SECTION 26 5600

EXTERIOR LIGHTING

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LANL MASTER SPECIFICATION

Word file at <http://engstandards.lanl.gov>

This template must be edited for each project.  In doing so, specifier must add job-specific requirements.  Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.  Once the choice is made or text supplied, remove the brackets.  The specifications must also be edited to delete specification requirements for processes, items, or designs that are not included in the project -- and specifier’s notes such as these.  To seek a variance from requirements in the specifications that are applicable, contact the Engineering Standards Manual Electrical[POC](http://engstandards.lanl.gov/POCs.shtml#elec). Please contact POC with suggestions for improvement as well.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General requirements.

Specification developed for ML-4 projects.  For ML-1, 2, and 3 applications, additional requirements and independent reviews should be added if increased confidence in procurement or execution is desired; see ESM Chapter 1 Section Z10 Specifications and Quality Sections.

Seismic: In order to edit this section for job-specific seismic requirements, refer to author notes that say/begin with “Seismic,” and the *Seismic Specification Guide for Nonstructural Components: Electrical Components* (posted on LANL specs [webpage](http://engstandards.lanl.gov/specs.shtml#40)) for guidance on properly editing this section.

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1. General

SECTION INCLUDES

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Edit the following list to match project requirements.

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* + 1. Exterior luminaires and accessories
		2. Lamps
		3. Ballasts
		4. Poles
		5. Pole foundations
		6. Grounding
		7. Conduit and wiring
		8. Lighting controls
		9. Luminaire ballast fuses.

Related sections

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Seismic: Refer to Guide for editing guidance.

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* + 1. Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*, for requirements pertaining to [manufacturer’s certification] [and] [special certification].
		2. Section 26 0548.16, *Seismic Controls for Electrical Systems*, for [seismic-design criteria,] submittal requirements, devices for seismic restraint, and installation requirements for these devices.

Action SUBMITTALS

* + 1. Submit the following in accordance with project submittal procedures.
			1. Catalog Data: Submit catalog data describing poles, luminaires, lamps, ballasts, and pole and luminaire finishes. Include data substantiating that materials comply with specified requirements. Arrange data for luminaires in the order of luminaire designation.
			2. Performance Curves/Data: Submit certified photometric data for each type of luminaire.

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Edit the following to match project requirements. Check with customer to see if there is a place to store these spare materials. If not, the customer may not want the spare materials and this section may be deleted.

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QUALITY ASSURANCE

* + 1. Comply with the following codes and standards:
			1. *National Electrical Code* (NEC) for installation requirements.
			2. AASHTO LTS-5 Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, including interim revisions,
			3. International Building Code
			4. ASCE-7, Minimum Design Loads for Buildings and Other Structures
			5. New Mexico Night Sky Protection Act
			6. The National Energy Policy Act and Energy Star requirements for lighting products.
		2. Provide luminaires listed and labeled by a nationally recognized testing laboratory (NRTL).
		3. Use manufacturers that are experienced in manufacturing poles, luminaires, lamps and ballasts similar to those indicated for this Project and have a record of successful in-service performance.

Service Conditions

* + 1. Elevation: 7500 feet above sea level.
		2. International Building Code and ASCE 7 design wind conditions:
			1. Exposure Category: C
			2. Basic Wind Speed: 90 mph (3-second gust at 33 ft. above ground, mean recurrence interval of 50 years).
			3. Importance Factor: 1.00.
		3. Ambient temperatures, deg. C (deg. F):
			1. Annual averages: 2.1 (35.8) minimum, 15.6 (60.0) maximum, 8.8 (47.9) average.
			2. Annual nighttime average: 5.4 (41.7)
			3. Annual extremes: -15.0 (5.0) minimum, 31.7 (89.0) maximum
			4. Annual warmest day 24-hour average: 20.7 (69.3)
			5. Annual warmest day nighttime average: 16.4 (61.6).
		4. Maximum solar heat gain: 110 W/sq. ft.
		5. Lightning flash density: three flashes to ground per square km per year.

dEFINITIONS

* + 1. Unless otherwise specified or indicated, terms used in this Section are as defined in the National Electrical Code or the IESNA Lighting Handbook.

