipment shall be properly identified as indicated in this SECTION.
  2. All equipment and materials shall be clean, dry and free of foreign materials. All screw and bolt connections shall be checked for tightness.
  3. Conductor connections and terminations, and all bus bar connections shall be checked for proper tightness and continuity.
  4. Provide 1000 volt "Megger" insulation testing on all 600 volt feeder conductors and motor power conductors.
  5. Test the grounding system to assure continuity and to assure that resistance to ground does not exceed specified limits.
- K. Demonstration of Complete Electrical Systems
1. The Owner will assume no liability or responsibility for any portions of the installation under this Contract until they are demonstrated and accepted in writing. Final demonstrations shall be made only after the Engineer is satisfied that the work has been completed in accordance with the intent of the Contract Documents.
  2. After the Electrical system is completed, and when directed by the Engineer, demonstrate the total system operation and make final adjustments to the system. If any system or piece of equipment within a system fails to function

properly, rectify such defects or inadequacies and make a final demonstration as directed by the Engineer.

3. Provide the services of authorized manufacturers' representatives to instruct the Owner's representatives in the proper operation of each partial or complete system installed under this Contract.
4. Pay all charges or fees, including the cost of any special test equipment, factory engineers, etc. necessary for the proper performance of the specified tests, demonstrations and instructions.
5. All demonstrations and instructions referred to shall be scheduled at the convenience of the Engineer and the Owner and in no case shall be scheduled without at least seventy-two (72) hours written notice. Provide written certification by system and / or major equipment system along with industry acceptable test documentation that the electrical and instrumentation systems have been completely tested and are in proper operational working condition.

L. Identification:

1. All distribution equipment (distribution panelboards, transformers, disconnects, starters, control panels, etc.) shall have an engraved bakelite tag, mounted adjacent to the manufacturer's nameplate, indicating the equipment's designation and identification number per the Contract Documents.
2. All distribution panel overcurrent devices, individually mounted motor controllers, disconnect switches, control devices, etc., shall be provided with engraved bakelite tags indicating the equipment which they serve or control per the equipment designation and identification number indicated in the Contract Documents, and in accordance with OSHA requirements.
3. All branch circuit panelboards shall have, on the inner side of the door, an engraved bakelite tag with the identification number of that panelboard. Provide and mount under plastic in the directory frame at each panelboard, a neatly typewritten directory identifying the branch circuit overcurrent devices and the circuits, devices and areas which they serve.
4. All individually mounted panelboards, disconnects, motor controllers, etc. shall have a second engraved bakelite tag below the first one which identifies from where the equipment is receiving power. This second label shall be smaller in height.
5. Power conductors shall be continuously polarized and color coded throughout using the following scheme:
  - a. White or gray - All neutral conductors, 208/120V systems
  - b. White w/tracer of any color but Green - All neutral conductors, 480/277 volt systems
  - c. Green - All ground conductors
  - d. Phase Conductors -

208/120V	480V & 480/277V
<u>Systems</u>	<u>Systems</u>
Phase A - Black	Phase A - Yellow
Phase B - Red	Phase B - Brown

- Phase C - Blue                      Phase C - Orange
- e. For conductors No. 6 and smaller, color coding shall correspond to the color of the conductor insulation. For color coding of wire larger than No. 6, use self-adhesive, wrap-around type markers. These markers shall be used at all panelboards, junction boxes, disconnect switches, circuit breakers, etc.
  - 6. Control conductors shall be identified using numerical tags corresponding to conductor designations indicated on approved shop drawings of schematic diagrams, and as required for clarification of system and equipment connections. Conductors shall be clearly identified at each terminal block, equipment connection and junction. Tags and labels shall be pre-manufactured for intended purpose.
  - 7. Bakelite tags shall be nominal 1" x 4" with 3/8" white lettering on black background.
- M. All electrical equipment shall be suitable for the areas where mounted in accordance with Area Classifications indicated on Electrical Drawings. Contractor shall assure that the proper type, enclosure, mounting and catalog numbers are provided during the Submittal phase.

## 1.2 QUALITY ASSURANCE

- A. Supply all new materials, devices and equipment in conformance with:
  - 1. Underwriter's Laboratory, Inc.
  - 2. National Electrical Manufacturers Association.
  - 3. American National Standards Institute.
  - 4. National Electrical Code.
  - 5. OSHA
- B. All materials provided under this Contract shall be equal in quality, appearance and performance to that specified herein and shall be subject to the review of the Engineer. Verify the availability of all materials proposed to be used in the execution of the work prior to submitting same for the Engineer's review. The discontinuance of production of any material or product after the Engineer's review has been made shall not relieve the Contractor from furnishing an alternate of equal quality and design without additional cost.
- C. Materials and equipment furnished under this Contract shall be standard products of manufacturers regularly engaged in manufacture of such products and shall be manufacturer's latest standard design that complies with Specification requirements. Products shall essentially duplicate material and equipment that have been in satisfactory local use at least three years.
- D. The Contractor shall have supplied comparable systems to those specified herein and shall maintain engineering and service departments capable of designing and maintaining these systems. For a period of twelve (12) months from the date of acceptance of the work, provide all necessary supervision, labor, materials, and equipment, in order to correct any defects in any system due to faulty materials, equipment, installation methods, or workmanship and consequent damage resulting

from such defects. This work shall be scheduled during normal working hours and at the convenience of the Owner.

