SP- 157005
(New)

SPECIAL PROVISIONS
FOR
ELECTRICAL SYSTEM

Dubuque County
TAP-U-2100(683)--8I-31

Effective Date
November 17, 2015

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

GENERAL ELECTRICAL REQUIREMENTS

1 GENERAL

1.01 SUMMARY

A. Work includes general requirements for all electrical work.

1.02 REFERENCES

A. ANSI/NFPA 70–National Electrical Code.

B. ANSI/IEEE C2–National Electrical Safety Code.

1.03 CONTRACT DOCUMENTS

A. Any equipment roughed in improperly and/or not positioned on implied centerlines or as dictated by good practice shall be repositioned at no cost to Contracting Authority.

B. The plans are generally diagrammatic, and Contractor shall coordinate the work so that interferences are avoided. Provide all offsets in conduit, fittings, etc., necessary to properly install the work. All offsets, fittings, etc., shall be provided without additional expense to Contracting Authority.

1.04 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 70.

B. Conform to ANSI/IEEE C2.

C. The rules and regulations of the federal, state, local, and civil authorities and utility companies in force at the time of execution of the Contract shall become a part of this specification.

D. Obtain electrical permits and inspections from authority having jurisdiction. Costs for permits and inspections shall be by Contractor.

1.05 CODES AND ORDINANCES

A. Contractor is expected to know or to ascertain, in general and in detail, the requirements of all codes and ordinances applicable to the construction and operation of systems covered by this Contract. Contractor shall know or ascertain the rulings and interpretations of code requirements being made by all authorities having jurisdiction over the work to be performed by them.

B. In preparing Bid, include the cost of all items and procedures necessary to satisfy the requirements of all applicable codes, ordinances, and authorities, whether or not these are specifically covered by the plans and specifications. All cases of serious conflict or omission between the plans, specifications, and codes shall be brought to Engineer's attention, as herein before specified. Contractor shall carry out work and complete construction as required by applicable codes and ordinances and in such a manner as to obtain approval of all authorities whose approval is required.

C. When requested by Engineer, provide written calculations to show compliance with

applicable codes or the Contract Documents. This shall include, but not be limited to, conduit and wire sizing, junction and pull box fill and sizing, handhole sizing, conductor derating, and voltage drop. Contractor shall indicate calculation method used as well as compliance with applicable code, drawing, or specification.

1.06 EQUIPMENT PROVIDED UNDER OTHER SPECIAL PROVISIONS

A. Included in this Contract are electrical connections to equipment provided under other special provisions. Refer to final shop drawings for equipment being furnished under other Special Provisions, for exact location of electrical equipment, and the various connections required.

1.07 ELECTRICAL DISTRIBUTION SYSTEM

A. Provide a complete electrical distribution system consisting of components indicated on the plans or specified herein including, but not limited to:
   1. Feeders, branch wiring, and electrical distribution equipment.
   2. All control wiring.
   3. Access panels and access doors for access to equipment installed under this Special Provision.
   4. Wiring between system components if equipment is not prewired.
   5. Lighting fixtures, lighting controls, and associated wiring.
   6. Support system design and supports for electrical raceways.
   7. Code-required disconnects.

B. Connect the following equipment furnished under other Special Provisions consisting of components indicated on the plans or specified herein, including, but not limited to, kiosk equipment.

C. Provide balancing and adjusting of electrical loads.

D. Instruct Contracting Authority's representative in the operation and maintenance of all equipment. The instruction shall include a complete operating cycle on all apparatus.

E. Provide miscellaneous items for a complete and functioning system as indicated on the plans and specified herein.

F. A partial list of work not included in this Special Provision is as follows: Painting (except as otherwise specified herein).

1.08 NOISE

A. Eliminate any abnormal noises that are not considered by Engineer to be an inherent part of the systems as designed. Abnormal buzzing in equipment components will not be acceptable.

1.09 PLANS

A. The plans indicate approximate locations of the various items of the electrical systems. These items are shown approximately to scale and attempt to show how these items should be integrated with construction. Locate all the various items by on-the-job measurements in conformance with contract documents and cooperation with other trades.

B. Prior to locating equipment, confer with Engineer as to desired location in the various

areas. In no case should equipment locations be determined by scaling plans. Relocate equipment and bear cost of redoing work or other trades' work necessitated by failure to comply with this requirement.

C. In certain instances, receptacles, switches, light fixtures, or other electrical devices and equipment, etc., may be relocated. Where relocation is within 10 feet of location shown on the plans, and when Contractor is informed of necessary relocation before work is begun on this portion of the job, the relocation shall be at Contractor's expense.

D. The plans are schematic in nature and are not intended to show exact locations of conduit, but rather to indicate distribution, circuitry, and control.

1.10 EXISTING UNDERGROUND UTILITIES

A. Record plans of existing underground electrical utilities are not available. Excavate and verify the location of all underground electrical prior to installing new electrical equipment. This shall include, but not be limited to, feeders to pathway control cabinets and equipment, branch circuit wiring, phone and communication cabling, instrument wiring, and control wiring. Temporarily relocate existing underground electrical to keep existing facilities in operation and for any new construction, and all costs for relocating existing electrical shall be included in the Bid.

1.11 SUBMITTALS

A. Submit to Engineer for approval prior to beginning work, shop drawings on the equipment and materials proposed to be furnished and installed. See Submittals section for requirements.

B. Submit plans and/or diagrams for review and for job coordination in all cases where deviation from the plans are contemplated because of job conditions, interference or substitution of equipment, or when requested by Engineer for purposes of clarification of intent. Submit detailed plans, rough-in sheets, etc., for all special or custom-built items or equipment. Plans and details under this section shall include, but not be limited to, the following, where applicable to this project:
   1. Electrical interconnection wiring diagrams; see Controls and Instrumentation.
   2. Major feeder and conduit routing in plan and elevation, including service entrance raceways and cable.

C. These plans and diagrams shall show all electrical switch and breaker sizes as well as the manufacturer's name and catalog number for each piece of equipment used.

D. Equipment and material submittals must show sufficient data to indicate complete compliance with contract documents as follows:
   1. Proper sizes and capacities.
   2. That the item will fit in the available space in the manner that will allow proper service.
   3. Construction materials and finishes.

E. When the manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. The shop drawings shall be clearly marked and noted accordingly.

F. When fixtures, equipment, and items specified include accessories, parts, and additional items under one designation, shop drawings shall be complete and include all components.

2 PRODUCTS

2.01 STANDARD PRODUCTS

A. All equipment shall be UL and NEMA approved.

B. Unless specified otherwise, major distribution equipment such as panelboards, SPD, control cabinets, etc., shall each be by the same manufacturer.