EXTRA MATERIALS

* + 1. Furnish the following extra materials matching products installed. Package with protective covering for storage and identify with labels describing contents.
			1. LED Luminaires: 5 percent of quantity of LED luminaires of each type, but no fewer than two of each type.
			2. HID Lamps: 5 percent of quantity of high intensity discharge (HID) lamps of each type, but no fewer than two lamps of each type.
			3. Ballasts: 1 percent of quantity of ballasts of each type, but not less than one of each type.
			4. Lenses, Diffusers, Covers, Globes, and Guards: 1 percent of quantity of each type, but not less than one of each type.
			5. Photoelectric Relays: 5 percent of quantity of photoelectric relays of each type, but not less than two of each type.
			6. Fuses: 5 percent of quantity of fuse of each type, but not less than two of each type.

Receiving, Storing and Protecting

* + 1. Receive, inspect, handle, and store products according to the manufacturer’s written instructions and NECA/IESNA 501, *Recommended Practice for Installing Exterior Lighting Systems*.
1. PRODUCTS

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Seismic: If Project Spec includes 26 0548.16, and if mounting and/or anchorage devices are to be used that differ from those specified in 26 0548.16, they must be described herein (in PART 2). If this applies, use the same terminology for these devices in PART 3 in order to identify the type of devices required for each application.

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* 1. PRODUCT OPTIONS AND SUBSTITUTIONS
		1. Alternate products may be accepted; follow Section 01 2500 *Substitution Procedures*.

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Seismic: For either paragraph 2.2.A or 2.2.B, if there are too many systems/components to list here, then list them in an appendix to this section, and then merely refer to that appendix in the paragraph

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* 1. SEismic Performance requirements
		1. The luminaires shall remain in place without separation of any parts when subjected to the design basis earthquake [per Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*] [as represented by the seismic forces derived from the criteria indicated [on the drawings] [in Section 26 0548.16, *Seismic Controls for Electrical Systems*]].
		2. The luminaires is a Designated Seismic Systems and, as such, it shall remain in place and be fully operational following the design basis earthquake [per Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*] [as represented by the seismic forces derived from the criteria indicated [on the drawings] [in Section 26 0548.16, *Seismic Controls for Electrical Systems*]].

Finishes

* + 1. Furnish luminaires, poles, and accessories with finishes as scheduled that are resistant to fading, chalking, and other changes due to aging and exposure to heat and ultraviolet light. Acceptable finishes for metals are:
			1. Hot-dipped galvanized steel: ASTM A 123/A 123M.
			2. Brushed aluminum
			3. Anodized aluminum: AAMA 611, *Anodized Architectural Aluminum*, Class I.
			4. Powder coated aluminum: Fluorocarbon polymer powder coating per AAMA 2605, *Superior Performing Organic Coatings* over chrome phosphate conversion coated aluminum.
			5. Powder coated steel: Fluorocarbon polymer powder coating per AAMA 2605, *Superior Performing Organic Coatings* over zinc phosphate conversion coated shot-blasted steel.
		2. Reject luminaires, poles, and accessories with finish having runs, streaks, stains, holidays and defects.
		3. Replace luminaires, poles, and accessories showing evidence of yellowing, fading, chalking, and other changes indicating failure during warranty period.
		4. Use stainless steel for exposed hardware.

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Edit the following article to match project. For example: F, G, and I do not apply to LED luminaires

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EXTERIOR Luminaires - General

