

## **SECTION 26 00 00 - ELECTRICAL GENERAL PROVISIONS**

### **1.0 GENERAL**

#### **1.1 SCOPE OF WORK**

a. The work covered by Division 26 includes the furnishing of all materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary and the complete installation of all electrical work required in the Contract Documents and specified herein. The intent of the Contract Documents is to provide an installation complete in every respect. In the event that additional details or special construction may be required for the work indicated or specified in Division 26 or work specified in other Divisions of the Specifications, it is the responsibility of the Contractor to provide all material and labor which is usually furnished with such systems in order to make the installation complete and operational.

b. The Contractor is responsible for the coordination and proper relation of his work to the building structure and to the work of other trades. The Contractor shall visit the site and thoroughly familiarize himself with the existing conditions that affect the work and to verify all dimensions. The Contractor shall advise the Engineer of any discrepancy prior to bidding. The submission of a bid shall be deemed evidence of the Contractor's site visit, the coordination of all existing conditions, and the inclusion of all consideration for existing conditions.

#### **1.2 CODES AND STANDARDS**

a. All work shall comply with the latest edition of the applicable rules and regulations of the National Electrical Code (NEC), the National Electrical Safety Code (NESC), the National Fire Protection Association (NFPA), International Fire Code (IFC), Americans with Disabilities Act (ADA), the terms and conditions of service of the electrical utility, as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provisions of this specification shall be construed as waiving any of the rules, regulations, or requirements of these codes or authorities.

b. The Contractor shall resolve any code violation discovered in the Contract Documents with the Engineer prior to award of the contract.

c. In any instance where the Plans or Specifications call for materials of a better quality or larger size than required by the codes, those provisions of the Drawings or Specifications shall take precedence. The codes shall govern in case of direct conflict between the codes and the Drawings or Specifications.

#### **1.3 RELATED DOCUMENTS**

a. The Plans and Specifications, the General Conditions, Supplementary General Conditions and other requirements of Division 01, apply to the work specified in Division 26, and shall be complied with in every respect. The Contractor shall examine all of the documents, which make up the Contract Documents, and shall coordinate them with the electrical work on the Electrical plans and in Division 26 of these Specifications.

#### **1.4 DRAWINGS AND SPECIFICATIONS**

a. The Specifications are accompanied by Drawings for the project and details of the installations indicating the locations of equipment, lighting fixtures, switches, controls, receptacles, etc. The Drawings and Specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

b. If any departures from the Contract Documents are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted in writing to the Engineer for review. No departures from the Contract Documents shall be made without prior written approval of the Engineer.

c. The interrelation of the Specifications, Drawings, and Schedules is as follows: The Specifications determine the nature and quality of the materials, the Drawings establish the quantities, dimensions and details, and the Schedules give the performance characteristics. Should the Drawings disagree in themselves, or with the Specifications, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Engineer in writing, shall be performed or furnished. In case the Specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on Drawings govern scale measurements and large scale details govern small scale Drawings. In case of disagreement between Specifications and Drawings, see Division 01 of the City of San Antonio Bid Specifications for clarification.

d. Items specifically mentioned in the Specifications but not shown on the Contract Drawings and/or items shown on the Contract Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

## **1.5 ELECTRICAL UTILITIES**

a. The Contract Documents reflect the general location, voltage, ampacity, size and manner of routing for all electrical utilities known to be required on this project. It is the responsibility of the Contractor to visit the site, meet with the local Electrical Company personnel in order to coordinate and confirm the exact requirements for all electrical utilities. The bid submitted by the Contractor shall include costs for all such coordination work as well as any and all utility company charges and/or fees. See Section 26 00 20 – Electrical Services.

## **1.6 TEMPORARY SERVICES**

a. At present, no electrical service exists on this site which may be used for temporary construction power. It is the responsibility of the Contractor to furnish and install a complete system for temporary construction power and lighting. Temporary services shall be installed in accordance with requirements of the National Electrical Code (NEC), the National Electrical Safety Code (NESC), and the Occupational Safety and Health Act (OSHA).

b. The Contractor shall pay for the cost of the temporary construction power and lighting systems and all electrical energy consumed by the temporary systems on the job site throughout the entire construction period.

c. Remove all temporary services upon completion of the work.

## **1.7 CONTRACTOR QUALIFICATIONS**

a. An acceptable Contractor for the work under this Division shall be a specialist in this field and have the personal experience, training, skill and the organization to provide a practical working system. If required, he shall be able to furnish acceptable evidence of having contracted for and installed not less than three systems of comparable size and type to this one, that have served their owners satisfactorily for not less than three years.

b. The foreman or superintendent for this work shall have had experience in installing not less than three such systems and shall be approved by the Engineer before the work is begun. Adequate and competent supervision shall be provided to ensure first class workmanship and installation.

- c. Work shall be executed and all materials installed to present a neat appearance when completed in accordance with the best practice of the trades in a thorough, substantial, workmanlike manner by competent workmen.
- d. The Contractor is responsible for all construction techniques required for all systems specified and shown on the drawings.

### **1.8 OBSERVATION OF THE WORK**

- a. Engineer's and/or Owner's authorized representative shall have the right to observe the work at any time. The Contractor shall have a representative present when his work is being observed, and he shall give assistance, as may be required, to the Engineer's representative. Recommendations made by observer shall be promptly carried out, and all unsatisfactory material and/or workmanship shall be replaced to the satisfaction of the Engineer.
- b. Periodic observation of the work by Engineer is only for Engineer shall not relieve Contractor, any Subcontractor, and/or Material Supplier of responsibility for deviation from requirements of Contract Documents nor for error or omissions in the performance of work.

### **1.9 SUBMITTALS**

- a. Submit shop drawings and product data as specified in Division 01 - General Requirements. Submittal data shall indicate the manufacturer's name, published performance, ratings and/or capacity data, detailed equipment drawings for fabricated items, wiring diagrams, installation instructions and other pertinent data. Where literature is submitted covering a group or series of similar items, the applicable items must be clearly indicated. Submittals shall be clearly marked highlighting all proposed equipment and devices to be used in this project. Submittals that do not comply with this requirement will be returned without review. Shop drawings shall note all deviations from contract documents.
- b. Review is only for general conformance with design concept of project and general compliance with the Contract Documents. Contractor is responsible for conforming and correlating equipment dimensions at job site; for information which pertains to fabrication processes or construction techniques; and for coordination of work of all trades. Review of submittals shall not relieve Contractor, any Subcontractor and/or Material Supplier of responsibility for deviation from requirements of Contract Documents nor for errors or omissions in submittals.
- c. Submittal of shop drawings, product data and samples will be accepted only when they are submitted by the Contractor. Each submittal shall indicate by signed stamp that the submittals have been checked and that they are in accordance with Contract Documents and that dimensions and relationship with work of other trades have been checked. Submittals that have not been checked and signed by the Contractor will be returned for checking before being reviewed.
- d. Engineer review of submittals constitutes an acknowledgment only and in no way relieves the Contractor of full responsibility for providing all materials and systems in accordance with the intent of the Contract Documents. Any material provided by the Contractor without Engineer's review constitutes the Contractor's agreement to comply with the Engineer's intent whether specified, shown or implied.
- e. **Electronic submission of submittal information is preferred. All digital files shall be PC compatible. All digital documents shall be in Portable Document Format (PDF) and compatible with Adobe Acrobat Version 9.0 or earlier. Organize data indexed by specification section. Paper copies may be submitted ORGANIZED IN A 3-RING HARDCOVER BINDER WITH DIVIDERS TABBED AND INDEXED BY SPECIFICATION SECTION.** Show any revisions to equipment layouts required by use of selected equipment. Type of submittal data is listed in the individual sections of this Division.

### **1.10 SUBSTITUTIONS AND PRODUCT OPTIONS**

a. Products List. Within 30 days after contract date, submit to Engineer a complete list of major products proposed to be used, with the name of the manufacturer and the installing subcontractor. Equipment provided under the switchgear sections of Division 26 shall be provided by the same manufacturer unless otherwise indicated.

b. Contractor's Options.

- (1) For products specified only by reference standard, select any product meeting that standard.
- (2) For products specified by naming several products or manufacturers, select any one of the products or manufacturers named, which complies with the specifications.

c. Substitution Provisions. Manufacturers' names and catalog numbers specified under sections of Division 26 are used to establish standards of design, performance, quality and serviceability and not to limit competition, nor to discriminate against an "approved equivalent" product of another manufacturer. Equipment of equivalent design to that specified, will be acceptable upon approval by the Engineer. The Engineer will only consider written requests for substitution of specified products submitted 10 days prior to bid opening and any approved substitutions will be addressed by Addendum before the bid opening. After that date, request for substitution will be considered only in cases of product unavailability or other conditions beyond control of the Contractor. It is the Contractor's responsibility to:

- (1) Personally investigate the proposed substitute product to determine that it has all the same accessories and is equal or superior in all respects to that specified.
- (2) Provide the same guarantee for the substitution that he would for that specified.
- (3) Coordinate the installation of the equipment which he proposes to substitute with all trades and includes the costs for any changes required for the work to be complete in all respects. The Contractor will prepare shop drawings where required by the Engineer or where dimensions vary.
- (4) Provide itemized breakdown including material and labor for the proposed product substitutions.
- (5) Submit complete design and performance data.

d. The Engineer will review Requests for Substitutions with reasonable promptness, and notify the Bidders, in writing, of the decision to accept or reject the requested substitution by Addendum.