C. All equipment and wiring shall be selected and installed for conditions in which it will perform (e.g., general purpose, weatherproof, raintight, dustproof, or any other special type).

2.02 SUBSTITUTION OF MATERIALS AND EQUIPMENT

A. While it is not the intention of Contracting Authority to discriminate against any manufacturer of equipment which may be equivalent to specified equipment, a strict interpretation of such equivalency will be exercised in considering any equipment offered as a substitute for specified equipment. Contractor shall submit with each request for approval of substitute material or equipment sufficient data to show conclusively that it is equivalent to that specified in the following respects:

1. Performance:
    a. Capacity at conditions and operating speeds scheduled shall be equal to or greater than that of the specified equipment.
    b. Energy consumption at the point of rating shall not exceed that of the specified equipment.
    c. Vibration and noise production at the point of rating shall not exceed that of the specified equipment.
2. Materials of construction.
3. Gauges, weights, and sizes of all portions and component parts.
4. Design arrangements, methods of construction, and workmanship.
5. Coatings, finishes, and durability of wearing parts.
6. National reputation of the manufacturer as a producer of first quality equipment of the type under consideration.
7. Availability of prompt, reliable, and efficient service facilities franchised by or affiliated with the equipment manufacturer. This shall include the maintenance of local stocks of critical replacement parts equal to those maintained for the specified equipment.

B. Requests for substitution shall include reason for the request.

C. If Engineer does not consider the items equivalent to those specified, provide those specified.

3 EXECUTION

3.01 CONTINUITY OF SERVICE

A. Provide and maintain continuous services (power, controls, alarms, etc.) during the entire construction period.

B. No service shall be interrupted or changed without permission from Contracting

Authority. Written permission shall be obtained before any work is started.

C. When interruption of service is required, all persons concerned shall be notified and a prearranged time agreed upon. Notice shall be a minimum of 72 hours prior to the interruption.

3.02 CLEANING UP AND REMOVAL OF RUBBISH

A. All lighting and appliance panelboards, junction boxes, and pullboxes shall be cleaned of debris and wires neatly arranged with surplus length cut off prior to installation of covers.

B. All lighting fixture lenses shall be cleaned at time of installation, and all lens exteriors shall be cleaned just prior to final inspection.

C. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt, and dust. All temporary labels not used for instruction or operation shall be removed.

3.03 CONCRETE WORK

A. All cast-in-place concrete for new electrical equipment bases shown on the plans shall be provided by Contractor, except where specifically noted to be provided by others.

B. Provide all anchor bolts, metal shapes, and templates to be cast in concrete or used to form concrete for support of electrical equipment.

3.04 PAINTING

A. All painting of electrical equipment shall be done by Contractor unless equipment is specified to be furnished with factory-applied finish coats.

B. All electrical equipment shall be provided with factory-applied prime finish, unless otherwise specified.

C. If the factory finish on any equipment furnished by Contractor is damaged in shipment or during construction, the equipment shall be refinished by Contractor.

D. One can of touch-up paint shall be provided for each different color factory finish which is to be the final finished surface of the product.

3.05 CAULKING

A. Caulk with a caulking sealant where indicated on the electrical plans or hereinafter specified.

B. Caulking sealant shall be silicone construction sealant as manufactured by General Electric or two-part polysulfide conforming to the requirements and bearing the seal of the Thiokol Chemical Corporation.

C. Caulking sealant shall contain no acid or ingredients that will stain stone, corrode metal, or have injurious effect on painting. It shall be colored to match adjacent surroundings.

D. Caulking shall be performed by craftsman skilled at such work.

3.06 COORDINATION

A. Provide wiring for all electrically powered or electrically controlled equipment.

B. All disconnects, relays, wire, conduit, and other devices for the power and control of electrical equipment shall be provided by Contractor except as specifically noted elsewhere in these specifications or on the plans.

C. Where other devices are provided by others, they shall be connected and wired by Contractor.

D. Provide all line voltage power and control wiring (100 volts and above). Low-voltage control wiring (below 100 volts) shall be provided by Contractor supplying the equipment that has low-voltage wiring, unless otherwise noted. Provide raceways for all low-voltage wiring.

E. Connect and wire all apparatus according to approved wiring diagrams furnished by the various trades.

3.07 EXCAVATION AND BACKFILL

A. Backfilling of all trenches beneath concrete shall be accomplished with gravel fill and shall be specially compacted to same density as surrounding area. Backfill of exterior trenches shall be compacted granular fill, unless otherwise noted. Compaction shall meet the requirements of Excavation, Fill, Backfill, and Grading. Refer to Conduit for additional requirements associated with PVC conduit installed in earth.

B. Care shall be taken to ensure no disturbance of bearing soil under foundations.

C. Follow underground pipe runs where possible to avoid additional rock excavation.

3.08 EQUIPMENT ACCESS AND LOCATION

A. Coordinate work of this Special Provision with that of other Special Provisions so that all systems, equipment, and other components will be installed at the proper time, will fit the available space, and will allow proper service access to those items requiring maintenance. This means adequate access to all equipment not just that installed under this Special Provision. Any components for the electrical systems that are installed without regard to the above shall be removed and relocated as required to provide adequate access at Contractor's expense.

B. Where various items of equipment and materials are specified and scheduled, the purpose is to define the general type and quality level, not to set forth the exact trim to fit the various types of ceiling, wall, or floor finishes. Provide materials that will fit properly the types of finishes actually installed.

C. All equipment, junction and pull boxes, and accessories shall be installed to permit access to equipment for maintenance. Any relocation of conduits, equipment, or accessories to provide maintenance access shall be accomplished by Contractor at no additional cost.

D. Electrical equipment, devices, instruments, hardware, etc., shall be installed with ample space allowed for removal, repair, calibration or changes to the equipment. Ready accessibility to equipment and wiring shall be provided without moving other equipment that is to be installed or that is already in place.

3.09 WORKMANSHIP

A. Install work using procedures defined in NECA Standard of Installation.

B. Location of process equipment as shown on the plans is approximate.

C. Utilization equipment and control devices required under these specifications shall be mounted in a code-approved manner.

D. Locations of utilization equipment and control devices as shown on plans are within 10 feet of actual positions. Any mounting of this equipment within this 10 foot distance will be performed at no additional cost to Contracting Authority.

E. Unless otherwise noted, equipment shall be fastened to equipment framework and not placed on the floor.

F. Where materials, equipment apparatus, or other products are specified by manufacturer, brand name, and type or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the Bid.