* + 1. Furnish exterior luminaires that comply with requirements specified in this Section and in the luminaire schedule on the Drawings.
		2. Luminaires shall be NRTL-listed as conforming to UL 1598–*Luminaires*.
		3. Photometric characteristics shall be based on IESNA approved methods for photometric measurements performed by a recognized photometric laboratory.
		4. Each exterior luminaire with light source exceeding 6400 lumens shall comply with the New Mexico Night Sky Protection Act. There shall be no light emitted above a horizontal plane through the lowest light-emitting part of the luminaire.
		5. Luminaire housing shall be primarily metal.
			1. Metal parts shall be free from burrs and sharp corners and edges.
			2. Sheet metal components shall be fabricated from corrosion-resistant aluminum, formed and supported to prevent sagging and warping.
			3. Exposed fasteners: Stainless steel.
		6. Doors and frames shall be smooth operating and free from light leakage under operating conditions.
			1. Relamping shall be possible without the use of special tools.
			2. Doors, frames, lenses and diffusers shall be designed to prevent accidental falling during relamping and when secured in the operating position.
			3. Door: Removable for cleaning or replacing lens.
		7. Luminaire minimum reflecting surface reflectance: As follows unless scheduled otherwise:
			1. White surfaces: 85 percent
			2. Specular surfaces: 83 percent
			3. Diffusing specular surfaces: 75 percent
		8. Provide lenses, diffusers, covers and globes as scheduled on the Drawings fabricated from materials that are UV stabilized to be resistant to yellowing and other changes due to aging or exposure to heat and ultraviolet radiation.
		9. Doors shall have resilient gaskets that are heat-resistant and aging-resistant to seal and cushion lens and refractor.

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Edit the following article to match project requirements; delete if LED luminaires are not used. Note: Some LED luminaire specs from Commercial Building Energy Alliances (CBEA) *LED Site Lighting Performance* [*Specification*](http://www1.eere.energy.gov/buildings/alliances/parking_lot_lighting.html) Version 1.2

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LED Luminaires

* + 1. Conform to UL 1598 and to UL 8250–*Safety Standard for Light-Emitting Diode (LED) Light Sources for Use in Lighting Products.*
		2. Lead and mercury free.
		3. Photometric characteristics: Established using IESNA LM-79, *IESNA Approved Method for the Electrical and Photometric Measurement of Solid-State Lighting Products.*
		4. Ingress protection for optical assembly: IP65 or better in accordance with ANSI/IEC 60529 - *Degrees of Protection Provided by Enclosures.*
		5. Color characteristics as follows in accordance with ANSI C78.377–*Specifications for the Chromaticity of Solid State Lighting Products*:
			1. Color temperature (deg K): 5000 to 6500
			2. Color rendering index: not less than 70
		6. LED and driver cooling system: Passive and shall resist the buildup of debris.
		7. LED luminaire output after 50,000 hours of operation: Not less than 70 percent of the initial lumen output when determined in accordance with IESNA LM-80-–*IESNA approved Method for Measuring Lumen Maintenance of LED Lighting Sources.*
		8. LED luminaire electrical characteristics:
			1. Supply voltage: 120 V, 208 V, 240 V, 277 V, or 480 V, as indicated on the Drawings.
			2. Total harmonic distortion (current): Not more than 20 percent
			3. Power factor: Not less than 90%
			4. RF interference: Meet FCC 47 CFR Part 15/18
			5. Driver input surge protection device: UL 1449 recognized component meeting IEEE C62.41.2–*IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits*, Category C, High Exposure.

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Delete the following if luminaire-mounted photocontrols are not required. Luminaire-mounted photocontrols are typically used for roadway lighting, but not for security, parking, or storage area lighting.

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* + 1. For each luminaire provide a luminaire-mounted locking-type photocontrol receptacle conforming to IEEE C136.10.
			1. Manufacturers:
				1. BetaLED “BLD”
				2. Leotek “SLN”
				3. Kim “Warp 9”

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Delete the following if HPS lamps are not used

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High Pressure Sodium LAMPS

* + 1. Comply with requirements specified below and the luminaire schedule on the Drawings.
			1. ANSI/ANSLG C78.42, American National Standard for Electric Lamps–High-Pressure Sodium (HPS) Lamps.
		2. Manufacturers: General Electric, North American Phillips, Sylvania

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Delete the following article if HPS lamp ballasts are not used

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HIGH Pressure Sodium LAMP BALLASTS

