SECTION 16010

ELECTRICAL GENERAL PROVISIONS

PART 1 GENERAL

1.1_ GENERAL CONDITIONS

A. The Instructions to Bidders, General Conditions, Special Conditions, Addendas, Alternates, these technical specifications and all drawings, together with the Form of Proposal and Agreement, comprise the Contract Documents for the Electrical Contract. The Electrical Contractor shall examine all of these documents prior to submitting his or her proposal.

B. The Contractor is required to read carefully the specifications for all parts of the work so as to become familiar not only with the work covered by this Section, but also that of other Divisions and Sections, including all drawings.

C. The Contractor shall watch the progress of the work and report to the Owner immediately any cases where ample space has not been provided to accommodate his work. He must not cut through any finished work until he has received permission from the Owner. No claims for extra work will be allowed because of misinterpretation of Plans and Specifications, or due to conflict between trades for useable space.

D. The Contractor is invited to submit alternative methods or materials as a cost reduction factor; however safety and integrity of the systems must be maintained. These alternative methods or materials are not to be implemented unless written permission is provided by the Owner.

E. The General Contractor shall be responsible for all work included in this section and the delegation of work to the Electrical Contractor, shall not relieve him of this responsibility. The Electrical Contractor and his subcontractors who perform work under this section shall be responsible to the General Contractor.

F. Before submitting bid, Contractor shall visit the site and examine all adjoining existing buildings, equipment and site conditions on which his work is in any way dependent for the best workmanship and operation according to the intent of specifications and drawings. He shall report to the Owner any condition which might prevent him from installing his equipment in the manner intended. No consideration or allowance will be granted for failure to visit site, or for any alleged misunderstanding of materials to be furnished, or work to be done.

1.2_ CONTENTS

A. Specified Herein: General requirements for electrical work.

B. Described herein are the following:
1. Scope.
2. Work not included.
3. Quality Assurance, Standards and Symbols.
4. Fees and Inspection Certificates.
5. Materials.
6. Submittals.
7. Substitutions.
8. Temporary Power and Light.
9. Electrical Drawings.
10. Coordination.
11. Equipment Identification and Marking.
12. Sleeves, Inserts, Fastenings, Supports, Cutting and Patching.
13. Scaffolding.
14. Trenching and Backfilling.
15. Testing, Adjusting, Cleaning.
16. As-Built Drawings.
17. Operation and Maintenance Manuals.

1.32_ CLEANING AND REPAIR

A. Clean and repair existing materials and equipment that remain or are to be reused.

B. Clean exposed panelboards surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

C. Remove all materials, scrap and debris relative to the electrical installation and leave the site and all equipment, lamps, fixtures, etc. in a clean and orderly condition. Any costs to the owner for clean-up of the site not provided by the contractor as defined in the drawings or specifications will be charged to the contractor.

1.4_ SCOPE

A. Any apparatus, appliance, material or work not shown on drawings but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be furnished, delivered and installed by the Contractor without additional expense to the Owner.

B. Minor details not usually shown or specified, but necessary for proper installation and operation, shall be included in the Contractor’s estimate, the same as if herein specified or shown. It is the intention of the Specifications and Drawings to call

for finished work, tested, and ready for operation.

C. With submission of bid, the Electrical Contractor shall give written notice to the Owner of any materials or apparatus believed inadequate or unsuitable, in violation of laws, ordinances, or rules; and any necessary items or work omitted. In the absence of such written notice, it is mutually agreed the Contractor has included the cost of all required items in his proposal, and that he will be responsible for the approved satisfactory functioning of the entire system without extra compensation.

D. Field coordination during construction is imperative. Contractors bidding this work must make reasonable allowances for unforeseen contingencies.

E. The work consists of the following:
1. Installation of pathway lighting.
2. Installation of Milbank panel, breakers, photocell and any associated equipment.
3. A complete conduit and raceway system, including rigid, thin-wall, flexible, sealtite and plastic conduits properly connected to the grounding system.
4. All power and control wiring including starters, switches, contactors, relays, fuses, etc., as shown on the plans or specified herein.
5. Cutting and patching of holes required for the installation in concrete, wood, steel or masonry.
6. Repair of all damage done as a result of the installation and removal of all debris or surplus material left by those engaged in the work.
7. Complete and thorough cleaning of all equipment furnished and installed, both inside and outside, and made ready for painting by others.
8. Testing and adjusting of all equipment.
9. Provisions and installation of all bases, supports, hangers and vibration isolators for the work outlined herein.
10. Cooperation with other crafts in putting the installation in place at any time when space required is ready and the progress of the work so dictates.