G. Materials and equipment of the types for which there are National Board of Fire Underwriters Laboratories (UL) listing shall be so labeled and shall be used by Contractor.

END OF SECTION

WIRE

1 GENERAL

1.01 SUMMARY

A. Work Included:
   1. Wire.
   2. Terminal blocks and accessories.
   3. Wiring connections and terminations.

1.02 QUALITY ASSURANCE

A. Manufacturers of Wire: Firms regularly engaged in the manufacture of electrical wire products of the types and ratings needed whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide electrical raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.

E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.03 SUBMITTALS

A. Submit shop drawings and product data under the provisions of Submittals section.

B. Submit shop drawings for wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.

C. Submit manufacturer's instructions.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Provide factory-wrapped, waterproof, flexible-barrier material for covering wire on wood reels, where applicable, and weather-resistant fiberboard containers for factory-packaging of wire, connectors, outlets, boxes, lamps, fuses, etc., to protect against physical damage in transit. Do not install damaged wire or other material; remove from project site.

B. Store wire and other material in factory-installed coverings in a clean, dry, indoor space which provides protection against the weather.

1.05 MEASUREMENT AND PAYMENT

A. All Work of this Special Provision is incidental to the lump sum Electrical bid item.

2 PRODUCTS

2.01 WIRE

A. All wire for permanent installation shall be new stranded copper delivered to project in unopened cartons or reels, except where specifically noted and be UL listed for the use intended. No wire smaller than No. 12 AWG shall be used unless specifically noted. The use of multiconductor cable is not allowed.

B. All wiring within pathway control cabinets that does not extend outside of the enclosure or pathway control cabinet shall be insulation type MTW, minimum size No. 16 AWG.

C. All wiring that extends outside of pathway control cabinets shall be XHHW-2.

D. All available colors shall be used; however, green shall be used only for equipment grounds. Where color-coded wire in larger sizes is not available, one wrap of 1 inch wide colored self-adhesive tape at each terminal end shall be used for identification. Initial phase color shall be used throughout the run, even for switch legs. Colors must meet code requirements for each class voltage. Do not duplicate colors, including neutral, on different voltages.

E. Color Coding:

	120/240 V
A Phase	Black
B Phase	Red
Neutral	White
Travelers	Yellow
Equipment Ground	Green

F. Branch circuit wiring for exterior lights and receptacles shall be minimum No. 10 AWG. Circuits 150 feet or over shall be sized for a maximum 2% voltage drop.

2.02 WIRING CONNECTIONS AND TERMINATIONS

A. Provide crimp type UL or ETL listed terminations for No. 6 AWG and smaller stranded conductor connections to electrical devices and equipment such as receptacles, switches, and terminal strips. Crimp devices shall be Sta-kon, or equal.

B. Provide insulated, silicone-filled spring wire connectors with plastic caps for No. 8 AWG conductors and smaller. Connectors shall be King Silicone-Filled Safety Connectors, or equal. Spring wire connectors shall only be allowed in junction, outlet, or switch boxes.

C. No splices will be allowed unless reviewed by Engineer or shown on plans. Where allowed, provide in-line splices for all conductor connections, No. 4 AWG and larger. Splice shall be made with NSi Industries Easy-Splice Gel Tap Splice Kit Model ESGTS Series, or equal. Splice kit shall include sealant gel, hinged splice enclosure, and be rated up to 1000 volts.

2.03 TERMINAL BLOCKS AND ACCESSORIES

A. Terminal Blocks: ANSI/NEMA ICS 4: UL listed.

B. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.

C. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts, as manufactured by Phoenix Contact Model UK 5 N, or equal. Multi-level terminal blocks are not allowed.

3 EXECUTION

3.01 INSPECTION

A. Examine the areas and conditions under which the work is to be installed and notify Engineer of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 GENERAL WIRING METHODS

A. Install electrical wire and connectors in accordance with the manufacturer's written instructions, applicable requirements of the NEC, the National Electrical Contractors Association's "Standard of Installation," and in accordance with recognized industry practices to ensure that products serve the intended functions. Use appropriate wiring methods and materials for the equipment or environment.

B. Stranded conductors shall be terminated using crimp-type devices specified herein. Conductors may not be wrapped around a terminal screw.

C. Place an equal number of conductors for each phase of a circuit in same raceway.

D. Torque conductor connections and terminations with calibrated torque wrench to manufacturer's recommended values. Provide permanent marking on lug, bolt, nut, or connection for conductors larger than No. 4 AWG.

E. Splice only in junction boxes, outlet boxes, or handholes. Splicing is not allowed in pathway control cabinets, light poles, etc. Avoid splices between terminals of interconnecting power and control wiring.

F. Spring wire connectors shall only be used in junction, outlet, or switch boxes. Equipment wireways, pathway control cabinets, and light poles shall not have any spring-wire connectors installed; all terminations shall be on terminal strips.

G. Neatly train, lace, and tie wrap all wiring inside boxes, equipment, and panelboards.

H. Make conductor lengths for parallel circuits equal.

I. The same color shall be used for each numbered wire throughout its entire length.

J. Terminate all wiring on terminal blocks in control panels, pathway control cabinets, and similar equipment. This shall include all spare or unused wires.

K. Provide preprinted adhesive or heat shrink-type wire numbering labels at all terminations and splices. Wire numbering preprinted on the conductor, flag-type labels, and individual wraparound numbers (e.g., Brady labels) are not acceptable.

L. Provide a dedicated neutral for each branch circuit or feeder requiring a neutral. Ampacity of neutral conductor shall match that of the branch circuit or feeder.

M. Do not use a pulling means that can damage the raceway.

N. Signal wiring (below 100 volts) wiring must be in a conduit separate from power and/or control wiring (over 100 volts). Signal wire shall include, but not be limited to, loop-powered devices, voice and data communications, and communication wiring (i.e., DeviceNet, RS-232, etc.).

O. Provide junction or pull boxes to facilitate the “pulling in” of wires or to make necessary connections. All raceways and apparatus shall be thoroughly blown out and cleaned of foreign matter prior to pulling in wires.

P. Thoroughly clean wires before installing lugs and connectors.

Q. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.

R. Terminate spare conductors within equipment, pathway control cabinets, etc., on terminal strips and label as “SPARE.” Spare wiring in pull or junction boxes may be terminated with electrical tape and labeled as “SPARE.” All spare conductor labels shall indicate where the conductors terminate. Refer to Electrical Identification, for additional requirements.