### **1.11 PROJECT RECORD DOCUMENTS**

a. Throughout progress of the work of this Contract, maintain an accurate record of all changes in the Contract Documents. Upon completion of the Work of this Contract, transfer the recorded changes to a set of reproducible Record Documents. Delegate the responsibility for maintenance of Record Documents to one person on the Contractor's staff. Thoroughly coordinate all changes within the Record Documents, making adequate and proper entries on each page of Specifications and each sheet of Drawings and other Documents where such entry is required to properly show the change. Accuracy of records shall be such that future search for items shown in the Contract Documents may reasonably rely on information obtained from the approved Record Documents. Make all entries within 24 hours after receipt of information.

b. The Contractor will mark all deviations on a daily basis. The Engineer will visit the site periodically and may request to see the "As-Built" documentation. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Engineer. Mark the drawings with a colored pencil. Record installed feeder conduits, dimensioning the exact location and elevation of the conduit.

c. Record Documents shall consist of the following:

- (1) Job Set: Promptly following award of Contract, secure from the Engineer, one complete set of all documents comprising the Contract.
- (2) Submit the completed total set of Record Documents to the Engineer as described above. Participate in review meeting or meetings as required by the Engineer, make all required changes in the Record Documents, and promptly deliver the final Record Documents to the Engineer. Upon completion of Work, the Contractor shall certify the "Record Drawings" for correctness by signing the following certification:

CERTIFIED CORRECT (3/8" high letters)

(Name of the Contractor)

By

Date

(Name of the Sub-Contractor)

By

Date

d. Deliver record drawings to the Engineer in the number and manner specified in Division 1 - General Requirements.

#### **1.12 OPERATION AND MAINTENANCE DATA**

a. Prepare and submit sets of product data, shop drawings, wiring diagrams, instructions and parts lists for operating and maintaining equipment and systems installed. Include in the instructions a description of normal adjustments and a list of items to be lubricated. Specify the type and frequency of lubrication required. Provide special servicing tools as required for this equipment. Deliver manuals and tools to the Engineer as a condition of final acceptance. Refer to Division 01 for other requirements. The manual shall include:

- (1) Manufacturer's installation instruction brochures.
- (2) Manufacturer's local representative and/or distributor's name and address.
- (3) Manufacturer's operating and maintenance brochures.
- (4) Manufacturer's internal wiring diagram.
- (5) Contractor's installation wiring diagram.
- (6) Control system installation drawings.
- (7) Replacement part number listings and/or descriptions.

- (8) Framed operating instructions when required.
- (9) Manufacturer's warranties and guarantees.
- (10) Training programs for systems provided under Division 26.

b. The manual shall include all of the above listed data bound into a permanent hard-back, three ring binder(s) identified on the cover as "Operating and Maintenance Manual" with additional cover display of the location of Building and the name, address and telephone number of the Owner, the Engineer, the Contractor, and the Subcontractors installing equipment represented in the brochure.

c. Contents of the manual shall be grouped in sections according to the various sections of Division 26, and shall be listed in a Table of Contents. Sections shall be organized as follows:

- (1) Each "tab" in the brochure shall identify the grouping of all literature required for a single class of equipment; i.e., "transformers", "lighting fixtures", "switchgear", etc., for all types of equipment on the job.
- (2) Contents under each "tab" shall refer to a single class of equipment, and shall be arranged in the following sequence: First, the manufacturer's installation brochure; second, the manufacturer's operating and maintenance brochure; third, the manufacturer's installation wiring diagram; fourth, the Contractor's field wiring diagram; if different, and fifth, the manufacturer's brochure listing replacement part numbers and description.
- (3) Provide final tab "Warranties and Guarantees" behind which all such items will be located.

d. Upon completion of the work, instruct the Owner's operating personnel in operation and maintenance of electrical equipment and systems furnished and installed under Division 26. The specified training shall be given at a time and location designated and provided by the Owner for personnel selected by the Owner, in addition to any necessary on-site orientation and training. Provide a minimum of 8 hours of general instruction in addition to any time specified in other sections of Division 26.

## **2.0 PRODUCTS**

### **2.1 CONSTRUCTION MATERIALS**

a. All materials shall be new and shall conform to the requirements of the National Electrical Code and/or the Standards Organizations regulating those products and shall be listed or labeled by Underwriters Laboratories. The listing or labeling by Underwriters Laboratories will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of a UL listing, the Contractor may submit a statement from a nationally recognized, adequately equipped independent testing agency, indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all contract requirements.

### **2.2 STANDARD PRODUCTS**

a. All materials and equipment shall be standard catalog products of domestic manufacturers regularly engaged in the manufacture of products conforming to these specifications. Materials and equipment shall have been in satisfactory use at least two years prior to bid opening. Where custom or special items are required, these shall be fully described by drawings and/or material list which detail the item proposed for use on this project.

### **2.3 MANUFACTURERS INSTRUCTIONS**

a. The Contractor is fully responsible for furnishing the proper electrical equipment and/or material and for seeing that it is installed as intended by the manufacturer's written instructions. If needed for proper installation, operation, or start up, the Contractor shall request advice and assistance from a representative of the specific manufacturer. The manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning all materials and equipment. The Contractor shall promptly notify the Engineer in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and shall obtain the Engineer's instructions before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer directions or instructions from the Engineer, he shall bear all costs arising in connection with correcting the deficiencies.

### **2.4 RUST PREVENTION**

a. All metallic materials shall be protected against corrosion. Exposed metallic parts of outdoor apparatus shall be given a rust-inhibiting treatment and standard finish by the manufacturer. All parts such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected by galvanizing, except where other equivalent protective treatment is specifically approved in writing.

### **2.5 DELIVERY AND STORAGE**

a. The Contractor shall not deliver any equipment to the job site until the equipment is ready to be installed or until there is suitable space provided to properly protect equipment from weather, humidity, dust, and physical damage.

b. All equipment shall be protected in accordance with the manufacturer's recommendations and the requirements of NFPA 70B, Annex M (2010), titled "Equipment Storage and Maintenance During Construction".

c. All equipment injured or damaged in transit from factory, during delivery to premises, while in storage on premises, while being erected and installed, and while being tested, until time of final acceptance, shall be replaced by the Contractor with new equipment.

### **2.6 CAPACITIES AND SPACE LIMITATIONS**

a. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of start-up or other overload conditions. Where equipment offered as a substitute is accepted and requires electrical power other than that indicated in the contract documents for the specified equipment, the Contractor is responsible for adjusting protective devices, starter sizes, conductors, conduits, etc., to accommodate the approved device electrically at no change in the contract price.

b. The Contractor is responsible to verify that the equipment he proposes to provide will physically fit within the space indicated on the Contract Documents and that the required code clearances and maintenance access are maintained. Any space conflicts shall be noted in the submittals. Provide scale drawings to the Engineer indicating proposed solutions to any space conflict for the Engineer's review and approval.

### **2.7 NAMEPLATES**

a. Each piece of equipment shall have a nameplate from the manufacturer with the following information: name, address, catalog number, voltage, phase, full load amperes or horsepower, and/or other pertinent information on a plate securely attached to the equipment. All data on nameplates shall be legible at the time of final inspection.

### **3.0 EXECUTION**

#### **3.1 PROTECTION OF EQUIPMENT**

- a. Moisture. During construction, protect switchgear, transformers, control equipment, and other items from insulation moisture absorption and metallic component corrosion by appropriate use of strip heaters, lamps or other suitable means. Apply protection immediately on receiving the products and maintain continuously.
- b. Clean. Keep products clean by elevating above ground or floor and by using suitable coverings.
- c. Damage. Take such precautions as are necessary to protect apparatus and materials from damage. Failure to protect materials is sufficient cause for rejection of the apparatus or material in question.
- d. Finish. Protect factory finish from damage during construction operations and until acceptance of the project. Satisfactorily restore any finishes that become marred or damaged.

#### **3.2 INSTALLATION**

- a. Cooperation with Other Trades. Cooperation with trades of adjacent, related or affected materials or operations, and of trades performing continuations of this work under subsequent contracts, is considered a part of this work. The Contractor is responsible to coordinate with other trades in order to effect timely and accurate placing of work and to bring together, in proper and correct sequence, the work of such trades.
- b. Concrete Equipment Pads. Install minimum 6-inch thick concrete housekeeping pads for electrical equipment. Exterior housekeeping pads shall be a minimum of 2-inches above finished grade and shall have 48 inches of pad space in front of the equipment for maintenance access. Trowel pads smooth and chamfer edges to a 1-inch bevel. Secure equipment to pads as recommended by the manufacturer.
- c. Setting of Equipment. All equipment shall be installed level and plumb. Provide corrosion-resistant bolts, nuts and washers to anchor equipment.
- d. Sealing of Equipment. Permanently seal outdoor equipment at the base using concrete grout. Seal or screen openings into equipment to prevent entrance of animals, birds and insects. Use galvanized steel or copper mesh with openings not larger than 1/16-inch for screened openings. Seal small cracks and openings from the inside with a silicone sealing compound.
- e. Concealed Work. Conceal electrical work underground except:
  - (1) Where shown or specified to be exposed. Exposed is understood to mean open to view.
  - (2) Where exposure is necessary to the proper function.
  - (3) Where size of materials and equipment preclude concealment.
- f. Access. All equipment shall be installed in a manner to permit access to parts requiring service. All electrical equipment shall be installed in such a manner as to allow removal for service without disassembly of other equipment.
- g. Clearance. Install all electrical equipment so that clearances are adhered to as required by the latest version of the National Electrical Code.



### **3.3 HOISTING, SCAFFOLDING, AND TRANSPORTATION**

- a. The Contractor shall provide his own hoisting, scaffolding and ladders as required to set his materials and equipment in place.
- b. The Contractor shall provide all necessary transportation to facilitate the delivery of all materials, equipment, tools, and labor to the job.

### **3.4 CLEANING**

- a. The Contractor shall, at all times, keep the premises free from accumulations of waste material or rubbish caused by him, his employees, or his work. Debris shall be removed, not only from the building, but also from the site and from any public area adjacent to the site.
- b. At completion of the project, the Contractor shall remove all of his tools, scaffolding, and surplus materials.

### **3.5 ELECTRICAL CONNECTIONS TO EQUIPMENT**

- a. Contractor shall coordinate with manufacturer as required to verify all electrical requirements. This is to include but not be limited to verification of power, voltage, phase and other characteristics as being compatible with that called for on the electrical drawings and Division 26 Specifications. This shall be done prior to placing orders for equipment or material, and prior to any rough-in, etc. Making adjustments to field conditions is considered a part of the work required.
- b. Terminate at proper points as indicated on detailed equipment shop drawings. Do not use Contract Drawings for rough-in locations, but only for general routing of circuiting.