F. Utility service requirements outlined above are general in nature. Consult with local utilities for exact requirements.

1.5_ WORK NOT INCLUDED

A. The following work is not included in this Division unless specifically called for in individual Sections:
1. Motors and controls, unless indicated otherwise, shall be furnished by others, but shall be installed and connected by the Electrical Contractor as indicated on the drawings.
2. Controls for motors will be furnished, installed, and wired by others, unless otherwise noted on the drawings.

1.6_ QUALITY ASSURANCE, STANDARDS AND SYMBOLS

A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards, utility company and fire insurance carrier's requirements. Contact proper authorities, obtain and pay for required permits, inspections and utility service connections. Do not include any utility company charges that can be billed directly to the Owner.

B. In case of difference between the building codes, specifications, state laws, local ordinances, industry standards, utility company regulations, fire insurance carrier's requirements, and the contract documents, the most stringent shall govern. The Contractor shall promptly notify the Owner in writing of any such difference.

C. Noncompliance: Should the Contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards, fire insurance carrier's requirements, and utility company regulations, he shall bear the cost arising in correcting any such deficiency.

D. Applicable codes and all standards shall include all state laws, local ordinances, utility company regulations and the applicable requirements of the following nationally accepted codes and standards:

1. Building Codes
    1. National Building Code.
    2. International Building Code.
    3. International Energy Conservation Code.
    4. Local Building Code.
    5. National Electrical Code.
    6. State Electrical Code.
    7. Local Municipal Electrical Code.
2. Industry Standards, Codes, and Specifications
    1. AMCA -Air Moving and Conditioning Association.
    2. ASHRAE - American Society of Heating, Refrigeration, and Air Conditioning Engineers.
    3. ASME - American Society of Mechanical Engineers.
    4. ASTM - American Society for Testing and Materials.
    5. EIA -Electronic Industries Association.
    6. IEEE - Institute of Electrical and Electronic Engineers.
    7. IPCEA - Insulated Power Cable Engineers' Association.
    8. NEC - National Electrical, Code (NFPA No. 70-1996).
    9. NBS - National Bureau of Standards.
    10. NEMA -National Electrical Manufacturers' Association.
    11. NFPA - National Fire Protection Association.
    12. USASI - United States of America Standards Institute.
    13. UL -Underwriters' Laboratories.
3. Insurance Carriers
    1. FIA - Factory Insurance Association.

2. FMED - Factory Mutual Engineering Division.

E. The Drawings are diagrammatic and indicate generally the locations of material and equipment. These Drawings shall be followed as closely as possible. The Electrical Contractor shall coordinate the work under this section with the Ownerural, structural, plumbing, heating and air conditioning, and the drawings of other trades for exact dimensions, clearances and roughing-in locations. This Contractor shall cooperate with all other trades in order to make minor field adjustments to accommodate the work of others. Do not rely on the scale of the drawings for rough-in measurements, nor use them as Shop Drawings.

F. All materials and equipment for which label service is available shall bear the label of the Underwriters' Laboratories Inc.

G. Guarantee: This Contractor shall guarantee his workmanship and material (incandescent lamps, fuses, and any existing equipment are exempt) for a period of one year from the date of final acceptance and leave his work in perfect order at completion. Should defects develop within the guarantee period, this Contractor shall, upon notice of same, remedy the defects and have all damages to other work or furnishings caused by the defects or the work of correcting same repaired and/or replaced at his expense, to the condition before such damage.

1.7_ FEES AND INSPECTION CERTIFICATES

A. The Contractor shall obtain and pay for all permits and inspection services and certificates in conjunction with this work.

B. Upon completion of the work, Contractor shall obtain the approval of all recognized agencies concerned with the work, along with the approval of the National Board of Fire Underwriters, such certificates of inspection and approval from said bureau and/or agencies must be submitted to the Owner.

1.8_ MATERIALS

A. All materials shall be new, the best of their respective kinds, unless otherwise specified, and shall be installed by labor thoroughly skilled in the class of work anticipated by this Contract.