3.03 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use UL-listed wire-pulling lubricant for pulling 4 AWG and larger wires. Wax-based pulling lubricant is not allowed unless it includes a Teflon additive.

B. Install wire in raceway after all mechanical work likely to injure conductors has been completed.

C. Completely and thoroughly swab raceway system before installing conductors.

D. Conductors No. 6 AWG and larger shall be pulled into conduits utilizing a tugger with built-in tension meter. Provide a report to Engineer for each pull indicating maximum tension reached during the pull along with manufacturer’s maximum pulling tension. Motorized machines of any type are not allowed for any wire pulling.

E. Conductors shall be installed in conduit system in such a manner that insulation is not damaged, conductors are not overstressed in pulling, and walls are not damaged. No splices are permitted except in junction boxes, outlet boxes, or handholes.

F. Observe code limitation on the number and size of wires in an outlet box. Either lay out work so that the wires do not exceed the particular box limitation or provide larger boxes approved for additional capacity.

G. Circuiting is indicated diagrammatically on the plans.

3.04 FIELD QUALITY CONTROL

A. Inspect wire for physical damage and proper connection.

B. Prior to energizing, check conduit, raceways, outlet boxes, and wire for continuity of circuitry and for short circuits. Correct malfunction when detected.

C. Subsequent to wire hookups, energize circuitry and demonstrate functioning in accordance with these specifications.

D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

E. Perform field inspection and testing according to provisions of this section.

3.05 ACCEPTANCE TESTS

A. Furnish all materials, labor, and equipment necessary for the acceptance tests specified herein. Acceptance tests shall be performed in the presence of Engineer and must be passed before final acceptance of the work.

B. Contractor shall be responsible for powered tests of each field-installed device unless specifically noted otherwise. Contractor shall be responsible for device operation as powered from its power source and signals as received at the I/O modules.

C. Operation Test: By operational testing, Engineer will give final acceptance of the wiring system when all of the wiring is considered a complete system. All equipment shall function and operate in the proper manner as indicated in the details of the specifications and on the plans.

D. At the request of Engineer, demonstrate by test the compliance of the installation with these specifications and plans, the National Electrical Code, and the accepted standards of good workmanship. These tests shall include operation of equipment, continuity of the conduit system, grounding resistance and insulation resistance.

E. A written record of performance tests on electrical and control and instrumentation systems and equipment shall be supplied to Contracting Authority. Such tests shall show compliance with governing codes.

F. The transformer, feeder, and subfeeds to the lighting panels shall be completely phased out as to sequence and rotation. Phase sequence shall be A-B as follows:
   1. Front-to-rear, top-to-bottom, or left-to-right when facing equipment.
   2. Phasing shall be accomplished by using distinctive colors for the various phases. The same color or variation of it shall be used for a particular phase throughout the building and project.

3.06 WIRE INSTALLATION SCHEDULE

A. Install all wiring in raceways except as otherwise noted. This includes all low-voltage wiring such as instruments, network, fiber-optic, etc.

END OF SECTION

SECONDARY GROUNDING

1 GENERAL

1.01 SUMMARY

A. Work Included:
   1. Power System Grounding.
   2. Electrical Equipment and Raceway Grounding and Bonding.

1.02 SUBMITTALS

A. Indicate location of system grounding electrode connections and routing of grounding electrode conductor.

B. Submit shop drawings and product data in accordance with provisions written in Submittals section.

1.03 MEASUREMENT AND PAYMENT

A. All Work of this Special Provision is incidental to the lump sum Electrical bid item.

2 PRODUCTS

2.01 MATERIALS

A. Ground Rods: Copper-bonded, 5/8 inch diameter; minimum length 10 feet.

B. Ground Connections Below Grade: Exothermic type by Cadweld, compression type by Thomas & Betts, or equal. Compression connectors shall be prefilled with an oxide inhibitor.

C. Ground Fittings: O-Z/Gedney, Type ABG, CG, TG, KG, GBL, or equal.

3 EXECUTION

3.01 INSTALLATION

A. Compression-type connectors shall be installed with the manufacturer recommended tools. Compression dies shall emboss index on the connector when installed correctly. An indenter crimp shall be made on ground rods prior to connection of grounding conductor.

B. Provide a separate insulated equipment grounding conductor for each feeder and branch circuit. Provide a dedicated neutral conductor sized to match the circuit or feeder conductors for each feeder or branch circuit requiring a neutral. Terminate each end on a grounding lug, bus, or bushing.

C. Bond together system neutrals, service equipment enclosures, exposed noncurrent

carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, and receptacle ground connectors.

D. Connect grounding electrode conductors using suitable ground clamps.

E. Ground system, transformer neutrals, and equipment as required by code and local ordinances.

F. All feeder neutrals shall be connected to neutral at only one point in the pathway control cabinets.

G. All bare copper conductors installed outdoors shall be buried a minimum of 2 feet below grade.

H. All grounding electrode conductors shall be installed in PVC conduit. All conduit bends shall be made using sweep elbows. Conduit bodies and 90 degree bends are not allowed.

I. Include ground for grounded receptacles, light fixtures, and equipment items shown on the plans.

J. Flexible connections do not qualify for ground. All flexible connections must have separate green ground wire from the lighting fixture or equipment frame to conduit system.

K. Provide a separate grounding conductor system for the grounding of all lighting fixtures and devices installed in the same conduit as the branch circuit conductors. Ground conductors shall be individually connected at each fixture or device.

L. All equipment that is fed from circuits in PVC conduit shall be provided with a separate green ground wire that is terminated at the metallic conduit system and the equipment.

M. Refer to Instrument Wire and Cable for Additional Grounding Requirements.

3.02 TESTING

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Provide ground system resistance test report for each ground grid. Test reports shall document ground system resistance following the three-point “Fall-of-Potential” test. The test results shall include a graph of the results plus a diagram of the testing layout. The remote current probe (C2) shall be placed a minimum of 100 feet from the ground system potential/current probe (P1/C1) or as required to provide sufficient spacing to demonstrate a resistance plateau on the graph. The ground resistance shall be tested with the potential probe (P2) between the P1/C1 probe and the C2 probe at 10% intervals starting at 0% and ending at 100% of the distance between P1/C1 and C2, 11 points total. A single point of measurement is not acceptable, and the two-point method of ground system testing shall only be used where there is no or insufficient "open earth" area to use the three-point Fall-of-Potential method. Resistance at any point in the grounding system shall not exceed 5 ohms. All ground system tests shall be witnessed by Engineer.