### **3.6 CUTTING AND PATCHING**

- a. When it becomes necessary to cut existing site paving, sidewalks, etc. to install any work under the Contract, or to repair any defects that may appear up to the expiration of the guarantee period, such cutting shall be done by the Contractor. The Contractor will not be permitted to cut or modify any structural members without the written permission of the Engineer.
- b. Patching of all items cut by the Contractor, or repairing of any damage to the work of other trades caused by cutting or by the failure of any part of the work installed under this Contract, shall be performed by the appropriate trade and shall be paid for by the Contractor.

### **3.7 EXISTING FACILITIES**

- a. The Contractor is responsible for loss or damage to the existing facilities used by his workmen, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices and receive written permission from the Owner to enter existing areas. Before beginning work in existing areas, make the necessary arrangements and perform other services required for the care, protection, and in service maintenance of all electrical and irrigation piping for existing facilities. The Contractor shall erect temporary barricades with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- b. The Contractor shall provide new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

c. Where existing construction is removed to provide working and extension access to existing utilities, the Contractor shall remove piping, conduit and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

### **3.8 TESTING**

a. Tests to be completed by the Contractor shall be of two types. During construction, system testing shall be accomplished to determine whether systems are suitably wired, or if systems operated as prescribed. Later, demonstration testing shall be accomplished for the purpose of showing that the systems operate as designed.

b. Demonstration Test of Completed Systems. Demonstrate the essential features of the specialty lighting fixtures.

c. Each system shall be demonstrated only once, after completion of satisfactory testing and acceptance.

d. The demonstration shall be held upon completion and acceptance of all systems at a date to be agreed upon in writing by the Engineer.

e. The demonstration shall be held by the Contractor or his representative in the presence of the Engineer or his representative, the manufacturer representative, and the Owner.

f. Demonstrate the functions of each system.

g. Demonstrate by "start-stop operation" how to work the controls, how to reset protective devices, how to replace fuses, and what to do in case of emergency.

h. The Contractor shall test all receptacles for power polarity and ground to assure that all receptacles are operating properly, correctly wired and suitably grounded. Furnish a statement to the effect that this work has been accomplished, when and by whom performed.

### **3.9 CONDITIONS OF EQUIPMENT AT FINAL ACCEPTANCE**

a. At time of acceptance, the Contractor shall have inspected all installed systems to assure the following has been completed:

- (1) Fixtures are operating, lamps, lenses and reflectors are free of dust, debris, and fingerprints.
- (2) Panelboards have all conductors neatly formed, laced and made-up tight. Enclosures shall be vacuum cleaned, surfaces clean of stray paint, dust, grease and fingerprints. All circuit directories to be neatly typed and in place.
- (7) All electrical equipment shall be labeled as specified under this section.

### **3.10 WARRANTIES**

a. The Contractor shall guarantee all materials and workmanship for a period of twelve (12) months after the substantial completion of work. The Contractor shall correct any faults or imperfections that arise due to defects or omissions in materials or workmanship during this twelve (12) month period.

End of Section 26 00 00

## **SECTION 26 00 10 - ALTERNATES**

### **1.0 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- a. Drawings and general provisions of the Contract apply to this Section.

#### **1.2 SECTION INCLUDES**

- a. Procedures for pricing alternates.
- b. Documentation of changes to Contract Sum.

#### **1.3 ACCEPTANCE OF ALTERNATES**

- a. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- b. Coordinate related work and modify surrounding work to integrate the Work of each alternate.

#### **1.4 DEFINITIONS**

- a. Definition: An Alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to the Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - (1) The cost for each alternate is the next addition to the Contract Sum to incorporate the Alternate into the Work. No other adjustments are made to the Contract Sum.

#### **1.5 PROCEDURES**

- a. Coordination: Modify or adjust affected Work as necessary to completely and fully integrate that Work into the Project.
  - (1) Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.
  - (2) Include as part of each alternate, costs coordination, modification, and/or adjustment to accommodate the accepted alternate.
- b. Notification: Immediately following the award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate whether alternates have been accepted, rejected or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- c. Execute accepted alternates under the same conditions as other Work of this Contract.

#### **1.6 SCHEDULE OF ALTERNATES**

- a. Alternate #1: Provide sports lighting for 25 foot-candles.
- b. Alternate #2: Provide sports lighting for 30 foot-candles.

**2.0 PRODUCTS – NOT USED**

**3.0 EXECUTION – NOT USED**

End of Section 26 05 26

## **SECTION 26 00 20 – ELECTRICAL SERVICES**

### **1.0 GENERAL**

#### **1.1 SCOPE**

a. This section specifies the furnishing and installation of materials and equipment and making arrangements for the connection of electrical service for the project.

#### **1.2 REFERENCE STANDARDS**

a. Comply with all service installation standards of the serving utility company.

#### **1.3 APPLICABLE PROVISIONS**

a. Refer to Section 26 00 00 - Electrical General Provisions.

#### **1.4 SUBMITTALS**

a. None required.

### **2.0 ELECTRICAL SERVICE REQUIREMENTS**

#### **2.1 SOURCES**

a. Electrical service will be provided from the existing CPS overhead system. The source characteristics are 277/480 volts, three phase, four wire, 60 hertz. Service to the project will be run via overhead distribution.

#### **2.2 MATERIALS AND EQUIPMENT**

a. Furnish materials and equipment required by the serving utility to connect the project service to the utility system.

b. Materials.

(1) Raceways shall be in accordance with Section 26 05 33.

(2) Boxes shall be in accordance with Section 26 05 34.

### **3.0 EXECUTION**

#### **3.1 INSTALLATION**

a. The location of the service entrance shall be coordinated with the local utility company.

b. Install each utility service as required by the Contract Documents. Demonstrate that the utility systems are operational.

End of Section 26 05 26

## **SECTION 26 05 19 - 600 VOLT INSULATED CONDUCTORS**

### **1.0 GENERAL**

#### **1.1 SCOPE**

- a. This Section specifies the furnishing and installation of 600 volt insulated conductors.

#### **1.2 REFERENCE STANDARDS**

- a. ANSI/UL 83 - Thermoplastic-Insulated Wires.
- b. ICEA S-61-402 (NEMA WC 5) - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- c. UL 486A - Standard for Safety Wire Connectors and Soldering Lugs for Use with Copper Conductors.

#### **1.3 APPLICABLE PROVISIONS**

- a. Refer to Section 26 00 00 - Electrical General Provisions.

#### **1.4 SUBMITTALS**

- a. Submit manufacturer's technical product data on conductors and connectors. Include data substantiating that materials comply with the requirements of this section.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- a. Deliver conductors properly packaged in factory-fabricated containers, or wound on NEMA-standard type wire and cable reels.
- b. Store conductors in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.
- c. Handle conductors carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of conductors is maintained.

### **2.0 PRODUCTS**

#### **2.1 600-VOLT INSULATED CONDUCTORS**

- a. Conductors shall be soft-drawn annealed copper with conductivity of not less than 98% at 20°C (68°F).
- b. Minimum wire size shall be No. 12 AWG unless otherwise noted on the drawings.
- c. Conductors No. 10 AWG and smaller may be stranded or solid and conductors No. 8 AWG and larger shall be stranded.
- d. Conductors shall be permanently marked to indicate voltage, insulation type and temperature rating and size in accordance with NEC Article 310.11.

- e. Insulation Identification:
  - (1) Ungrounded Conductors: Furnish factory colored insulation for conductors No. 10 AWG and smaller. Color code No. 8 AWG and larger insulated conductors with a field applied tape.
  - (2) Grounded and Grounding Conductors: Furnish factory colored insulation for conductors No. 6 and smaller. Color code No. 4 AWG and larger insulated conductors with field applied tape.
- f. Insulation shall be as follows:
  - (1) Type THW: For dry and wet locations; maximum operating temperature 75°C. Flame-retardant moisture and heat resistant thermoplastic.
  - (2) Type THHN or THWN: For dry and wet locations; maximum operating temperature 75°C (THWN) or 90°C (THHN). Flame-retardant, heat and/or moisture and/or oil-resistant thermoplastic insulation with nylon outer jacket.

### **3.0 EXECUTION**

#### **3.1 INSTALLATION**

- a. Mechanically protect conductors by installing in raceways. Do not install the conductors until raceway system is complete and properly cleaned. Use an approved wire-pulling compound when pulling large conductors. Wiring pulling compound shall be UL listed and as recommended by the conductor manufacturer. Do not bend any conductor either permanently or temporarily during installation to radii less than four times the outer diameter of the insulated conductors. Do not exceed manufacturer's recommended values for maximum pulling tension.
- b. Pull conductors simultaneously where more than one conductor is being installed in the same raceway.
- c. Use pulling means including fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceway.
- d. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A.
- e. Neatly and securely bundle all conductors in enclosures using nylon straps with a locking hub or head on one end and a taper on the other.

#### **3.2 SPLICES AND TERMINATIONS**

- a. Install splices, taps and terminations which have equivalent-or-better mechanical strength and insulation as the conductor. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- b. Use crimp or compression type connectors for splices of all stranded conductors. Mechanical type connectors for conductor splices are not acceptable. Splices shall be kept to a minimum. Splices shall only be made in junction and/or pull boxes. Splices in conduit fittings (i.e., conduit bodies), and in panelboards are not acceptable. Use insulated electrical spring connectors for conductors No. 10 AWG and smaller. Use ring-tongue type terminators on all control wiring. All connectors shall be of material

recommended by conductor manufacturer(s) to prevent any corrosion or electrolysis between dissimilar metals. Use hot or cold shrink cable end caps to seal and insulate all conductor splices in underground installations and for terminations when conductors are terminated on mechanical lugs and for motor connections.

### **3.3 CONDUCTOR SIZING**

a. Install conductor size required by the more stringent requirements of the drawings or specifications.