B. Provide products, which are compatible with other products of the electrical work and with other work-requiring interface with the electrical work, including electrical connections and control devices. For exposed electrical work, coordinate colors and finishes with other work.

C. Grounding systems use driven ground rod as grounding electrodes. Grounding system connections use mechanical fasteners.
1. Select materials, sizes, and types of anchors, fasteners, and supports to carry loads of equipment and raceway, including weight of wire and cable

in raceway.

D. All equipment and materials used in relation to control work for the project shall be new and shall bear the manufacturer’s name and trade name. The equipment and material shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment and shall be the manufacturer's latest approved design.

1.9_ SUBMITTALS

A. Furnish the Owner with complete shop drawings and associated data in accordance with General Conditions, for all major elements of the Electrical work for review, checking and approval. None of the following equipment shall be fabricated, delivered, erected or connected other than from drawings officially approved by the Owner.
   1. Enclosed controls commercial pedestal.
   2. Lighting fixtures.
   3. Conduit, wiring, and fittings.
   4. Photocells.
   5. Junction boxes and pull boxes.

B. The Electrical Contractor shall furnish and present three (3) copies of shop drawings or brochures for all fixtures, equipment, and accessories to the Engineer for the Engineer's approval. The Electrical Contractor shall furnish and present three (3) copies of a schedule of manufacturers of all materials for which shop drawings or brochures are not presented. No equipment shall be ordered, purchased, or installed prior to approval of the shop drawings, brochures, and schedules. Checking is only for general conformance with the design concept of the project and general compliance shown is subject to the requirements of the plans and specifications. Contractor is responsible for: dimensions, which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.

1.10_ SUBSTITUTION OF MATERIALS

A. In general, the contract drawings and specifications show and describe arrangements suitable for the specific items of equipment either named or described. In the event that Contractor submits for approval, and receives such approval, for a device or piece of equipment which requires connections or arrangements of these services differing from those indicated or described in the contract documents, Contractor shall give timely notice and shall make suitable alterations in the work to accommodate the substitute equipment, and shall be responsible for any and all additional costs incurred by virtue of the substitution of such equipment for the equipment named or described in the contract documents. The naming of a certain brand or make or manufacturer in the specifications is to establish a quality standard for the article desired. The Contractor is not restricted to the use of the specific brand of the manufacturer named unless so indicated in the specifications. However, where a substitution is requested, a substitution will be permitted only with the written approval of the Owner. Request for such substitutions shall be submitted in triplicate to the Owner at least five working days prior to the Bid Opening date. Such requests shall be accompanied by Manufacturer's Data Sheets and other information that, in the opinion of the Owner, is necessary for review. No substitute material or equipment shall be ordered, fabricated, shipped or processed in any manner prior to the approval of the Owner. The Contractor shall assume all responsibility for

additional expenses as required in any way to meet changes from the original material or equipment specified.

1.11_ TEMPORARY POWER AND LIGHTING

A. The Electrical Contractor shall be responsible for all arrangements and costs for providing temporary electrical metering, main switches, and distribution panels at the site as required for construction purposes. The distribution panels shall be located at a central point designated by the Owner. The General Contractor shall indicate prior to installation whether three phase or single-phase service is required.

B. Installation
   1. Install work in neat and orderly manner.
   2. Make structurally and electrically sound throughout.
   3. Maintain to give continuous service and to provide safe working conditions.
   4. Modify and extend service as work progress requires.
   5. Locate so that power is available at any desired point with no more than 100 ft. (30.00 m) extension, and with no more than 5% voltage drop at full load.
   6. Provide circuit breaker protection for each outlet with ground fault interrupting capacity.
   7. Provide equipment grounding continuity for entire system.
   8. Completely remove temporary materials and equipment upon completion of construction. Repair damage caused by installation and restore to specified or original condition.

1.12_ ELECTRICAL DRAWINGS

A. The Drawings are diagrammatic and indicate generally the locations of material and equipment. These Drawings shall be followed as closely as possible. The Electrical Contractor shall coordinate the work under this section with the Ownerural, structural, plumbing, heating and air conditioning, and the drawings of other trades for exact dimensions, clearances and roughing-in locations: This Contractor shall cooperate with all other trades in order to make minor field adjustments to accommodate the work of others. Do not rely on the scale of the drawings for rough-in measurements, nor use them as Shop Drawings.