C. The test meter shall be Associated Research Vibroground test set with null balance, James A. Biddle Megger Earth-Tester-Null Balance, or equal. All ground system tests shall be performed in accordance with the procedures outlined in the instruction manuals of the ground system test report.

D. In lieu of testing the ground grid as a system, Contractor may choose to test individual ground rods separately. Individual ground rods when tested separately shall be isolated from all metallic connections, such as from the ground rod to other grounded structures and electrical system neutrals.

E. Multiple ground rod grids shall be isolated from all metallic connections such as from grid under test to other grounded structures and electrical system neutrals.

F. Provide test report using the attached form. Each ground grid shall have a form submitted.

END OF SECTION

GROUND ROD RESISTANCE TO EARTH TEST RECORD

1. DATE _____

2. PROJECT NAME _____

3. LOCATION OF TEST _____

4. DRAWING NO. _____

5. GROUND ROD TYPE _____

   DIAMETER _____

   LENGTH _____

6. TEST METHOD _____

   INSTRUMENT TYPE _____

   SERIAL NO. _____

7. REQUIRED MAXIMUM RESISTANCE TO EARTH _____

8. MEASURED RESISTANCE TO EARTH

   ROD 1 _____

   ROD 2 _____

   ROD 3 _____

   GROUND ROD SYSTEM _____

TEST PERFORMED BY: _____
Signature

TEST WITNESSED BY: _____
Signature

SUPPORTING DEVICES

1 GENERAL

1.01 SUMMARY

A. Work Included:
   1. Conduit and equipment support members.
   2. Fastening hardware.

1.02 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Submittals section.

1.04 MEASUREMENT AND PAYMENT

A. All Work of this Special Provision is incidental to the lump sum Electrical bid item.

2 PRODUCTS

2.01 MATERIAL

A. Support Members: 316 stainless steel. PVC-coated steel where used with PVC-coated conduit.

B. Hardware: Stainless steel in all locations.

C. Manufacturers: Unistrut P-1000, B-line, Superstrut, or equal.

3 EXECUTION

3.01 INSTALLATION

A. All supporting devices and support structures shall be constructed such that the structure adequately supports the load of the equipment installed on it including any wind and/or snow loads. Provide additional support members to those shown on the plans where required to adequately support load.

B. Where support members are used for conduit, cutoff ends shall be ground smooth. Cutoff PVC-coated support members shall be ground smooth and touched up with PVC coating material from the manufacturer.

C. Do not fasten supports to piping or conduit.

D. Do not use powder-actuated anchors.

E. Do not drill structural steel members.

F. Fabricate supports with welded end caps and all welds and surfaces ground smooth for neat appearance. Use hexagon head bolts with steel spring-lock washers under all nuts.

G. Install free-standing electrical equipment on concrete pads. Anchor all equipment with standoffs and caulk.

H. Install cabinets and panelboards with minimum of four anchors.

I. Do not use chain hangers.

J. All welds shall be continuous and ground smooth.

END OF SECTION

CONDUIT

1 GENERAL

1.01 SUMMARY

A. Work Included:
   1. Rigid aluminum conduit.
   2. PVC externally and internally coated galvanized rigid metal conduit.
   3. Polyvinyl chloride conduit and fittings.
   4. Liquidtight flexible metal conduit and fittings.
   5. Conduit seals and special fittings.

1.02 REFERENCES

A. ANSI C80.5–Electrical Rigid Aluminum Conduit (ERAC).

B. ANSI/NEMA FB 1–Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, and Cable.

C. NEMA RN 1–Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit.

1.03 QUALITY ASSURANCE

A. Manufacturers of Raceways: Firms regularly engaged in the manufacture of electrical raceways of the types and capacities required whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that for the project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide electrical cable, raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.

E. Prior to shipment to the site, all conduit provided shall be new, unused material and may not have been stored outdoors or exposed to weather.

F. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Submittals section.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Provide color-coded thread protectors on the exposed threads of threaded rigid metal conduit.

B. Handle conduit carefully to prevent end damage and to avoid scoring the finish.

C. Store conduit inside and protect from weather. When necessary to store outdoors, elevate well above grade and enclose with durable, waterproof wrapping.

1.06 MEASUREMENT AND PAYMENT

A. All Work of this Special Provision is incidental to the lump sum Electrical bid item.

2 PRODUCTS

2.01 RIGID METAL CONDUIT AND FITTINGS

A. Rigid Aluminum Conduit: ANSI C80.5. Heavy wall.

B. Conduit bodies for rigid aluminum conduit shall be as manufactured by Appleton, Form 85, or equal, and be constructed of pressure-cast, copper-free aluminum for sizes 2 inches and under, and sand-cast, copper-free aluminum for sizes over 2 inches. Conduit bodies shall have built-in pulling rollers, domed gasketed covers, and stainless steel screws. Covers for conduit bodies shall have bolts that thread into the conduit body. Snaptight and wedge nut covers are not allowed. CONTRACTOR shall select body style and size per application.

C. PVC coated conduit and fittings shall be internally and externally hot dipped galvanized rigid metal conduit with hot dipped galvanized threads and PVC coating. PVC coating shall be UL listed with rigid metal conduit as the primary means of corrosion protection for the conduit, and PVC coating shall have an external 40 mil thickness with an internal 2 mil urethane coating. Acceptable manufacturers shall be Plasti-bond RedH2OT by Robroy Industries, Ocal-Blue by Thomas & Betts, or equal. PVC coated conduit and fittings shall meet the following listings and manufacturing standards, without exception. All installers shall be field-certified from the factory for installation and shall provide proof of certification:
   1. Federal Specification WW-C-581 E.
   2. ANSI C80.1.
   3. UL6.
   4. NEMA RN1.

D. Conduit bodies for PVC-coated rigid conduit shall be as manufactured by Plasti-bond RedH2OT by Robroy Industries, Ocal Blue by Thomas & Betts, or equal, and have a 40 mil PVC exterior coating and 2 mil red urethane interior coating. Conduit bodies shall be Form 8 style or pulling elbow and include pulling rollers, domed, gasketed covers and stainless steel screws. Covers for conduit bodies shall have bolts that thread into the conduit body. Snaptight and wedge nut covers are not allowed. CONTRACTOR shall select body style and size according to application.

E. Fittings and Conduit Bodies: ANSI/NEMA FB 1; threaded-type material to match conduit. Split couplings are not allowed.

F. Supports: One-hole or two-hole pipe straps may be used for surface-mounted conduit. Where one-hole straps are used, provide conduit clamp and back spacer. Where

standoffs are required, provide pipe straps and supporting devices as specified in Supporting Devices. Support material shall match that of the conduit type provided.