### **3.4 HOMERUNS**

a. Install no more than three phase conductors of different phases, neutrals and a grounding conductor in a single raceway unless specifically noted on the drawings. Comply with NEC Table 310.15(B)(2)(a) for conductor adjustment (derating) factors.

b. Use homerun circuit numbers as indicated for panelboard connections.

c. Comply with ampacity adjustment factors as required by the NEC Article 310.15.

d. Each 120 volt and 277 volt branch circuit phase conductor shall have a neutral conductor of the same size. The neutral shall be considered a current carrying conductor.

### **3.5 IDENTIFICATION**

a. Refer to Section 26 05 53 for the requirements for the color code identification of 600 volt insulated conductors.

### **3.6 TESTING**

a. Refer to Section 26 00 00 for conductor testing requirements.

End of Section 26 05 19



## **SECTION 26 05 26 - GROUNDING**

### **1.0 GENERAL**

#### **1.1 SCOPE**

a. This section specifies the furnishing and installation of grounding and bonding equipment for electrical systems as required by Articles 200 and 250 of the NEC, as specified herein, and as shown on the contract documents.

#### **1.2 REFERENCE STANDARDS**

a. ANSI/IEEE Std. 81 - Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System.

b. ANSI/IEEE Std. 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

c. ANSI/UL 83 - Standard for Safety Thermoplastic-Insulated Wires and Cables.

d. ANSI/UL 467 - Standard for Safety Grounding and Bonding Equipment.

e. ANSI/UL 486A - Standard for Safety Wire Connectors and Soldering Lugs for Use with Copper Conductors.

#### **1.3 APPLICABLE PROVISIONS**

a. Refer to Section 26 00 00 - Electrical General Provisions.

#### **1.4 SUBMITTALS**

a. Submit manufacturer's technical product data and installation instructions on grounding materials. Include product data substantiating that materials comply with the requirements of this section.

### **2.0 PRODUCTS**

a. All grounding system equipment and components used on this project shall be manufactured by firms that have been regularly engaged in the manufacturer of grounding equipment and components for at least five years.

#### **2.1 GROUND RODS**

a. Provide 3/4-inch by 10-foot long, copper-clad, steel grounding electrodes. Furnish rods to which the copper cladding is permanently and inseparably bonded to a high strength steel core.

#### **2.2 CONNECTIONS**

a. For below grade and concrete encased connections provide exothermic welded type, unless otherwise noted. For above grade connections provide bonds and clamps of a non-ferrous material which will not cause electrolytic action between the conductor and the connector.

### **2.3 BUSHINGS**

- a. Provide threaded malleable iron or steel insulated bushings with external lug for grounding conductor.

### **2.4 CONDUCTORS**

- a. Provide bare conductors for bonding jumpers. Furnish 600-volt insulated conductors having a green-colored insulation for grounding electrode and equipment grounding conductors. Use solid conductors for No. 12 AWG and No. 10 AWG wire; stranded for No. 8 AWG and larger.

### **3.0 EXECUTION**

#### **3.1 INSTALLATION**

- a. All metallic conduits shall be electrically continuously.
- b. Install bonding jumpers in raceway system around expansion joints.
- c. Install grounding conductors in the shortest and straightest paths as possible to minimize transient voltage rises.
- d. Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed.
- e. Install clamp-on connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.
- f. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A to assure permanent and effective grounding.

#### **3.2 GROUNDING ELECTRODE**

- a. Install a grounding electrode system for the service entrance equipment per NEC Article 250.52. Install a bonding conductor between the service equipment ground and neutral bus.

#### **3.3 SYSTEM GROUND**

- a. System Neutral. Where a system neutral is used, ground the system neutral conductor as required by NEC Article 250. Ground the system neutral only at the point of service and isolate it from ground at all other points in the system.
- b. Separately Derived Systems. Ground neutrals of separately derived systems such as generators, transformers, etc., in accordance with NEC Article 250.30.
- c. Size. Size the system grounding conductors to comply with NEC Table 250.66, unless shown larger.

#### **3.4 EQUIPMENT GROUND**

- a. Raceway Systems, Equipment Enclosures, and Equipment.

- (1) Install bonding jumper and grounding-type bushing on each metallic raceway entering or leaving the enclosure of the service equipment.
- (2) Install insulated grounding-type bushings for metal raceways 1-1/2-inch and larger terminating in equipment enclosures containing a ground bus and connect the bushing to the ground bus.
- (3) Install a green insulated equipment grounding conductor for each feeder and branch circuit. Green tape may be used for conductors larger than #6 when conductor is accessible.
- (4) Install bonding jumpers and ground wire throughout to ensure electrical continuity of the grounding system.
- (5) Ground cabinets, boxes, motors, controllers, raceways, switchgear, transformer enclosures, other equipment and metallic enclosures. Ground equipment and enclosures to the continuous-grounded metallic raceway system in addition to any other specific grounding shown.
- (6) Install a separate grounding conductor within all flexible raceways and securely bond to the conduit and device, etc., on both sides of the flexible raceway.
- (7) All receptacles shall be bonded to its respective device box. The connection shall be made by means of a bonding jumper between the device and the box. Where the receptacle mounting yoke is designed and listed for the purpose of grounding; the bonding jumper may be omitted.
- (9) All exterior grade mounted equipment shall have their enclosures grounded directly to a separate driven ground rod at the equipment in addition to the building ground connection.
- (10) All lighting standards over 10 feet high shall have a separate driven ground rod and #6 copper grounding conductor from the ground rod to the lighting standard ground connection.

b. Size. When grounding and bonding conductors are not sized on drawings, size the grounding conductors in accordance with NEC Table 250.122. Size bonding jumper so that minimum cross-sectional area is equal to or greater than that of the equivalent grounding conductor as determined from NEC Table 250.66.

End of Section 26 05 26

## **SECTION 26 05 33 - RACEWAYS**

### **1.0 GENERAL**

#### **1.1 SCOPE**

- a. This Section specifies the furnishing and installation of raceway systems.

#### **1.2 REFERENCE STANDARDS**

- a. ANSI/ANSI C80.1 - Rigid Steel Conduit - Zinc-Coated.
- b. ANSI/ANSI C80.5 - Rigid Aluminum Conduit.
- c. ANSI/ANSI C80.6 - Intermediate Metal Conduit (IMC) - Zinc-Coated.
- d. ANSI/UL 6 - Standard for Safety Rigid Metal Electrical Conduit.
- e. ANSI/UL 360 - Standard for Safety Liquid-Tight Flexible Steel Conduit.
- f. ANSI/UL 467 - Standard for Safety Electrical Grounding and Bonding Equipment.
- g. ANSI/UL 651 - Standard for Safety Schedule 40 and 80 Rigid PVC Conduit.
- h. ANSI/UL 870 - Standard for Safety Wireways, Auxiliary Gutters and Associated Fittings.
- i. ANSI/UL 1242 - Standard for Safety Intermediate Metal Conduit.
- j. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

#### **1.3 APPLICABLE PROVISIONS**

- a. Refer to Section 26 00 00 - Electrical General Provisions.

#### **1.4 SUBMITTALS**

- a. Submit manufacturer's technical product data for each type of raceway system required. Include data substantiating that materials comply with the requirements of this section.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- a. Deliver and store fittings in suitable containers.
- b. Store raceways and fittings in suitable areas to prevent corrosion.
- c. Handling shall be done to assure that raceways are not crushed or damaged in any way which would restrict cross sectional area or cause oxidation.

### **2.0 PRODUCTS**

#### **2.1 CONDUIT AND FITTINGS**

- a. Rigid Metal Conduit

- (1) Either rigid aluminum (alloy 6063-T1) conduit or hot-dip galvanized rigid steel conduit. All threads on rigid steel conduit shall be galvanized after cutting. A uniform zinc coating shall be applied to the inner and outer walls of rigid steel conduit.
  - (2) Fittings for rigid aluminum conduit shall be threaded aluminum. Fittings for rigid steel conduit shall be threaded, malleable iron, either cadmium plated or hot-dip galvanized.
- b. Intermediate Metal Conduit.
- (1) Conduit shall be similar to rigid steel conduit except thinner wall.
  - (2) Fittings shall be threaded, malleable iron, either cadmium plated or hot-dip galvanized.
- c. Rigid Nonmetallic Conduit.
- (1) Conduit shall be schedule 40 polyvinyl chloride (PVC) or fiberglass, UV stabilized, rated for 90°C conductors.
  - (2) Fittings shall be solvent weld socket type.
- d. Liquid-Tight Flexible Steel Conduit.
- (1) Spirally wound continuously interlocked zinc coated strip steel with a UV stabilized polyvinyl chloride (PVC) outer jacket bonded to the conduit.
  - (2) Fittings shall be compression type, malleable iron, with insulated throat, either cadmium plated or hot-dip galvanized.

### **3.0 EXECUTION**

#### **3.1 CONDUIT AND FITTINGS**

- a. The minimum conduit size shall be 1/2-inch except for final connections to individual light fixtures which may be 3/8-inch flexible metal conduit in lengths up to six feet.
- b. Types According to Use. Use rigid metal conduit throughout the project except as specified below. Encase rigid metal conduit in a minimum 3-inch thick concrete envelope where installed below grade outside of the building line. Concrete encasement may be omitted when conduit is installed below slabs on grade.
- (1) Intermediate metal conduit may be used in lieu of rigid metal conduit.
  - (2) Rigid nonmetallic conduit may be installed in concrete slab on grade construction where the nominal trade size diameter is equal to or less than 20 percent of the minimum slab thickness and that all stub-ups transition to rigid steel at the elbow. Conduits in slabs shall be run under the top layer of slab reinforcing. Provide a minimum of 1-1/2-inch clear between conduits and between conduit and parallel reinforcing. Do **not** bundle conduits. Rigid nonmetallic conduit may also be used for underground branch circuits and feeders outside of the building line as permitted by the NEC and local codes. When rigid nonmetallic conduit is used for underground feeders, it shall be encased in a minimum 3-inch thick concrete envelope. All vertical transitions in rigid nonmetallic conduit shall be made using galvanized rigid steel or fiberglass elbows.