B. The Drawings and Specifications are complementary, each to the other, and the work required by either shall be included in the Contract as if called for by both.

C. If directed by the Owner, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

D. Electrical symbols used on this project are shown in a Symbol List on the accompanying working drawings. This list shows standard symbols and all may

not appear on the project drawings. However, wherever the symbol on project drawings occurs, the item shall be provided and installed.

E. Conductor and conduit sizes are shown on the drawings in an equipment schedule for equipment and in the one line diagram for electrical distribution. Unless otherwise noted all other circuits shall be 2" schedule 80 PVC conduit with 2#4(CU, THWN). In any case, minimum sizes for wire and conduit shall comply with all applicable codes.

F. The drawings are indicative of the work to be installed, but do not show all bends, fittings, boxes and specialties required to complete the installation.

G. All conduits, wires, outlet boxes, devices and fixtures shall be included in the work.

H. The Electrical Contractor shall note that all items of equipment are specified in the singular; however, the Contractor shall provide and install the number of items of equipment as indicated on the drawings and as required for complete systems.

I. Where it is stated that the contractor shall "provide" a device or piece of equipment, it shall mean that such devices or equipments are furnished and installed.

1.13_ COORDINATION

A. General: It is recognized that the contract documents are diagrammatic in showing certain physical relationships which must be established within the electrical work, and in its interface with other work including utilities and mechanical work, and that such establishment is the exclusive responsibility of the Contractor. Install the wiring and equipment at such times and in such manner as will in no way retard progress or completion of the project.

B. The layout of wiring on the small scale drawings shall not be considered absolute. The design shall be subject to such revisions as may be necessary to overcome obstructions.

1.14_ EQUIPMENT IDENTIFICATION AND MARKING

A. Identification of Equipment
   1. Provide and install laminated black and white lamacoid nameplates for all service switches, distribution switches, distribution switchboards, branch circuit panelboards, safety switches, cabinets, starters, and other equipment with their correct designation. Label equipment in areas accessible to the public on inside of enclosure only. Nameplates shall be firmly secured to front cover or door with two properly sized pop rivets.
   2. Mount a typewritten directory behind plastic on the inside of each branch

circuit panel door, giving the number, description and location of the circuit controlled by each circuit breaker. Revise existing directories to reflect circuit modifications under this contract.

3. All fused safety switches and fused switch units in switchboards shall individually bear a fuse label showing proper size and type of fuse to be used.
4. Install wiring diagrams on the inside cover of all starters, switches and other such equipment. Such diagrams shall not be handwritten.
5. All junction boxes with blank covers shall have circuits contained therein identified by means of permanent black "Magic Marker" on the cover.

B. Lettering shall include name of equipment, the specific unit number and any reference to "On-Off", or other instructions that are applicable.

C. Nameplates shall be laminated phenolic with a black surface and white core. Use 1/16" thick material for plates up to 2" x 4". For larger sizes use 1/8" thick material.

D. Lettering shall be condensed Gothic. The space between lines shall be equal to the width of the letters. Use 1/4" minimum height letters which occupy four to the inch. Increase letter size to 3/4" on larger plates.

E. Provide warning signs where there is hazardous exposure or danger associated with access to, or operation of, electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.

F. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical systems, provide tags of plasticized card stock, either pre-printed or hand printed to convey the message; example: "DO NOT OPEN THIS SWITCH WHEN BURNER IS OPERATING".

G. Feeders, mains, branches for power and light, common and section wires for any special signal or control systems, etc., shall be tagged and identified with standard wire markers in all panels and pull boxes. The tagging should convey the circuit number and the equipment it serves (i.e. - “PP1-7,9,11 AC-1". Lighting and receptacle circuits need only identify the circuit number.

H. All exterior underground conduits shall be identified with a 4" plastic ribbon tape for the full length of the underground conduit, installed 6" below the ground and above the conduit. Tape shall be printed to warn and identify electrical conduit buried below.

1.15_ SLEEVES, INSERTS, FASTENINGS, SUPPORTS, CUTTING AND PATCHING

A. The Electrical Contractor shall provide and install metallic supports as required for the proper installation of raceway systems and all other equipment installed under this division of the contract conforming to the latest edition of the NEC.