* + 1. Ballasts with associated capacitors and igniters shall comply with requirements below for lamps specified in this Section and in the luminaire schedule on the Drawings.
		2. Conform to UL 1029 - *High-Intensity-Discharge Lamp Ballasts* and NEMA C82.4 - *Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.*
		3. Ballasts shall be of the following circuit types:
			1. Lamp rated 150 watts or less: lag type – high reactance autotransformer – high power factor (HX-HPF).
			2. Lamp rated 250 watts or greater: constant wattage autotransformer (CWA).
		4. Core and coil ballasts: Constructed with class H or higher insulation system vacuum-impregnated with a 100-percent-solids-based resin.
		5. Design to operate for at least 180 cycles of 12 hours off and 12 hours on, with lamp in an open or a short-circuited condition without undue reduction in ballast life.
		6. Ballast and igniter/starter combination shall reliably start HPS lamp down to -40 C.
			1. Solid-state igniter/starter or accessory shall automatically deactivate if a lamp arc cannot be initiated after 10 to 12 minutes.
			2. Where scheduled on the Drawings, provide HPS ballasts for 150 watt and smaller lamps with an instant re-strike starter that will generate a multiple pulse to re-strike lamp arc after a momentary power interruption.
			3. Solid-state igniter/starter shall have an average life in the pulsing mode of 10,000 hours at the intended ambient temperature. Igniter case temperature not to exceed 90 degrees C.
		7. Oil-filled capacitors shall have metal cans and circuit interrupter devices to prevent catastrophic failure. Provide bleeder resistor with each capacitor
		8. Manufacturer: GE Lighting

POLES AND ACCESSORIES

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Edit the following to match project requirements. This Specification contemplates poles 30 ft and taller used for roadway and parking lot lighting; less rigorous requirements would apply to pedestrian-scale poles.

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* + 1. Furnish poles and accessories that comply with requirements specified in this Section and the luminaire schedule on the Drawings.
		2. Pole, base, and anchorage shall carry the luminaires, supports, and appurtenances at the indicated height above grade without deflection or whipping.
		3. Mountings, fastenings and other appurtenances shall be fabricated from corrosion-resistant materials that are compatible with poles and luminaires and will not cause galvanic action at contact points. Mountings shall correctly position luminaires to provide scheduled light distribution.
		4. A reinforced access handhole, minimum 2.5 x 5 inches, shall be located in the wall of each metal pole.
		5. A welded grounding lug, with ½ inch hole, shall be accessible through the handhole of each metal pole. Grounding connection shall be designed to prevent electrolysis when used with copper ground wire.
		6. Metal poles shall have anchor type bases and galvanized steel anchor bolts, leveling nuts and bolt covers.
		7. Where poles are indicated as “breakaway” type on the Drawings, each pole shall have a frangible aluminum transformer base that meets the requirements of AASHTO LTS-5.
		8. Each non-breakaway metal pole shall have a metal base cover that covers the entire base plate and anchorage.
		9. Protect painted, anodized, or brushed pole finishes during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

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Edit the following to match project requirements; delete if steel poles are not used. Consult structural engineer for appropriate metal gauge; 7-gauge or even 3-gauge poles may be needed for tall poles or special applications.

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* + 1. Steel poles shall be fabricated from tubing having minimum [11-gauge][7-gauge][3-gauge] steel with minimum yield/strength of 48,000 psi.
			1. Poles shall be anchor bolt mounted type.
			2. Poles shall be one-piece construction up to 40 feet in length. Poles over 40 feet in length may be in two or more sections with overlapping joints.
			3. Poles shall be tapered, either round in cross section or polygonal.
			4. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved.
			5. Tops of shafts shall be fitted with a round or tapered cover.
			6. Pole markings shall be approximately 3 to 4 feet above grade and shall include manufacturer, year of manufacture, and length.
			7. Provide poles with finish color indicated on the Drawings and conforming to FINISHES article of this Section. If pole is not galvanized, coat inside of pole with suitable rust-inhibiting finish.
			8. Base covers for steel poles shall be structural-quality, hot-rolled carbon-steel plate having a minimum yield of 36,000 psi. Finish shall be the same as the corresponding poles.

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Delete the following if aluminum poles are not used

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* + 1. Aluminum poles shall be fabricated from corrosion resistant aluminum Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys or Alloy 356-T4 for cast alloys.

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Edit the following to match project requirements. Consult structural engineer for appropriate metal thickness; 0.188-inch or even 0.220-inch wall-thickness poles may be needed for tall poles or special applications.