2.02 POLYVINYL CHLORIDE CONDUIT AND FITTINGS

A. Conduit: Heavy wall rigid, Schedule 40, Schedule 80 where noted, UL listed for underground, encased, and aboveground applications. PVC conduit installed in exterior locations shall be UV resistant.

B. Conduit bodies for PVC conduit shall be as manufactured by Carlon, or equal, and be suitable for use with Schedule 40 or Schedule 80 PVC conduit. Conduit bodies shall have smooth hubs, textured lids, and foam-in-place gaskets. CONTRACTOR shall select body style and size per application.

C. Supports: Two-hole nonmetallic clamps or conduit support straps may be used for surface-mounted conduit. Where standoffs are required, provide pipe straps and supporting devices as specified in Supporting Devices. Support material shall match that of the conduit type being provided.

2.03 FLEXIBLE METAL CONDUIT AND FITTINGS

A. Conduit: Electrogalvanized single-stip steel with sunlight resistant and flame retardant PVC coating and integral grounding conductor. Conduit shall be UL lighted, Type LA, or equal.

B. Fittings: ANSI/NEMA FB 1, and be UL listed. Fittings located in NEMA 4X areas shall be stainless steel and be UL listed.

2.04 CONDUIT SEALS AND SPECIAL FITTINGS

A. Expansion Fittings: Crouse Hinds or Robroy type XJG, or equal, for rigid or PVC-coated rigid conduit. Crouse Hinds, type XD, or equal for PVC conduit.

B. Expansion Deflection Fittings: O-Z type “DX,” Crouse Hinds, type XD (PVC conduit only), or Appleton.

C. Ground Bushings: Crouse-Hinds GLL, or equal.

D. Watertight Hubs: Diecast, insulated and gasketed, rated for wet locations outdoors. Watertight hubs shall be Appleton HUB, Crouse-Hinds Myers Hubs, or equal.

E. Conduit Plugs: Kwik N Sure pipe plug as manufactured by Cherne Industries, or equal. Plug shall include natural rubber O-ring with galvanized wing nut and hex nut.

3 EXECUTION

3.01 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

A. Size conduits for branch circuit conductors, control wires, and instrumentation cables so as to have not less than 25% spare capacity after installation; 3/4 inch minimum size. 1/2 inch minimum size for liquid-tight flexible conduit.

B. Maintain at least 1 inch of separation between conduit sizes to 1 1/2 inches and 2

inches between conduits 1 1/2 inches or larger. Maintain 1 foot of separation between signal conduits (below 100 volts) and power conduits (100 volts and above).

C. All conduit shall be supported in accordance with the NEC and as specified herein. This shall apply to all conduit types.

D. Provide for the proper application, installation, and location of inserts, supports, and anchor bolts for a satisfactory raceway system. Where any component of the raceway system is damaged, replace or provide new raceway system.

E. Run conduits concealed to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid all materials and equipment of other trades.

F. Center conduit in structural slabs (other than topping), clear of reinforcing steel and spaced on centers equal to or exceeding three times the conduit diameter. Outside diameter of conduit shall not exceed one-third the slab thickness for each run of conduit 1 1/4 inches or larger. Provide shop drawings when it will be installed in structural slabs. Conduits shall not be run in slabs-on-grade or structural topping slabs.

G. Independently support or attach the raceway system to structural parts of construction in accordance with good industry practice.

H. Watertight hubs shall be used in all locations.

3.02 GENERAL CONDUIT INSTALLATION REQUIREMENTS

A. Exterior conduit shall be buried below grade. Exposed conduit runs are not allowed.

B. All conduit installed belowgrade shall be buried a minimum of 2 feet 0 inches, except conduits for fiber-optic cabling shall be buried a minimum of 42 inches.

C. PVC conduit installed in earth shall be bedded in compacted sand with a minimum of 6-inch cover on all sides.

D. Ream conduit smooth at ends, cap upon installation and securely fasten to all outlet boxes, panel cabinets, junction boxes, pull boxes, safety switches, and all other components of the raceway system.

E. Conduits installed for future equipment or electrical work shall be cut off and capped watertight. Conduit ends shall have threaded fittings to accommodate future conduit installation.

F. Provide all empty raceways 2 1/2 inches and over with No. 10 galvanized fishwire, and nylon cord for conduits smaller than 2 1/2 inches. Empty raceways and fishwire/nylon cord shall be identified with permanent label, and label shall include conduit termination point. All empty conduits shall be threaded and capped. Exposed conduits shall be threaded and capped.

G. Provide conduit raceway for exposed cables that are not UV resistant. This shall include, but not be limited to, instrument wiring, etc.

H. Provide conduit expansion-deflection fittings as specified herein in all conduit runs where movement perpendicular to axis of conduit may be encountered.

I. Conduits shall be pitched so that drainage is towards handholes and away from all pathway control cabinets.

J. Conduit bends for PVC conduit shall be made using a hot box, heat blanket, or glycol bender. Open flame or point heat sources of any type are not allowed.

K. The PVC-coated rigid conduit manufacturer's touch-up compound shall be used on all conduit interior and exterior bare steel exposed because of nicks, cuts, abrasions, thread cutting, and reaming; minimum six coats.

L. In all PVC conduit runs below grade 200 feet and longer, PVC coated rigid steel conduit shall be used for all 90 degree bends.

M. Where below-grade PVC conduit is connected to rigid metal conduit, the length of PVC conduit shall be a minimum of 10 feet. For short, below-grade conduit runs where required lengths of rigid metal conduit limit the length of PVC conduit to less than 10 feet, rigid metal conduit shall be used for the entire run.

3.03 CONDUIT PENETRATIONS AND TERMINATIONS

A. Where fittings are brought into an enclosure with a knockout, a gasket assembly consisting of an O-ring and retainer shall be installed on the outside. Fittings shall be insulated throat type.

B. Conduit penetrations for control panels or enclosures containing electronic equipment shall be made on the sides or bottom of the enclosure. Conduits shall not penetrate the top of the enclosure.

C. Provide conduit expansion fittings as specified herein for conduits protruding from earth where the conduit is terminated within 5 feet of finished grade.

D. All conduits that protrude from poured concrete shall be PVC-coated rigid conduit. Conduit shall extend continuously (i.e., no joints) a minimum of 4 feet beyond the poured concrete (both sides).

E. Conduits passing through masonry, concrete, or similar construction shall be cast in place using PVC-coated rigid conduit extending completely through the construction.