B. Conduit shall be supported on approved types of wall brackets, strap hangers or pipe supports. All fastenings, supports, clamps and anchors, etc., shall be of type made for the purpose. The use of insulated wire shall not be acceptable as an attaching means for conduit or other equipment.

C. Conduit shall be securely fastened to all sheet metal outlets, junction and pull boxes with two galvanized locknuts and bushing, care being taken to see that the full number of threads project through, to permit the bushing to be drawn tight against the end of the conduit, after which the locknuts shall be made tight sufficiently to draw them into firm electrical contact with the outlet box. Install a plastic bushing on end of conduits stubbed into ceiling spaces to protect cabling.

D. The Electrical Contractor shall be responsible for all concrete pads, supports, piers, bases, foundations, and encasement required for the electrical equipment and conduit. The concrete pads for the electrical equipment shall be six inches larger all around than the base of the equipment unless specifically indicated otherwise.

E. Obtain written approval of the Owner before notching, boring, chipping, burning, drilling, and welding to structural members.

F. Furnish and install all sleeves which are required to protect equipment or which may be necessary to facilitate its installation. Sleeves used in conjunction with formed concrete shall be located where required and approved by the Owner. Provide "Flameseal" or other approved fire stopping material at all penetrations through rated walls, floors and ceilings.

G. Provide and install all inserts required for equipment. Inserts shall be cast iron or cast steel of slotted type to receive a machine bolt head or nut, after installation. Be responsible for the proper spacing of inserts and their alignment and preservation before and during construction.

1.16_ TRENCHING AND BACKFILLING

A. Perform all trenching and backfill required by work under this division of the specifications. Trenching and backfilling shall be done in accordance with the "Site Work" division of the specifications and as herein specified. This portion of the work shall be executed under the direct supervision of the General Contractor. Trenches shall be excavated to the depth required for the utilities involved. The trench bottom shall be graded true and free from debris, stones and soft spots. Where direct burial cables are used, four inches of fine sand shall be placed in the bottom of the trench prior to cable placement.

1.17_ TESTING, ADJUSTING AND CLEANING

A. As soon as electric power is available and connected to serve the equipment, and

everything is ready for final testing and placing in service, a complete operational test shall be made in the presence of the Owner. The Contractor shall furnish all necessary instruments and equipment, and make all tests, adjustments, and trial operations required to place the system in balanced and satisfactory operating condition, and he shall pay all professional engineering fees required in such testing. Data on all tests shall be submitted to the Owner. Furnish all necessary assistance and instructions to properly instruct the Owner's authorized personnel in the operation and care of the system.

B. The voltage levels between the different phases shall be balanced to within 5% of each other. A recording meter shall be used to measure simultaneously the voltages from phase to phase, and phase to neutral, for a continuous period of not less than 24 hours. The printed results of this test shall be forwarded to the Owner for review. The Electrical Contractor shall be responsible for making any circuiting changes deemed necessary by the Owner in order to maintain the balanced voltage levels under normal operating conditions.

C. Prior to testing the system, the feeders and branch circuits shall be continuous from main feeders to main panels, to subpanels, to outlets, with all breakers and fuses in place. The system shall be tested free from shorts and grounds.

D. No circuits shall be energized without the Owner's approval.

E. The right is reserved to inspect and test any portion of the equipment and/or materials during the progress of its erection. The Contractor shall further test all wiring and connections for continuity and grounds before connecting any fixtures or equipment.

F. The Contractor shall test the entire system in the presence of the Owner or his engineer when the system is finally completed to insure that all portions are free from short circuits or ground faults.

G. The Electrical Contractor shall provide the Owner with certification of the inspection and approval of an active member of the International Association of Electrical Inspectors of all work completed and included in the section, if required. The Contractor shall be responsible for notifying the Inspector when work reaches inspection stage.

H. The Electrical Contractor shall pay for all permits, inspection fees, and installation fees as required to complete the work under this Section of the Contract.

I. This Contractor shall guarantee the materials and workmanship for a period of twelve (12) months from the time the installation is accepted by the Owner. If, during this time, any defects should show up due to any defective materials, workmanship, negligence or want of proper care on the part of this Contractor, he shall furnish any new materials as necessary, repair said defects, and put the system in order at his own expense on receipt of notice of such defects from the Owner. This specification is not intended to imply that the Electrical Contractor

shall be responsible for negligence of the Owner.