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* + - 1. Poles shall be square or round, tapered or straight as indicated on the Drawings.
			2. Aluminum poles over 30 feet tall shall include factory-installed vibration dampers.
			3. Poles shall be seamless extruded or spun seamless type with minimum [0.125 inch][0.188 inch][0.220 inch] wall thickness.
			4. Tops of shafts shall be fitted with a round or tapered cover.
			5. Base shall be anchor bolt mounted, made of cast 356-T6 aluminum alloy in accordance with ASTM B 108/B 108M, *Standard Specification for Aluminum-Alloy Permanent Mold Castings* and shall be machined to receive the lower end of shaft. Joint between shaft and base shall be welded.
			6. Base cover shall be cast 356-T6 aluminum alloy in accordance with ASTM B 108/B 108M.
			7. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel.

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Delete the following if wood poles are not used

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* + 1. Pressure-treated wood poles shall conform to ATIS Standard O5.1, Specifications and Dimensions (for Wood Poles).
			1. Treatment material shall be copper naphthenate.
			2. Treatment shall conform to AWPA C4, Poles–Preservative Treatment, Pressure Processes for the wood species used.
			3. Bore, roof and gain poles before treatment.

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Delete the following if steel mast arms are not used

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* + 1. Steel mast arms shall be fabricated from 2-inch pipe, continuously welded to pole attachment plate and have span and rise as indicated on the Drawings. Provide with same finish as pole.

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Delete the following if aluminum mast arms are not used

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* + 1. Aluminum mast arms shall be tapered oval tubing, continuously welded to pole attachment plate and have span and rise as indicated on the Drawings. Provide with same finish as pole.

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Delete the following if metal pole brackets are not used

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* + 1. Metal pole brackets shall be designed to match pole metal and finish. Provide cantilever brackets without underbrace, in the sizes and styles indicated on the Drawings, with straight tubular end section to accommodate the luminaire.

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Delete the following if wood pole brackets are not used

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* + 1. Wood pole brackets shall conform to ANSI C136.13 - Roadway Lighting Metal Brackets for Wood Poles.

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Delete the following if pole-top tenons are not used

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* + 1. Pole-top tenons: Conform to IEEE C136.21, fabricated to support the luminaire indicated, and securely fastened to the pole top.

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Delete the following if drill-in light pole foundations will be used.

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* + 1. Anchor bolts: Steel rod having minimum yield strength of 50,000 psi, with the top 12 inches galvanized per ASTM A153/A153M.
		2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
			1. Holophane Corporation
			2. Hubbell Lighting, Inc.
			3. Lithonia Lighting.
			4. Millerbernd Manufacturing Company.
			5. Union Metal Corp.
			6. Valmont Industries, Inc.

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Delete the following if drill-in lighting pole foundations are not used.

Drill-in lighting pole foundations may be a cost-effective alternative to cast-in-place lighting pole foundations. This Specification contemplates foundations for 30 ft. to 50 ft. poles used for roadway and parking lot lighting; less rigorous requirements would apply to pedestrian scale poles.

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Drill-in Lighting Pole foundations