- (3) Liquid-tight flexible steel conduit shall be used for final connections to utilization equipment. Liquid-tight flexible steel conduit shall be used for all exterior locations subject to moisture, vibrations, and dry-type transformers.

c. Transitions.

- (1) Continue the heavier, more protective type conduit application not less than 4 inches into the area where lighter, less protective type conduit is permitted.
- (2) For below-grade to above-grade outdoor locations, extend concrete encasement around conduit 4-inches above finished grade and slope top away from conduit with a 6-inch-per-foot slope. After concrete has set, caulk the concrete-to-conduit joint with a silicone rubber compound.

d. Installation Requirements.

- (1) Raceways shall be installed in a neat and orderly manner.
- (2) Install raceway systems where indicated on the Drawings, complete with all junction and pull boxes as necessary and as noted on plans.
- (3) Metallic conduits shall be continuous between enclosures and boxes. The conduit shall be secured to enclosures and boxes so that the raceway system is electrically continuous throughout. Where threaded conduits enter enclosures or boxes without threaded hubs, install locknuts on the inside and outside of the enclosure or box.
- (4) Where threaded conduits are terminated in enclosures without threaded hubs, install insulated bushings for conductor protection. Provide insulated throats or bushings for all fittings and terminations.
- (5) Rigid nonmetallic conduit shall be solvent welded at the joints to form a tight, waterproof connection.

e. Installation Methods.

- (1) Raceway systems shall be complete before installing conductors.
- (2) Raceways shall have openings temporarily plugged to exclude foreign objects. The interior of all raceways shall be cleaned before installing conductors.
- (3) Joints shall be cut square and be reamed smooth. Field threaded conduits shall be coated with an approved zinc chromate or with a 90 percent zinc paint.
- (4) Bends shall be made with standard ells or conduit field bent to radii in accordance with NEC Article 344. Conduit bodies may be used in lieu of conduit ells where ease of installation and appearance warrants their use. Field bends shall be made using equipment designed for the particular conduit material and size. Bends shall be free from dents or flattening. There shall be no more than the equivalent of three ninety degree bends in any raceway between enclosures and boxes.

### 3.2 INSTALLATION OF UNDERGROUND RACEWAYS

- a. Minimum raceway burial depth shall be 24-inches below finished grade to top of the raceway. Multiple raceways shall be installed on nonmetallic spacers with a minimum of 2-inches from adjacent raceways. Spacers shall be on not greater than five foot spacing. Stagger joints in adjacent raceways a

minimum of 6-inches. Use long sweep bends for horizontal changes in direction. Use minimum 36 radius for vertical changes of direction.

b. Excavate trenches to the proper width and depth for the installation of the underground raceways. All trenching shall be done in accordance with OSHA requirements and any state or local safety code pertaining to trench safety. Before beginning trenching operations, stake out the proposed routing to avoid conflicts with field conditions and obtain approval of the Owner and/or Engineer for the routing.

c. Where the bottom of the trench is excavated below the necessary elevation, it shall be brought to proper grade by the use of sand or pea gravel.

d. Where unstable ground is encountered in the bottom of the trench, it shall be excavated to a depth of at least 12-inches below the burial depth of the raceways, and replaced with coarse gravel to the proper height.

e. Where the excavation for its entire depth is in water or wet sand, slope or pump trench so as to drain it effectively prior to placement of raceways.

f. Backfill trenches with the excavated material unless otherwise specified. Backfill shall be thoroughly compacted to 95 percent density of surrounding undisturbed soil. Sodded areas shall be compacted to 95 percent density up to topsoil layer. Topsoil layer shall be lightly compacted then soil mounded to allow for settling.

g. Where raceways are to be installed under existing sidewalks, roads or curbs, saw cut and remove same in order to install the raceways. All sidewalks, roads or curbs shall be replaced with material equal to or better than those now in place.

h. Conduit required to be concrete encased shall be installed on nonmetallic spacers to allow a minimum of 3-inches encasement on all sides a minimum of 2-inches between parallel runs of conduit. Care shall be taken to prevent movement of conduit during pouring. Concrete shall be 2500 PSI, 28 day compressive strength.

i. Thoroughly clean all raceways before installing conductors.

### **3.3 IDENTIFICATION**

a. Refer to Section 26 05 53 for the requirements for identification of raceways.

End of Section 26 05 33

## **SECTION 26 05 34 - ELECTRICAL BOXES**

### **1.0 GENERAL**

#### **1.1 SCOPE**

- a. This Section specifies the furnishing and installation of all outlet boxes, junction boxes and pull boxes.

#### **1.2 REFERENCE STANDARDS**

- a. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
- b. UL 50 - Standard for Safety Enclosures for Electrical Equipment.
- c. UL 514A - Standard for Safety Metallic Outlet Boxes.
- d. UL 514B - Standard for Safety Fittings for Conduit and Outlet Boxes.

#### **1.3 APPLICABLE PROVISIONS**

- a. Refer to Section 26 00 00 - Electrical General Provisions.
- b. Refer to Section 25 05 43.62 – Handholes – Precast Concrete.

#### **1.4 SUBMITTALS**

- a. Submit manufacturer's technical product data on electrical boxes. Include data substantiating that materials comply with the requirements of this section.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- a. Deliver and store boxes in suitable containers.

### **2.0 PRODUCTS**

#### **2.1 OUTLET BOXES**

- a. Exposed Device Boxes. Furnish FS or FD cast boxes for rigid metal conduit systems.

#### **2.2 JUNCTION AND PULL BOXES**

- a. Junction and Pull Boxes: Furnish galvanized code-gauge sheet steel junction and pull boxes where shown on the drawings or where installation conditions warrants their use. Boxes shall be furnished with screw-on covers or hinged covers. Size of cover shall be such that it can easily be handled by one person. All hardware and fasteners shall be stainless steel.
- b. Furnish NEMA 3R boxes in all exterior locations and interior locations subject to moisture.

### **3.0 EXECUTION**



### **3.1 OUTLET BOXES**

- a. Box Openings. Install only the conduit openings necessary to accommodate the conduits at the individual location. Install knockout closures to cap all unused openings.
- b. Gasketing. Install weatherproof outlets and outlets in areas subject to moisture with gaskets between the box and the coverplate.
- c. Coverplates. All boxes shall be installed with coverplates.

### **3.2 JUNCTION AND PULL BOXES**

- a. Installation. Install boxes as required to facilitate conductor installation in raceway systems. Junction and pull boxes shall be sized to accommodate conductor system splices and associated insulation.
- b. Covers. Install boxes so that covers are readily accessible and easily removable after completion of the installation. Select a practical size for each box and cover. All boxes shall have covers.

### **3.3 IDENTIFICATION**

- a. Refer to Section 26 05 53 for the requirements for the identification of electrical boxes.

End of Section 26 05 34

## **SECTION 26 05 43.62 - HANDHOLES - PRECAST CONCRETE**

### **1.0 GENERAL**

#### **1.1 SECTION INCLUDES**

a. This Section specifies the furnishing and installation of precast handholes for power and telecommunications systems.

#### **1.2 REFERENCE STANDARDS**

a. ANSI/ACI 301 - Specifications for Structural Concrete for Buildings.

b. ANSI/ASTM A 615 - Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

### **2.0 PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

a. Precast handholes shall be manufactured by Dalworth Concrete Products, Brooks Products, Quazite Utility Products, Oldcastle Precast, Hanson Products, or approved equivalent.

#### **2.2 GENERAL**

a. All precast concrete handhole sections shall be manufactured in a plant especially designed for that purpose. All units shall conform to the design shown on the drawings, and all work shall be done under strict plant controlled supervision.

#### **2.3 DESIGN LOADS**

a. Design loads shall consist of dead load, live load, impact, and in addition, loads due to water table, and any other loads which may be imposed upon the manhole or handhole. Live loads shall be for HS-20 per AASHTO Standard Specifications for Highway Bridges with revisions. Design wheel load shall be 16 kips. The load case shall be that which produces the maximum shears and bending moments in the manhole or handhole.

#### **2.4 FORMS**

a. All forms used in placing concrete shall be metal and sufficiently designed and braced to maintain their alignment under pressures of the concrete during placing. Coordinate blockouts to receive all proposed duct bank connections. The lowest edge of blockout shall be no less than 6 inches above the inside surface of the floor of the base connection.

#### **2.5 CONCRETE**

a. Aggregate. All aggregates fine and coarse, other than lightweight aggregate, shall conform to specifications outlined by ASTM C 33. Lightweight aggregates fine and coarse shall conform to the specifications outlined by ASTM C 330. Aggregates shall be free of deleterious substances causing reactivity with oxidized hydrogen sulfide. Both types of aggregate shall be graded in a manner so as to produce a homogeneous concrete mix. All materials are to be accurately weighted at a central batching facility for mixing.

b. Cement. All cement shall be Portland cement conforming to ASTM C 150. Type I, Type III or Type V if specified. Cement content shall be sufficient to produce minimum strength of 4,500 psi, or other design strengths required.

c. Placing. All concrete shall be handled from the mixer or transport vehicle to the place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients, until (the approved unit operation) is completed. Concrete shall be placed in layers not over one-foot deep. Each layer shall be compacted by mechanical internal or external vibrating equipment. Duration of the vibration cycle shall be limited to the time necessary to produce satisfactory consolidation without causing objectionable segregation.

d. Curing. For purposes of early reuse of forms, the concrete may be heated in the mold, after initial set has taken place. The temperature shall not exceed 160 degrees, and the temperature shall be raised from normal ambient temperatures at a rate not to exceed 40 degrees per hour. The cured unit shall not be removed from the forms until sufficient strength is obtained for the unit to withstand any stresses that may be subjected during the form stripping operation. After the stripping of forms, further curing by means of water spraying or a membrane curing compound may be used and conform to ASTM C 309.