J. Upon completion of the work, all component parts, both singularly and as a whole, shall be adjusted and left in satisfactory condition. All parts of the installation, including lighting fixtures, panelboards, etc., shall be cleaned, dusted or washed and adjusted to the satisfaction of the Owner.

1.18_ AS-BUILT DRAWINGS

A. Contractor shall keep an accurate record of all deviations from contract drawings and specifications. He shall neatly and correctly enter in colored ink or pencil any deviations on drawings affected, and shall keep drawings available for inspection.

B. At the completion of the job, and before final acceptance, the Contractor shall provide to the Owner two complete sets of electrical prints marked to show the work "as-built". The Contractor shall show modifications to locations for all major electrical devices, including panelboards and all major runs of conduit, the circuiting of each fixture, outlet, etc., shall be shown. Certify to the accuracy of each print, by signature and date thereon, and deliver same to Owner. Drawings shall be reproducibles.

1.19_ OPERATION AND MAINTENANCE MANUALS

A. Contractor shall prepare, assemble and submit three (3) copies of an Operation and Maintenance Manual for the electrical system as installed.

B. Operation and Maintenance manuals shall be typed and bound in a hard cover, three ring binder or equivalent protection, and shall contain as a minimum the following:
   1. Maintenance instructions for all equipment furnished under this contract.
   2. Table of equipment listing motor starter sizes, overload sizes, and fuse sizes.

C. Table of light fixtures listing manufacture and model number; lamp type, manufacture and model number; ballast type, manufacture and model number.

D. A list of contacts with phone numbers for all systems for Owners' use, in the event the electrical system requires service work within the Warranty period.

E. Copy of Certificate of Acceptance from the Electrical Inspector, and any other applicable authorities.

F. Copy of Warranty Letter from Electrical Contractor and appropriate sub-contractors.

G. Final acceptance by the owner will not occur until all operating and maintenance manuals are received and owner's personnel have been thoroughly indoctrinated in the maintenance and operation of all equipment.

1.20_ PROJECT CLOSEOUT

A. Training of owner's operating and maintenance personnel:
   1. Provide a qualified representative of the supplier of each item or system for which training is specified or required, for the purpose of instructing specific personnel, as designated by the owner, in the operation and maintenance of such items or systems.
   2. Provide training when the installation is complete and at times coordinated with the owner a minimum of 14-days in advance. A representative of the contractor shall be present for all training.

B. The electrical system installed under this contract shall be left in proper working order. Replace, at no additional cost to the owner, any work, materials, or equipment which exhibit defects in design, construction or workmanship within one year, or as specifically noted elsewhere in these specifications, from date of final owner acceptance.

END OF SECTION 16010

SECTION 16060

GROUNDING AND BONDING

1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Rod electrodes.
   2. Active electrodes.
   3. Wire.
   4. Grounding well components.
   5. Mechanical connectors.
   6. Exothermic connections.

B. Related Sections:
   1. Section 02590 - Site Grounding: Site related grounding components for buildings and facilities.
   2. Section 03200 - Concrete Reinforcement: Bonding or welding bars when reinforcing steel is used for electrodes.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
   2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:
   1. Rod electrode.

1.4 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 25 ohms maximum.

1.5 SUBMITTALS

A. Product Data: Submit data on grounding electrodes and connections.

B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.7 QUALITY ASSURANCE

A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

B. Perform Work in accordance with State of Colorado and Municipality of Grand Junction standard.

C. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.10 COORDINATION

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Complete grounding and bonding of building reinforcing steel prior concrete placement.

2 PRODUCTS

2.1 ROD ELECTRODES

A. Manufacturers:
1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. O-Z Gedney Co.
5. Thomas & Betts, Electrical.
6. Substitutions: Permitted.

B. Product Description:
1. Material: Copper-clad steel or Copper.
2. Diameter: 3/4 inch (19 mm).
3. Length: 8 feet (2.4 m).

C. Connector: Connector for exothermic welded connection or U-bolt clamp.

2.2 WIRE

A. Material: Stranded copper.

B. Foundation Electrodes: 4 AWG.

C. Grounding Electrode Conductor: Copper conductor bare.

D. Bonding Conductor: Copper conductor bare or insulated.

2.3 MECHANICAL CONNECTORS

A. Manufacturers:
1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. ILSCO Corporation.
5. O-Z Gedney Co.
6. Thomas & Betts, Electrical.
7. Substitutions: Permitted.