F. All spare conduits that terminate below grade shall be plugged with conduit plugs as specified herein.

3.04 CONDUIT INSTALLATION SCHEDULE

A. The following schedule lists specific conduit types allowed in designated areas. Those areas not listed under a specific conduit type shall not have that type of conduit installed:

1. Rigid aluminum:
   - Exterior locations (except in earth) and locations exposed to weather.
   - All locations where attached to aluminum railings or aluminum structural members.
   - Where noted on plans.
2. PVC coated rigid steel:
   - Conduits protruding from concrete.
   - All exterior locations.

- Earth.
- Within 6 feet of a handhole.

3. PVC:
   - Earth, except within 6 feet of a vault or handhole. PVC conduit under pavement or roadways shall be Schedule 80.
   - Buried below slabs on grade.

END OF SECTION

HANDHOLES

1 GENERAL

1.01 DESCRIPTION

A. Work Included: Precast polymer concrete handholes.

1.02 REFERENCES

A. ASTM D4101–Specification for Polypropylene Injection and Extrusion Materials.

B. ANSI/SCTE 77–Specification for Underground Enclosure Integrity.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Submittals section.

B. Shop drawing submittals shall include the following:
   1. Interior elevations of each wall of all handholes provided under this Contract. Each conduit shall be identified as to what it serves.
   2. Product data: Manufacturer's technical information for handholes and accessories proposed for use.

1.04 MEASUREMENT AND PAYMENT

A. All Work of this Special Provision is incidental to the lump sum Electrical bid item.

2 PRODUCTS

2.01 PRECAST POLYMER CONCRETE HANDHOLES

A. Material and Construction:
   1. Precast polymer concrete.
   2. Duct entrances sized and located to suit duct banks.
   3. Enclosures, boxes and covers are required to conform to test provisions of ANSI/SCTE 77 for Tier 22 applications.
   4. All covers are required to have a minimum coefficient of friction of 0.50 in accordance with ASTM C1028.
   5. Covers shall have the following stamped logo: “ELECTRICAL”
   6. Handholes shall be Hubbel, Quazite, PG-Style, or equal.
   7. Handholes for 120/240-volt power shall be minimum 13 inches by 24 inches. All handholes installed in grassy areas shall be colored forest green.

3 EXECUTION

3.01 INSPECTION AND COORDINATION

A. Examine conditions under which the Work is to be installed and notify Engineer in

writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

B. Coordinate handhole installation with piping, sheeting, and other underground systems and structures, and locate clear of interferences.

3.02 INSTALLATION

A. Install handholes where shown and verify locations in field. Perform excavation and backfilling required for installation. Excavation and backfilling shall be in accordance with General Electrical Requirements.

B. Install handholes on a 3/4-inch crushed stone foundation 1 foot under all handholes, and within 2 feet of exterior of handholes. Handhole bases shall be set at the proper grade and carefully leveled and aligned.

C. Grounding: Install a 5/8 inch by 10 foot copper-clad ground rod for each handhole. Bond all exposed metal vault accessories and the concrete reinforcing rods with No. 4 AWG minimum bare copper wire, and connect to the ground rod.

D. All conduits must enter the sides of handholes. Conduits entering the bottom will not be permitted.

E. Handholes shall be considered wet locations for purposes of equipment selection.

F. All conduits shall be pitched so that drainage is towards handholes and away from all structures.

3.03 GRADING AT HANDHOLES

A. Handholes in unpaved areas shall be built as shown to a rim elevation higher than the original ground. The ground surface shall be graded to drain away from the handhole. Fill shall be placed around handholes to the level of the upper rim of the handhole frame, and the surface evenly graded on a one (vertical) to five (horizontal) slope to surrounding ground, unless otherwise shown.

B. Contractor shall be solely responsible for proper height of handholes necessary to reach final grade. Engineer's review of shop drawings for handhole components is general in nature, and Contractor shall provide random length precast handhole riser sections to adjust handholes to meet field conditions for final grading.

END OF SECTION

ELECTRICAL IDENTIFICATION

1 GENERAL

1.01 SUMMARY

A. Work Included:
   1. Nameplates.
   2. Wire markers.

1.02 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Submittals section.

B. Provide schedule for nameplates and labeling tags with shop drawings. Reference plans for type used.

1.03 MEASUREMENT AND PAYMENT

A. All Work of this Special Provision is incidental to the lump sum Electrical bid item.

2 PRODUCTS

2.01 NAMEPLATES

A. Type “A”:
   1. Use: Field devices.
   2. Size: 2 inch by 3 inch.
   3. Material: Three layer laminated Micarta.
   4. Background Color: Black.
   5. Character Color: White.
   6. Character Size: 1/4 inch.
   7. Engraving: As requested by Engineer. Label shall include equipment number and description.
   8. Mounting Location: Front exterior.

2.02 WIRE AND CABLE MARKERS

A. Wire and cable markers shall be permanently-attached, heat-shrink type labels.
   1. Sleeve: Permanent, PVC, white, with legible machine-printed black markings.
   2. Acceptable Manufacturers: Raychem Model D-SCE or ZH-SCE, Brady Model 3PS, or equal.
   3. Grounding Conductor: Provide green wire marker; minimum 2 inches wide.

B. Wire or cable numbering preprinted on the conductor or cable insulation, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable. All wire markers shall be the same throughout the project.

3 EXECUTION

3.01 INSTALLATION

A. Degrease and clean surfaces to receive nameplates.

B. Install nameplates parallel to equipment lines.

C. Affix nameplates with UV-resistant adhesive.

D. Affix labeling tags with stainless steel leaders; vinyl locking wire ties are not acceptable. Provide 3/8 inch hole to accommodate wire tie.

E. Prepare and install neatly-typed directions in all panels where work is done under this Contract.

3.02 WIRE IDENTIFICATION

A. Provide wire markers on each conductor, including neutral and spare conductors, in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Spare conductors shall have control wire number or shall indicate termination point of wire.

B. Conductors in pull boxes, pathway control cabinets, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system. All wiring labels shall be able to be read without removing wire management (i.e., wiring trough covers, spiral windings, etc.) or twisting the wire/cable.

C. Power Conductor Insulation Color Code:
   1. No. 6 AWG and Larger: Provide general-purpose, flame-retardant, permanent tape at each termination and at accessible locations such as handholes, junction and pull boxes, panelboards, etc. Apply tape with at least six full, overlapping wraps; minimum 2 inches wide.
   2. No. 8 AWG and Smaller: Provide conductors with color-coded insulation.
   3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
120/240 Volts Single-Phase, Three Wire	Grounded Neutral One Hot Leg Other Hot Leg	White* Black Red
* When installed as part of a 120-volt or 277-volt branch circuit, provide a color-coded stripe on the white neutral conductor insulation matching the branch circuit insulation.		