## **2.6 REINFORCING STEEL**

a. All reinforcing steel, including welded wire mesh, shall be of the size and in the location as recommended by the precast manhole/handhole manufacturer. All reinforcing shall be sufficiently tied to withstand any displacement during the pouring operation. All bars shall be intermediate or hard grade billet steel conforming to ASTM A 615 or A 706, Grade 60. Welded wire mesh shall conform to ASTM A 497, Grade 70. Bars other than 1/4-inch round, or smaller, shall be deformed in accordance with ASTM A 305.

## **2.7 FRAME AND COVER**

a. Cast in frame and cover shall be made of galvanized plate steel with angle stiffness as required by the loading requirements for the area in which the manholes/handholes will be installed. Provide AASHT70 H20 wheel load covers in roadway areas, sidewalk covers in concrete walks and AASHTO H10 wheel load covers in grassy areas. Covers shall have door hinges, drop handles and padlock hasps.

## **3.0 EXECUTION**

### **3.1 LOCATION AND INSPECTION**

a. Install handholes approximately where shown on the drawings. Final location may be adjusted slightly to fit actual field conditions.

b. Before beginning excavation operations, stake out the proposed manhole and handhole locations and obtain approval of the Engineer.

c. The Contractor shall prepare the excavation for the correct elevation after the base has been properly installed. The depth of the base and the material used for the base shall meet the requirements for the type of soil at the setting location. The base shall be compacted and level before placing the bottom section of the handhole. All shoring and sheeting required to perform and protect the excavation and to safeguard employees shall be provided.

d. Coordinate installation of the precast handhole with the manufacturer to assure the proper grout sealant is provided to form a water-tight barrier.

- e. Install top of handholes level with existing grades. Provide domed concrete housekeeping pads around handholes covers. Extend 24 inches down and out from edge of handhole cover starting 2 inches above grade at cover edge to grade at edge of pad.
- f. Final locations of all handholes shall be identified on project Record Drawings.

### **3.2 EXCAVATION AND BACKFILL**

- a. Perform all necessary excavation and backfill for proper installation of precast handholes as recommended by manufacturer. Use excavated soil for backfill and supplement as necessary with select materials. Compact all backfill and restore adjacent areas disturbed by excavation and backfilling operations to a condition equal to the original.

### **3.3 CLEANING**

- a. Before any equipment or cable is installed, remove all dirt and debris and pump out the manhole and handhole so that it is free of standing water.

### **3.4 IDENTIFICATION**

- a. Provide identification on top of cover to indicate Electric usage.

End of Section 23 05 43.62

## **SECTION 26 05 53 - ELECTRICAL IDENTIFICATION**

### **1.0 GENERAL**

#### **1.1 SCOPE**

a. This Section specifies the furnishing and installation of products for the identification of electrical materials and equipment.

#### **1.2 REFERENCE STANDARDS**

- a. ANSI/NFPA 70 - National Electrical Code.
- b. OSHA - Occupational Safety and Health Act.

#### **1.3 APPLICABLE PROVISIONS**

- a. Refer to Section 26 00 00 - Electrical General Provisions.
- b. Refer to Section 26 27 26 – Wiring.

#### **1.4 SUBMITTALS**

a. Submit manufacturer's technical product data for each type of product furnished. Include data substantiating that materials comply with the requirements of this section. Refer to paragraph 3.7(b).

### **2.0 PRODUCTS**

#### **2.1 UNDERGROUND INSTALLATION MARKING TAPE**

a. Furnish Seton style 37236 and 45384 or approved equivalent 4-mil thick by 6" wide polyethylene non-adhesive tape for marking the installation of underground raceways.

#### **2.2 COLORED TAPE**

a. Furnish Scotch No. 35 or approved equivalent 7-mil thick by 3/4" wide vinyl adhesive tape for color coding of No. 8 AWG and larger 600 volt insulated conductors.

#### **2.3 PLASTIC NAMEPLATES**

a. Furnish engraved black-white-black plastic laminate nameplates for identification of normal service equipment. Edges of nameplates shall be chamfered.

### **3.0 EXECUTION**

#### **3.1 INSTALLATION**

- a. Install identification products as required by the NEC and OSHA and elsewhere where required by this section.
- b. Install identification products in accordance with manufacturer's written instructions.
- c. Where identification is to be applied to surfaces that require a field finish, install identification after completion of the finish work.

### 3.2 UNDERGROUND RACEWAYS

a. Install underground installation marking tape 6 to 12-inches below grade directly over all underground raceways that are exterior to the building.

- (1) Warning tape over electrical installation under 600 volts shall be red with black lettering stating "BURIED ELECTRICAL LINE".

### 3.3 INSULATED CONDUCTORS

a. Color code all 600 volt ungrounded, insulated conductors by installing conductors with factory colored insulation for conductors No. 10 AWG and smaller in accordance with the table in paragraph c. below. Factory colored insulation for 600 volt grounded and grounding conductors shall be provided for No. 6 and smaller.

b. Install colored tape on all 600 volt ungrounded, insulated conductors No. 8 AWG and larger in accordance with the table in paragraph c. below. Install colored tape on all 600 volt grounded and grounding conductors No. 4 and larger. Apply tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Do not cover factory applied cable identification markings with taping; tape locations may be adjusted slightly to prevent the covering of factory markings.

c. Color code conductors with the table below or as required by local codes if different from the color scheme indicated.

Phase	480Y/277	120/240
A or L1	Purple	Black
B or L2	Brown	Red
C or L3	Yellow	---
Neutral	Gray	White
Ground	Green	Green

### 3.4 WARNING SIGNS

a. Install flash protection warning signs per NEC Article 110.16.

### 3.5 EQUIPMENT

a. Install engraved plastic laminate nameplates as listed below. The intent of the equipment nameplate is to provide 3 or 4 lines of information for future maintenance action as follows:

- (1) Line 1 - Equipment name.
- (2) Line 2 - Description (what it is, i.e. panelboard, disconnecting means).
- (3) Line 3 - Service (what it serves).
- (4) Line 4 - Additional data as appropriate.

b. Contractor shall submit a nameplate schedule for approval by the A/E prior to installation.

<b>EQUIPMENT</b>	<b>SIZE LETTERING</b>	<b>INFORMATION</b>
<b>PANELBOARDS</b>		
Name/Ratings	1/4" /1/8"	Panelboard designation/ampere rating and voltage characteristics EX: 1LB3 225A 208Y/120V
<b>TRANSFORMERS</b>	1/8"	Load served, KVA rating and circuit number EX: PANEL 1LB3, 30KVA CKT SWBD1-1
<b>SAFETY SWITCHES</b>	1/8"	Load served, HP and circuit number EX: ELEVATOR NO. 1, 30HP CKT 1LB3 -37,39,41

c. Install nameplates labels in locations on the equipment for best convenience of viewing without interfering with the operation and maintenance of equipment. Secure nameplate to equipment by means of stainless steel self-tapping machine screws.

End of Section 26 05 53

## **SECTION 26 24 16 - PANELBOARDS**

### **1.0 GENERAL**

#### **1.1 SCOPE**

- a. This Section specifies the furnishing and installation of branch circuit panelboards.

#### **1.2 REFERENCE STANDARDS**

- a. ANSI/NEMA PB 1 - Panelboards.
- b. ANSI/UL 67 - Standard for Safety Panelboards.
- c. ANSI/UL 489 - Standard for Safety Molded-Case Circuit Breakers and Circuit-Breaker Enclosures.
- d. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
- e. NEMA AB 3 - Molded Case Circuit Breakers and Their Application.
- f. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- g. UL 50 - Standard for Safety Enclosures for Electrical Equipment.
- h. UL 508 - Standard for Safety Industrial Control Equipment.

#### **1.3 APPLICABLE PROVISIONS**

- a. Refer to Section 26 00 00 - Electrical General Provisions.
- b. Refer to Section 26 28 00 – Overcurrent Protective Devices.

#### **1.4 SUBMITTALS**

- a. Submit manufacturer's technical product data on circuit breakers and accessories.
- b. Submit shop drawings for each panelboard which include outline and support points, dimensions, voltage, main bus ampacity, short circuit ampere interrupting rating, circuit breaker arrangement, sizes and number of poles. Shop drawing shall list all circuit breakers to be installed in panelboard.
- c. Circuit breaker arrangement must be identical to the schedules or one line diagram unless there is a technical reason for deviation. All reasons for deviation must be stated on the shop drawings.

#### **1.5 OPERATION AND MAINTENANCE DATA**

- a. Submit manufacturer's standard operation and maintenance data/manuals.

### **2.0 PRODUCTS**

#### **2.1 GENERAL**

- a. Furnish copper bus.



- b. Furnish full size neutral bus in all panels or as required by the panel schedule and/or one line diagram.
- c. Furnish all panelboards with a separate equipment ground bus.
- d. Furnish all spaces specified on the schedules complete with all breaker mounting accessories required to accommodate the breaker frame size specified.
- e. Furnish nameplate and a welded circuit directory frame and card with a clear plastic covering on the inside of the door for all panelboards. All circuit loads shall be identified on the circuit directory as specified in Section 26 00 00.

## **2.2 SHORT CIRCUIT RATINGS**

- a. Each panelboard, shall have a short circuit current rating equal to or greater than the rating shown on the panelboard schedule or on the one-line diagram. The short circuit rating shall be based solely on the ratings of the branch breakers in the panel. Series rating of standard AIC branch breakers with high AIC integral or remote main/feeder breakers is not acceptable.
- b. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage. 240 volt maximum branch circuit panels shall be rated 10,000 AIC RMS symmetrical minimum. 480 volt maximum branch circuit panels shall be rated 14,000 AIC RMS symmetrical minimum and distribution panels shall be rated 22,000 AIC RMS symmetrical minimum.