* + 1. Furnish drill-in lighting pole foundations as indicated on the Drawings.
		2. Drill-in lighting pole foundations for 30 ft., 35 ft., and 40 ft. poles with one or two luminaires shall have the following minimum dimensions:
			1. Base Plate: 15.75 inches square, 1 inch thick, 11 to 17 inch diameter bolt circle, slots for four 1” x 4” carriage bolts.
			2. Shaft: 8 inch diameter, 7 ft. long, 0.25 inch wall thickness, with two 2.5 x 12 inch cable slots with top 12 inches below the base plate.
			3. Helix: 14 inch diameter, 0.38 inch thick, with 3-inch pitch formed by metal die.
		3. Drill-in lighting pole foundations for 45 ft., and 50 ft. poles with one or two luminaires shall have the following minimum dimensions:
			1. Base Plate: 15.75 inches square, 1 inch thick, 13.5 to 17 inch diameter bolt circle, slots for four 1” x 4” carriage bolts.
			2. Shaft: 10 inch diameter, 10 ft. long, with two 2.5 x 12 inch cable slots with top 12 inches below the base plate.
			3. Helix: 16 inch diameter, 0.38 inch thick, with 3-inch pitch formed by metal die.
		4. All material shall be mill traceable to the following specifications:
			1. Base Plate: ASTM A36 structural steel.
			2. Shaft: Steel pipe piles, seamless or straight welded, Grade -2 per ASTM A252 or steel pipe Type E or S Grade-B per ASTM A 53.
			3. Helix: ASTM A29 Grade M1010 hot-rolled steel plate or coil.
			4. Pilot point: ASTM 575 hot rolled steel bar, 1.25 inch diameter.
			5. Bolts: Carriage bolts per ANSI G-18.21, SAE J429 Grade 5, ANSI B-18.5 1-8UNC-2A x 4” long, hot-dip galvanized per ASTM A153.
			6. Nuts: Heavy hex per ASTM A-194 Grade 2H or ASTM A563 Grade DH, meeting the supplementary requirements of ASTM A562, and ANSI B-10.2.2 1-8UNC-2B.
		5. Base plate shall be perpendicular to the shaft axis within 1 degree and the hole centerline shall be concentric to the shaft axis within 0.2 inches.
		6. Pilot point and shaft axes shall be concentric within 0.125 inches and in-line within 2 degrees.
		7. Clean all welds on base plate, helix, and pilot point by hand-grinding and sand-blasting. Hot-dip galvanize foundations per ASTM A153 after fabrication, welding, and cleaning to a minimum 3-mil coat thickness.
		8. Manufacturer’s identification and date code shall be permanently stamped on the base plate.
		9. Manufacturer: Hubbell Power Systems

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Edit the following to match project requirements. Comply with exterior lighting system control requirements in LANL Engineering Standards Manual, Chapter 7, Section G4020. The building automation system may be used to good advantage instead of time switches and photocontrols for control of exterior lighting so long as LANL ESM functional requirements are met.

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Lighting Control Equipment

* + 1. Furnish photoelectric relays to control exterior lighting as indicated on the Drawings.
			1. For photoelectric relays mounted on luminaires use products that conform to UL 733, *Plug-in, Locking Type Photocontrols for Use with Area Lighting* with single-pole single-throw contacts arranged to fail in the “ON” position. For each luminaire provide a luminaire-mounted locking-type receptacle conforming to IEEE C136.10.
			2. For photoelectric relays not mounted on luminaires use products conforming to either UL 773 or UL 773A, *Non-industrial Photoelectric Switches for Lighting Control*. Provide the photoelectric relays with single-pole double-throw contacts to switch mechanically-held contactors.
			3. Photoelectric relay contacts shall be factory set to turn exterior lighting “ON” at or below 3 foot-candles and “OFF” at 4 to 10 foot-candles. A time delay shall prevent switching from transient light sources.
		2. Furnish one or more time switches to control exterior lighting as indicated on the Drawings.
			1. Use a mechanical astronomic dial type or an electronic type time switch, arranged to turn “ON” at sunset and turn “OFF” at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes
			2. Time switch shall have either an automatically wound spring mechanism or an energy-storage capacitor to maintain accurate time for a minimum of 7 hours following power failure.
			3. Time switch shall have Form C contacts to switch mechanically-held contactors and a manual on-off bypass switch.
			4. Provide time switch with NEMA 3R housing if installed outdoors or NEMA 1 housing if installed indoors.
		3. Furnish a “hand-off-auto” control switch and enclosure to facilitate testing of the lighting system.
		4. Furnish one or more multi-pole lighting contactors to control exterior lighting as indicated on the Drawings.
			1. Mechanically-held contactors shall conform to NEMA ICS 2 Industrial Controls and Systems: Controllers, Contactors, and Overload Relays.
			2. Contactors shall have the number of contacts as indicated on the Drawings or as required by the number of circuits to be controlled. Contacts shall have a minimum rating of 30 amperes at 277 volts AC per pole for ballast loads. Contacts shall be field-convertible from normally-open to normally-closed, or shall be Form C.
			3. Use 120 volts AC operating coils, or as shown on drawings.
			4. Provide contactor with NEMA 3R housing if installed outdoors or NEMA 1 housing if installed indoors.