D. Control Panel and Field-Installed Control Conductor Insulation Color Code:
   1. All conductors shall have color-coded insulation.
   2. Colors:

System	Conductor	Color
Supply Voltage	Ungrounded Circuit Conductors Neutral	Black White
Discrete 120-volt AC Input/Output	Control Circuit Conductor Neutral	Red White
Discrete 12/24-volt DC Input/Output	Control Circuit Conductor Common	Blue White with Blue Stripe

E. Circuit Identification
1. Identify power, instrumentation, and control conductors at each termination and at accessible locations such as manholes, handholes, junction and pull boxes, panelboards, etc.
2. Conductors for panelboard circuits shall identify circuit matching the circuit directory designations, including the neutral conductor.
3. Control conductor identification shall match the associated terminal block label.
4. Circuits Not Listed in Circuit Directories:
   a. Assign circuit name based on unique device or equipment at load end of circuit.
   b. Where unique device or equipment names are not available or apparent, add a unique number or letter modifier to each otherwise identical circuit name.

END OF SECTION

WIRING DEVICES

1 GENERAL

1.01 SUMMARY

A. Work Included:
   1. Receptacles.
   2. Cover plates.

1.02 REFERENCES

A. NEMA WD 1–General-Color Requirements for Wiring Devices.

B. Drawings–Bill of Materials.

1.03 QUALITY ASSURANCE

A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide electrical cable, raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.

E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Submittals section.

B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

1.05 MEASUREMENT AND PAYMENT

A. All Work of this Special Provision is incidental to the lump sum Electrical bid item.

2 PRODUCTS

2.01 RECEPTACLES

A. GFCI Receptacle: GFCI receptacles shall be UL 943 listed, Pass and Seymour 2095, Cooper TRVGF20 receptacle with integral ground fault current interrupter. Receptacles shall be mounted vertically. GFCI receptacles shall not be series wired. Provide ivory color.

2.02 COVER PLATES

A. While in use receptacle covers for exterior use shall be Leviton M5979, or equal.

3 EXECUTION

3.01 INSTALLATION

A. All receptacles shall be mounted vertically.

B. GFCI receptacles shall not be series wired.

C. Convenience Receptacles: Specification grade self-grounding.

D. Install devices and cover plates flush and level.

E. Back-wiring is not allowed for receptacles. Wires shall be terminated with the device screw terminal.

F. Individual labels shall be placed on the back of all receptacle faceplates indicating the pathway control cabinet, lighting panel, and circuit from which the switch or receptacle is fed. Labels shall be White background with Black lettering no smaller than 12 point font. Provide Pan Net permanently attached self-adhesive type, machine fed, and self-laminating labels, or equal. All labels must be by the same manufacturer, same size, and same font. Handwritten labels are not acceptable.

END OF SECTION

EXTERIOR LIGHTING

1 GENERAL

1.01 SUMMARY

A. Work Included: Exterior lighting fixture work as shown on the plans and in schedules.

1.02 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of exterior lighting fixtures of the types and rating for the project, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with exterior lighting fixture work similar to that in this project.

C. NFPA Compliance: Comply with National Electrical Code as applicable to installation and construction of exterior lighting fixtures.

D. NEMA Compliance: Comply with applicable portions of National Electrical Manufacturers Association Standards pertaining to outdoor lighting equipment.

E. ANSI Compliance: Comply with applicable American National Standards pertaining to lamp materials and lighting ballasts.

F. UL Labels: Provide exterior lighting fixtures which have been listed and labeled by Underwriters Laboratories.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Submittals section.

B. Shop Drawings–Exterior Lighting Fixtures: Submit dimensioned plans of installed exterior lighting fixtures, including, but not necessarily limited to, layout, conduit, wiring, etc. Submit fixture shop drawings in booklet form with a separate sheet for each fixture, assembled in luminary-type alphabetical order, with the proposed fixture and accessories clearly indicated on each sheet.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver exterior lighting fixtures individually wrapped in factory-fabricated fiberboard-type containers.

B. Handle exterior lighting fixtures carefully to prevent breakage, denting, and scoring the fixture finish. Do not install damaged lighting fixtures; replace and return damaged units to equipment manufacturer.

C. Store exterior lighting fixtures in a clean, dry space. Store in original cartons and protect from dirt, physical damage, weather, and construction traffic.

1.05 MEASUREMENT AND PAYMENT

A. All Work of this Special Provision is incidental to the lump sum Electrical bid item.

2 PRODUCTS

2.01 MATERIALS

A. Furnish all labor and material necessary to install exterior lighting as indicated on the plans and specified herein.

B. Concrete foundations for poles shall be round, as shown on the plans.

C. Fixture schedule shows style of fixture, pole heights where poles are required, and basic IES distribution pattern. Include all fittings, brackets, mounting plates, etc., for a proper installation. Verify finish color with Engineer prior to releasing fixtures for fabrication.

3 EXECUTION

3.01 LIGHTING CONTROLS

A. Light fixtures shall be controlled as specified herein and as shown on the plans. See Controls and Instrumentation for pathway lighting controls.

3.02 INSPECTION

A. Examine the areas and conditions under which exterior lighting fixtures are to be installed, and notify Engineer of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.03 INSTALLATION

A. Provide exterior lighting fixtures of the types indicated, where shown on the plans and at the indicated heights, in accordance with the fixture manufacturer's written instructions and with recognized industry practices, to ensure that the fixtures comply with the requirements and serve the intended purposes. Comply with NEMA Standards and requirements of the National Electrical Code pertaining to installation of exterior lighting fixtures, and with applicable portions of NECA's "Standard of Installation."

B. Entire exterior lighting assembly, including fixtures and poles, shall be capable of withstanding sustained winds of 100 mph.

C. Fasten fixtures securely to indicated structural support, and check to ensure that fixtures are plumb.

D. All bases for fixtures shall be provided by Contractor. Where square or rectangular poles or fixture heads are used, verify with Engineer the orientation of fixture heads and poles.

E. Provide fixtures, poles, hardware, etc., for complete system.

F. Ground all pole-mounted fixtures.

3.04 ADJUST AND CLEAN

A. Clean exterior lighting fixtures of dirt and debris upon completion of installation.

B. Protect installed fixtures from damage during the remainder of the construction period.

3.05 FIELD QUALITY CONTROL

A. Upon completion of installation of exterior lighting fixtures and after branch supply circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting. All testing shall take place at night.

END OF SECTION