## **2.3 BRANCH CIRCUIT PANELBOARDS**

- a. Panelboard bus structure and main lugs or main circuit breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests, conducted in accordance with UL Standard 67. Bus structure shall be insulated. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or phase sequence type. All current carrying parts of the bus structure shall be plated.
- b. The panelboard bus assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. The size of wiring gutters shall be in accordance with UL Standard 67. The box shall be fabricated from galvanized steel. Each cabinet shall include a hinged door-in-door steel front cover and have a flush, cylinder tumbler-type lock with catch and spring-loaded stainless steel door pull. All panelboards shall be keyed alike. Fronts shall have adjustable indicating trim clamps which shall be completely concealed when the doors are closed. Doors shall be mounted with completely concealed steel hinges. Fronts shall not be removable with door in the locked position.

## **2.4 OVERCURRENT PROTECTIVE DEVICES**

- a. Furnish thermal magnetic circuit breakers for branch circuit panelboards for the specified service with the number of poles and ampere ratings indicated.
- b. Furnish breakers which are quick-make and quick-break on both manual and automatic operation. Use a trip-free breaker which is trip indicating. Incorporate inverse time characteristic by bi-metallic overload elements and an instantaneous characteristic by magnetic trip. Where indicated, provide ground fault breakers (GFCB).
- c. For 2-pole and 3-pole breakers, use the common-trip type so that an overload or fault on one pole will trip all poles simultaneously. Handle ties are not acceptable except where multiple single breakers are used to serve modular furniture.

d. Connect breakers to the branch circuit panelboard main bus by means of a solidly bolted connection. Use breakers which are interchangeable, capable of being operated in any position within the panel. Independently mount breakers so that a single unit can be removed from the front of the panel without disturbing or removing main bus, other units or other circuit breaker connections.

## **2.5 ACCEPTABLE MANUFACTURERS**

a. Eaton, General Electric, Siemens Energy & Automation, Square D.

## **3.0 EXECUTION**

### **3.1 INSTALLATION**

a. At the completion of the electrical system, the Contractor shall check each phase of all panelboards under full load conditions and arrange so that all phases shall carry approximately the same load. Refer to Section 26 00 00 for Test Requirements.

### **3.2 MOUNTING HEIGHT**

a. Install the panelboards to comply with the applicable provisions of NEMA Standard PB1.1 and such that the center of the switch or circuit breaker in the highest position will not be more than 6-1/2 feet above the floor or working platform.

### **3.3 PANELBOARD DIRECTORY**

a. Prepare a neatly typed circuit directory and install behind a clear heat-resistant plastic protector on the inside of the door of each panelboard. Identify circuits by equipment served and by room numbers selected by the Owner; names and numbers may be different from those shown on drawings. Indicate spares and spaces with light, erasable pencil marking.

### **3.4 IDENTIFICATION**

a. Refer to Section 26 05 53 for the requirements for the identification of panelboards.

End of Section 26 24 16

## **SECTION 26 28 00 - OVERCURRENT PROTECTIVE DEVICES**

### **1.0 GENERAL**

#### **1.1 SCOPE**

- a. This Section specifies the furnishing and installation of low voltage fuses rated 600 volts and below, 600 amperes and below and automatic circuit breakers.

#### **1.2 REFERENCE STANDARDS**

- a. ANSI/ANSI C97.1 - Standard for Low Voltage Cartridge Fuses 600 Volts and Less.
- b. NEMA FU 1 - Low Voltage Cartridge Fuses.
- c. NEMA AB 1 - Molded Case Circuit Breakers.
- d. NEMA AB 2 - Procedures for Verifying the Performance of Molded Case Circuit Breakers.
- e. UL 198.3 - High-Interrupting-Capacity Class K Fuses.
- f. UL 198.4 - Class R Fuses.

#### **1.3 APPLICABLE PROVISIONS**

- a. Refer to Section 26 00 00 - Electrical General Provisions.

#### **1.4 SUBMITTALS**

- a. Submit shop drawings and product data for fuses and circuit breakers.
- b. Include time current curves, dimensions, voltage, short circuit ampere interrupting rating, continuous current rating and number of poles.

#### **1.5 OPERATION AND MAINTENANCE DATA**

- a. Provide operation and maintenance data in accordance with Section 26 00 00.

### **2.0 PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- a. Subject to compliance with the requirements, acceptable manufacturers shall be as follows:
  - (1) Fuses.
    - (a) Bussmann - Cooper Industries.
    - (b) Littelfuse, Inc.
    - (c) Mersen.

- (2) Circuit Breakers.
  - (a) Eaton.
  - (b) General Electric Co.
  - (b) Siemens Energy and Automation Inc.
  - (c) Square D Co.

## **2.2 FUSES**

- a. Provide fuses with a voltage rating suitable for the normal voltage of the system in which they are to be applied.
- b. Class RK1 Time-Delay Fuses: Fuses rated from 1/10 to 600 amperes shall be UL Class RK1, dual element time-delay type. The fuses shall have separate overload and short circuit elements. The fuses shall have a spring assisted thermal element with a melting point of 284°F. The two elements shall be physically separated in different chambers. The fuse shall be capable of maintaining an overload of 500% of its rated current for a minimum of 10 seconds. The fuses shall have a U.L. listed interrupting rating of 200,000 amperes rms/sym.
- c. Class RK5 Time-Delay Fuses: Fuses rated from 1/10 to 600 amperes shall be UL class RK5, dual element time-delay type. The fuses shall have separate overload and short circuit elements. The fuses shall have a spring assisted thermal element with a melting point of 284°F. The two elements shall be physically separated in different chambers. The fuse shall be capable of maintaining an overload of 500% of its rated current for a minimum of 10 seconds. The fuses shall have a U.L. listed interrupting rating of 200,000 amperes rms/sym.

## **2.3 CIRCUIT BREAKERS**

- a. Molded-Case Circuit Breakers: Provide molded-case thermal magnetic circuit breakers. Provide breakers with permanent thermal and instantaneous magnetic trips in each pole. Two and three pole breakers shall be common trip. Construct with overcenter, trip-free, toggle type operating mechanisms with quick-make, quick-break action and positive handle indication. Construct breakers for mounting and operating in any physical position and operating in an ambient temperature of 40 degrees C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated for 65° or 75°C wire for breaker sizes less than 100 amperes and 75°C for breaker sizes 100 amperes and greater. The circuit breakers shall have a minimum 10,000 AIC at 120/208 volts and 14,000 AIC at 277/480 volt. Provide breakers with an AIC rating equal to or greater than the minimum rating noted on the panelboard schedules.

## **3.0 EXECUTION**

### **3.1 INSTALLATION**

- a. Install overcurrent protective devices for all wiring and equipment as indicated, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of overcurrent protective devices.

### **3.2 FUSES**

- a. Check all fuse clip fasteners for alignment and tightness in accordance with the manufacturers recommendations.

- b. Install fuses so label is in an upright, readable position.
- c. All fused disconnects shall have a label placed on the inside of the door that indicates fuse size and type. The manufacturers standard label shall suffice.

### **3.3 CIRCUIT BREAKERS**

- a. Fasten circuit breakers without mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cabling.
- b. Set field-adjustable circuit breakers for trip settings as indicated, subsequent to installation of units.
- c. Inspect circuit-breakers operating mechanisms for malfunctioning and, where necessary, adjust or replace units for free mechanical movement.

### **3.4 SPARE FUSES**

- a. As spares, provide the greater amount of either three fuses or 10 percent of each size and type installed. Deliver the spare fuses to the Owner at the time of final acceptance of the project. Neatly encase the spare fuses in suitable containers or cabinets.

End of Section 26 28 00

## **SECTION 26 28 16 - ENCLOSED SAFETY SWITCHES**

### **1.0 GENERAL**

#### **1.1 SCOPE**

- a. This Section specifies the furnishing and installation of enclosed safety switches.

#### **1.2 REFERENCE STANDARDS**

- a. ANSI/UL 98 - Standard for Safety Enclosed and Dead-Front Switches.
- b. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

#### **1.3 APPLICABLE PROVISIONS**

- a. Refer to Section 26 00 00 - Electrical General Provisions.

#### **1.4 SUBMITTALS**

- a. Submit manufacturer's technical product data for all disconnect switches. Include data substantiating that materials comply with the requirements of this section.

### **2.0 PRODUCTS**

#### **2.1 CHARACTERISTICS**

- a. Voltage. Furnish switches with voltage rating of 250 volts d-c, 240 volts or 600 volts a-c, as required for the installed system voltage.
- b. Type. Furnish switches conforming to NEMA Standard KS 1 for Type HD (heavy duty).
- c. Contacts. Furnish switches with quick-make, quick-break contacts.
- d. Poles. Furnish 3-pole, visible blade switches, unless otherwise indicated on the drawings.

#### **2.2 CONSTRUCTION**

- a. Enclosure. NEMA 3R for outdoor location, unless otherwise indicated.
- b. Operating Handle. Furnish a handle suitable for padlocking in the OFF position with as many as three padlocks of 5/16-inch diameter shank. Use a defeatable, front accessible, coin-proof door interlock to prevent opening the door when the switch is in the ON position and to prevent turning the switch ON when the door is open.
- c. Terminal Shield. Furnish incoming line terminals with an insulated shield so that live parts are not exposed when the door is open.
- d. Neutral. Where neutrals are indicated furnish switches with an isolated, fully rated neutral block. Make provisions for bonding the block to switch enclosure.
- e. Fuse Holders. Where fusible switches are indicated, furnish switches with rejection-type fuse holders and fuses conforming to Section 26 28 00, Overcurrent Protective Devices.

f. Nameplates. Furnish a front cover mounted metal nameplate, indicating the switch type, catalog number and horsepower rating (with both standard and time delay fuses).

g. Provide grounding bar.

### **2.3 ACCEPTABLE MANUFACTURERS**

a. Eaton, General Electric, Siemens Energy & Automation, Square D.

### **3.0 EXECUTION**

#### **3.1 INSTALLATION**

a. Install switches for all equipment that requires them. Mount so that operating handle is approximately 48-inches above finished floor. Where grouped, align tops of switches.

#### **3.2 IDENTIFICATION**

a. Refer to Section 26 05 53 for the requirements for the identification of safety switches.