### 1.3 SUBMITTALS

#### A. Substitutions

1. Where new equipment is specified to be provided as part of an extension to an existing system, the manufacturer of that equipment shall match that of the original. Substitutions will not be considered as equal unless specifically noted so.
2. Certain new equipment and systems have been specified with one or more make(s) followed by the phrase "or equal". In such cases, the Contractor may submit a proposed substitution for review by the Engineer. The decision of equality of a proposed substitution rests fully with the Engineer.
3. Certain new equipment and systems have been specified with one or more make(s) WITHOUT the phrase "or equal". In such cases, only one of the manufactured products listed will be allowed.
4. Where substitutions are allowed as "equal" it shall be the Contractor's responsibility to make any and all necessary modifications required to accommodate the installation of the substituted item(s).

#### B. Shop Drawings and Samples:

1. Submit Shop Drawings in accordance with General Conditions and as indicated herein.
2. Shop Drawings shall be submitted on all items of equipment and systems as indicated in related sections of DIVISION 16.
3. Shop Drawings shall be thoroughly checked by the Contractor for compliance with the Contract Documents. Verify that all equipment and materials proposed to be furnished will fit into available space and maintain specified clearances, and that all equipment is compatible with the general building construction of the areas into which they are to be installed. The submittal of any Shop Drawing implies that the Contractor has reviewed this Shop Drawing and that the above requirements have been met.
4. Shop Drawings Shall Consist Of:
  - a. Project name and location.
  - b. Contractor's name.
  - c. Index Sheet - Listing the equipment being submitted utilizing equipment designations, or symbols, indicated on the Contract Documents together with the proposed manufacturer, style/ type and catalog number.
  - d. Manufacturer's scale or dimensioned drawings along with standard catalog "cut" sheets.
  - e. Equipment ratings, service clearances and configuration.
  - f. Listing of accessories to be furnished.
  - g. Single-line and schematic diagrams where applicable.
  - h. Refer to related sections of the specifications for special shop drawing requirements for individual equipment types.

5. Provide samples of such items as lighting fixtures and wiring devices upon request of the Engineer.
- C. Provide all certificates of inspection and approval from all regulatory agencies having jurisdiction over the Work under Division 16.
- D. Maintain properly documented and witnessed test and checkout reports and submit these to the Engineer prior to energizing the Electrical system.
- E. Upon completion of the Work and before request for final payment, deliver to the Engineer three (3) bound sets of full and complete directions pertaining to the operation and maintenance of all equipment and systems installed under this Contract. These directions shall be neatly bound, consist of typewritten on 8-1/2" x 11" sheets with index tabs, and shall be accompanied by plans, diagrams, etc. of the work installed, parts lists, etc. necessary for the guidance of the Owner in operating, altering or repairing the installation. In addition to the foregoing, furnish the Engineer a written statement from the Owner indicating that he is satisfied with the operating instructions given.
- F. Provide the Owner with a list of local service departments of duly authorized distributors of materials and equipment of the type installed, which will stock the manufacturer's standard parts, etc.
- G. At the completion of the installation, provide reproducible Record Drawings indicating the final configuration of all Electrical Systems as they were installed. Symbols, equipment designations, etc. shall be consistent with the Contract Documents. Provide exact locations of all work which has been concealed in concrete, masonry or underground.
- H. Contractor shall provide detailed instrumentation loop diagrams, control panel diagrams, and motor schematics indicating exact point to point wiring. The electrical contractor and instrumentation vendor shall prepare the diagrams jointly to allow full coordination.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Coordinate material and equipment delivery with the project schedule. Notify the Engineer immediately, in writing, if material or equipment delivery will adversely affect the project schedule, include documentation from equipment suppliers indicating the revised delivery dates and the reason for the delay.
- B. Exercise care during loading, transporting, unloading and handling of materials to prevent damage.
- C. Check for defective or damaged materials, and for incomplete equipment shipments within seven (7) days after equipment delivery to the project site.
- D. Store materials and equipment on the construction site in enclosures or under protective covering in order to assure that materials and equipment are kept undamaged, clean and dry.
- E. Replace or repair, to the satisfaction of the Engineer, all materials and equipment that are defective or that have been damaged during installation, at no additional cost to the Owner.

1.5 JOB CONDITIONS

- A. Temporary light & power.
  - 1. Coordinate temporary power usage with all other trades.
  - 2. The General Contractor shall provide all temporary power, and shall pay for all temporary power.
  - 3. Limit temporary service to 100 amperes, 120/240 volt, 1 phase, 3 wire.
  - 4. Limit power and hand tool usage to motors not exceeding 1/2 HP.
  - 5. Temporary power shall be separate from process power.
- B. Schedules:
  - 1. Cutting and Patching: Perform all cutting, patching, trenching, trench covers, plastering, chases, slots, furring, grounds, masonry foundations, piers, excavating, pole bases, backfilling, pads, and other work incidental to installation of apparatus as required for electrical work.

1.6 GUARANTEE

- A. Guarantee all equipment, materials and workmanship in accordance with the General Conditions of the Construction Contract and Section 11000.
- B. Warrant all material furnished and work executed is in accordance with all applicable laws and regulations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials shall be as specified in the appropriate Sections of DIVISION 16.
- B. Approval of materials shall be as indicated in this Section.

PART 3 - INSTALLATION

3.1 INSTALLATION

- A. Installation shall be as specified in the appropriate Sections of DIVISION 16.

3.2 TESTS

- A. Refer to paragraphs 1.IJ and 1.IK of this SECTION.
- B. Provide additional testing as indicated in the appropriate Sections of DIVISION 16.

3.3 CLEANING

- A. Do not allow refuse and surplus materials to accumulate on the project site during the course of the work.
- B. Upon completion of the work, remove all refuse and surplus materials and leave the premises neat and clean.
- C. Clean all equipment surfaces and touch up all damaged surfaces to the satisfaction of the Engineer.

- D. Clean all lighting fixture reflector assemblies, lenses, louvers and lamps upon completion of the installation.

END OF SECTION