B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

A. Manufacturers:
   1. Apache Grounding/Erico Inc.
   2. Cadweld, Erico, Inc.
   3. Copperweld, Inc.
   4. ILSCO Corporation.
   5. O-Z Gedney Co.
   6. Thomas & Betts, Electrical.
   7. Substitutions: Section 01600 - Product Requirements.

B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

3 EXECUTION

3.1 EXAMINATION

A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 INSTALLATION

A. Install in accordance with IEEE 142 and 1100.

B. Install rod electrodes as required to achieve specified resistance to ground.

C. Install grounding and bonding conductors concealed from view.

D. Install 4 AWG bare copper wire in foundation footing.

E. Bond together metal siding not attached to grounded structure; bond to ground.

F. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder circuit raceway. Terminate each end on suitable lug, bus, or bushing.

G. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panel boards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.

H. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.

I. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panel boards with installed number 12 conductor to grounding bus.

J. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.

K. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.4 FIELD QUALITY CONTROL

A. Perform ground resistance testing in accordance with IEEE 142.

B. Perform continuity testing in accordance with IEEE 142.

C. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION

SECTION 16400

LOW-VOLTAGE DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

1. Section includes enclosed circuit breakers; panelboards and load centers;

1.2 SUBMITTALS

1. Product Data: Submit catalog data showing products with specified features.

1.3 EXTRA MATERIALS

1. Furnish two of each panelboard key.

PART 2 PRODUCTS

2.1 BRANCH CIRCUIT PANELBOARDS

1. Manufacturers:
    1. Milbank.
    2. Substitutions: Not Permitted.

2. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

3. Minimum Integrated Short Circuit Rating: 22,000 amperes rms symmetrical.

4. Panelboard Bus: Copper.

5. Molded Case Circuit Breakers: NEMA AB 1, plug-on type thermal magnetic trip circuit breakers, with common trip handle for poles, listed as Type SWD for lighting circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

6. Enclosure: NEMA PB 1, Type to meet conditions.

7. Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 EXECUTION

3.1 EXISTING WORK

1. Disconnect abandoned distribution equipment. Remove abandoned enclosures and boxes.

2. Maintain access to existing distribution equipment remaining active and requiring access. Modify installation or provide access panel.

3. Clean and repair existing distribution equipment to remain or to be reinstalled.

3.2 INSTALLATION

1. Install distribution equipment plumb.

2. Select and install overload heater elements in motor controllers to match installed motor characteristics.

3. Install panel boards in accordance with NEMA PB 1.1.

4. Provide typed or neatly handwritten circuit directory for each branch circuit panel board.

END OF SECTION

SECTION 16520

EXTERIOR LUMINAIRES

1 GENERAL

1.1 SUMMARY

A. Section includes exterior luminaries, poles, and accessories.

1.2 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit dimensions, ratings, and performance data.

1.3 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Product storage and handling requirements.

1.5 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

1 PRODUCTS

1.1 LUMINARIES

A. Product Description: Complete exterior luminaire assemblies, with features, options, and accessories as scheduled.

1.1 METAL POLES

A. Material and Finish: Steel with prime finish for field painting.

B. Section Shape and Dimensions: Round.

C. Height: As scheduled.

D. Base: As shown in site drawings.

1.2 LED LAMPS

A. Manufacturers:
   1. Sternburg Lighting.
   2. Substitutions: Permitted.

2 EXECUTION

2.1 EXAMINATION

A. Verify foundations are ready to receive fixtures.

2.2 INSTALLATION

A. Install concrete bases for lighting poles at locations as indicated on Drawings.

B. Install poles plumb. Install shims or double nuts to adjust plumb. Grout around each base.

C. Install lamps in each luminaire.

D. Bond and ground luminaries, metal accessories and metal poles in accordance with Section 16060.

2.3 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for improper connections and operation.

B. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

2.4 ADJUSTING

A. Aim and adjust luminaries to provide illumination levels and distribution as indicated on Drawings.

2.5 CLEANING

A. Clean photometric control surfaces as recommended by manufacturer.

B. Clean finishes and touch up damage.

2.6 PROTECTION OF FINISHED WORK

A. Re-lamp luminaries having failed lamps at Substantial Completion.

END OF SECTION