End of Section 26 28 16

## **SECTION 26 56 68 – EXTERIOR ATHLETIC LIGHTING**

### **1.0 GENERAL**

#### **1.1 SUMMARY**

a. Work covered by this Section of the specifications shall conform to the Contract Documents, engineering plans as well as state and local codes.

b. The purpose of these specifications is to define the lighting system performance and design standards for Copernicus Park using an LED Lighting source. The Contractor shall supply Musco Sports lighting equipment to meet or exceed the standards set forth in these specifications. Contact Tim Oordt, Musco Lighting at 512-658-6884. Proposed substitutions shall be submitted at least 10 days prior to bid opening and any approved substitutions will be addressed by Addendum prior to bid opening.

c. The sports lighting will be for the following venues

- (1) Multi-Use Area – Base Bid 20 foot-candles.
- (2) Multi-Use Area – Alternate 1 – 25 foot-candles.
- (3) Multi-Use Area – Alternate 2 – 30 foot-candles.

d. The primary goals of this sports lighting project are:

- (1) **Guaranteed Light Levels:** Selection of appropriate light levels impact the safety of the players and the enjoyment of the spectators. Therefore light levels are guaranteed to not drop below specified target values for a period of 25 years.
- (2) **Environmental Light Control:** It is the primary goal of this project to minimize spill light to adjoining properties and glare to the players, spectators, and neighbors. The LED design should provide better control than a good HID design.
- (3) **Life-Cycle Cost:** In order to reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be eliminated for the duration of the warranty.
- (4) **Control and Monitoring:** To allow for optimized use of labor resources and avoid unneeded operation of the facility, customer requires a remote on/off control system for the lighting system. Fields should be proactively monitored to detect luminaire outages over a 25-year life cycle. All communication and monitoring costs for 25-year period shall be included in the bid.

#### **1.2 LIGHTING PERFORMANCE**

a. **Illumination Levels and Design Factors:** Playing surfaces shall be lit to an overage target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified below. Appropriate light loss factors shall be applied and submitted for the basis of design. Average illumination level shall be measured in accordance with EISNA LM-5-04 (IESNA Guide for Photometric Measurements of Area and Sports Lighting Installations). Illumination levels shall not drop below desired target values in accordance to IES RP-6-15, Page 2, Maintained Average Illuminance and shall be guaranteed for the full warranty period.



Area of Lighting	Average Target Illumination Levels	Max to Min Uniformity Ratio	Grid Points	Grid Spacing
Multi-Use Area Base Bid	20fc	3.0:1.0	324	20' x 20'
Multi-Use Area Alternate 1	25fc	2.5:1.0	324	20' x 20'
Multi-Use Area Alternate 2	30fc	2.0:1.0	324	20' x 20'

b. Hours of usage: Designs shall be based on the following hours of usage.

Area of Lighting	Annual Usage Hours	25 Year Usage Hours
Multi-Use Area	1000	25,000

c. Color: The lighting system shall have a minimum color temperature of 5700K and a CRI of 75.

d. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, minimum mounting heights shall be as described below. Higher mounting heights may be required based on photometric report and ability to ensure the top of the field angle is a minimum of 10 degrees below horizontal.

# of Poles	Pole Designation	Pole Height
4	P2, P3, P5, P6	70'
2	P1, P4	80'

**1.3 ENVIRONMENTAL LIGHT CONTROL**

a. Light Control Luminaries: All luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers and external shields. No symmetrical beam patterns are accepted.

b. Spill Light and Glare Control: To minimize impact on adjacent properties, spill light and candela values must not exceed the following:

Property Line at 20 footcandles	Maximum
Maximum Vertical Footcandles	1.0 fc
Horizontal Footcandles	0.9 fc
Max Candela	215,000 Cd (Along the East and South property lines.)

<b>Property Line at 25 footcandles</b>	<b>Maximum</b>
Maximum Vertical Footcandles	1.25 fc
Horizontal Footcandles	1.25 fc
Max Candela	215,000 Cd (Along the East and South property lines.)

<b>Property Line at 30 footcandles</b>	<b>Maximum</b>
Maximum Vertical Footcandles	1.75 fc
Horizontal Footcandles	1.5 fc
Max Candela	225,000 Cd (Along the East and South property lines.)

c. Spill Scans: Spill scans must be submitted indicating the amount of horizontal and vertical footcandles along the specified lines. Light levels shall be taken at 20-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights. Illumination level shall be measured in accordance with the IESNA LM-0-5-or after 1 hour warm up.

**1.4 LIFE-CYCLE COSTS**

a. Manufacturer shall submit a 25-year life cycle cost calculation as outlined in the required submittal information.

b. Preventative and Spot Maintenance: Manufacturer shall provide all preventative and spot maintenance, including parts and labor for 25 years from the date of equipment shipment. Individual outages shall be repaired when the usage of any field is materially impacted. Owner agrees to check fuses in the event of a luminaire outage.

**2.0 GENERAL**

**2.1 SPORTS LIGHTING SYSTEM CONSTRUCTION**

a. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.

b. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel of 18-8 grade or better passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A 153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.

- c. System Description: Lighting system shall consist of the following:
- (1) Galvanized steel poles and cross-arm assembly.
  - (2) Non-approved pole technology.
    - (a) Square static cast concrete poles will not be accepted.
    - (b) Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and exterior corrosive reaction to the soils and long term performance concerns.
  - (3) Lighting systems shall use concrete foundations See Section 2.3 for details.
    - (a) For a foundation using a pre-stressed concrete base embedded in concrete backfill the concrete shall be air-entrained and have a minimum compressive design strength at 28 days of 3,000 Psi. 3,000 Psi concrete specified for early pole erection, actual required minimum allowable concrete strength is 1,000 Psi. All piers and concrete backfill must bear on and against firm undisturbed soil.
    - (b) For anchor bolt foundations or foundations using a pre-stressed based in a suspended pier or reinforced pier design pole erection may occur after 7 days. Or after a concrete sample from the same batch achieves a certain strength.
  - (4) Manufacturer shall supply all drivers and supporting electrical equipment.
    - (a) Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure will be located in the enclosure.
  - (5) Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2\_2002.
  - (6) Wire harness shall be complete with an abrasion protection sleeve, strain relief and plug-in connections for fast trouble-free installation.
  - (7) All luminaires, visors, and cross-arm assemblies shall withstand 150 mph winds and maintain luminaire aiming alignment.
  - (8) Control cabinet to provide remote on-off control and monitoring of the lighting system. See Section 2.4 for further details.
  - (9) Manufacturer shall provide lightning grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.
    - (a) Integrated grounding via concrete encased electrode grounding system.
    - (b) If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780. The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet of embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductors with a minimum size of 2 AWG for

poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.

- d. Safety: All system components shall be UL listed for the appropriate application.

## **2.2 ELECTRICAL**

- a. Electric Power Requirements for the Sports Lighting Equipment:

- (1) Electric power: See plans.
- (2) Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

- b. Energy Consumption: The kW consumption for the field lighting system shall be 54.10 kW.
- c. Energy Consumption **20fc**: The kW consumption for the field lighting system shall be 39.1 kW.
- d. Energy Consumption **25fc**: The kW consumption for the field lighting system shall be 46.0 kW.
- e. Energy Consumption **30fc**: The kW consumption for the field lighting system shall be 52.9 kW.

## **2.3 STRUCTURAL PARAMETERS**

- a. Wind Loads: Wind loads shall be based on the 2015 International Building Code. Wind loads to be calculated using ASCE 7-10, an ultimate design wind speed of 115 and exposure category C.
- b. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to 2009 AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-5).
- c. Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report.
- d. The Contractor shall submit detailed pole calculations and a foundation design, stamped by a structural engineer licensed in the state of Texas proving compliance with the paragraphs above, if any changes are made to the foundation detail on the drawings.

## **2.4 CONTROL**

- a. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.
- b. Lighting contactor cabinet(s) constructed of NEMA Type 4 aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.
- c. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).
- d. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of luminaire outages, control operation and service. Mobile application will be provided suitable for IOS, Android and Blackberry devices.

e. Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the Owner.

- (1) Cumulative hours: shall be tracked to show the total hours used by the facility
- (2) Report hours saved by using early off and push buttons by users.

f. Communication Costs: Manufacturer shall include communication costs for operating the controls and monitoring system for a period of 25 years.

### **PART 3 – EXECUTION**

#### **3.1 SOIL QUALITY CONTROL**

a. It shall be the Contractor's responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner's approval / payment for additional costs associated with:

- (1) Providing engineered foundation embedment design by a registered engineer in the State of Texas for soils other than specified soil conditions;
- (2) Additional materials required to achieve alternate foundation;
- (3) Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

#### **3.2 DELIVERY TIMING**

a. Delivery Timing Equipment On-Site: The equipment must be on-site 6 – 8 weeks from receipt of approved submittals and receipt of complete order information.

#### **3.3 FIELD QUALITY CONTROL**

a. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA LM-5-04 and verified by an independent NETA (National Electrical Testing Association) certified testing organization.

b. Field Light Level Accountability

- (1) Light levels are guaranteed not to fall below the target maintained 30 foot candle light levels for the entire warranty period of 25 Years.
- (2) The Contractor/manufacturer shall be responsible for an additional inspection one year from the date of commissioning of the lighting system and will utilize the manufacturer's certified color and cosine corrected foot candle light meter in the presence of the owner.
- (3) The Contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities. The Contractor will be held responsible for any damage to the fields during these repairs.

c. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles and uniformity ratios are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.

### **3.4 WARRANTY AND GUARANTEE**

a. 25-Year Warranty: The manufacturer shall supply a signed warranty covering the entire system for 25 years from the date of shipment. Warranty shall guarantee specified light levels. Manufacturer shall maintain specifically-funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.

b. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and luminaire outage for 25 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Owner agrees to check fuses in the event of a luminaire outage.

End of Section 26 56 68

**City of San Antonio  
Copernicus Park**

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ELECTRICAL SPECIFICATIONS**

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