Fuses and Fuse holders

* + 1. Furnish fuse overcurrent protection for each pole-mounted luminaire to isolate faulted ballasts or drivers from the lighting circuit.
			1. Use 600 volt, Class CC, time-delay, current-limiting fuses.
			2. Select fuses rated between 200% and 300% of the luminaire ballast or driver maximum current.
			3. Manufacturer: Bussman “LP-CC”
		2. Furnish in-line fuse holders for installation in pole hand hole or transformer base.
			1. Use non-breakaway type fuse holders unless breakaway poles are indicated on the Drawings.
			2. Use breakaway type fuse holders where breakaway poles are indicated on the Drawings.
			3. Load and line terminal sizes and types shall correspond to line and load conductor sizes and quantities.
			4. Both breakaway and non-breakaway fuse holders shall have insulating boots.
			5. Manufacturers: Ferraz Shawmut “FEC” for phase conductor(s), “FEBN” for neutral conductor.
1. EXECUTION

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Seismic: For luminaires that are subject to seismic design, if Project Spec includes 26 0548.16, and if requirements associated with installation, testing, and inspection of mounting and/or anchorage devices differ from those requirements in 26 0548.16, they must be described herein (in PART 3). Also, if this is applicable, identify special types of seismic-control devices required for each application using the same terminology used for those devices in PART 2.

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* 1. EXISTING WORK

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Delete when existing construction is not affected. \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

* + 1. Disconnect and remove abandoned exterior luminaires as indicated on the Drawings.
		2. Disconnect and remove abandoned luminaire poles and associated foundations as indicated on the Drawings.
		3. Maintain electrical circuit to existing exterior luminaires that are to remain active.
		4. Clean and repair existing exterior luminaires that are to remain or be reinstalled, as a part of the scope of this project.

EXAMINATION

* + 1. Examine areas, spaces, and surfaces to receive exterior luminaire (s) or poles for compliance with installation tolerances and other conditions affecting performance of the product. Do not proceed with installation until unsatisfactory conditions have been corrected.

INSTALLATION

* + 1. Install products in accordance with manufacturer's instructions, NECA/IESNA 501, and approved shop drawings.
		2. Locations of luminaires and poles shown on the Drawings are diagrammatic. Coordinate luminaire locations with building finishes, building structure, paving and striping, utility piping, security fences, and existing trees. Obtain approval for location changes through LANL Subcontract Technical Representative (STR).
		3. Set poles and luminaires plumb, square, level and secure.
		4. Install surface mounted luminaires directly to an outlet box which is supported from structure, or as shown on drawings.
		5. [Install lamps in luminaires in accordance with manufacturer's instructions.]

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Seismic: Refer to Guide for editing guidance.

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* 1. FLEXIBLE CONNECTIONS
		1. Install flexible connections for [\_\_\_\_\_\_\_\_\_] where shown on drawings.

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Delete the following if drill-in light pole foundations will be used

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CONCRETE FOUNDATIONS

* + 1. Construct concrete foundations with exterior 4,500 psi concrete and reinforcing conforming to Section 03 3001, *Reinforced Concrete*.
		2. Comply with details on the Drawings and manufacturer's recommendations for foundation dimensions, reinforcing, anchor bolts, nuts and washers.
		3. Position power conduits [and ground rod] to terminate within the pole shaft area and a minimum of one inch above the top of the foundation; refer to Section 26 0533, *Raceways and Boxes for Electrical Systems*.
		4. Cure concrete foundations for 7 full curing days before erecting poles.

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Delete the following if drill-in lighting pole foundations are not used.

Drill-in lighting pole foundations may be a cost effective alternative to cast-in-place lighting pole foundations. This Specification contemplates foundations for 30 ft. to 50 ft. poles used for roadway and parking lot lighting; less rigorous requirements would apply to pedestrian scale poles.

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Drill-in Lighting Pole foundations

* + 1. Install drill-in light pole foundations in accordance with the manufacturer’s instructions.
		2. Set foundation plumb with base plate a minimum of 2 inches above finished grade.
		3. Align cable slots with conduit trench.
		4. Position power conduits to terminate within the pole shaft area and a minimum of 1 inch above the top of the foundation; refer to Section 26 0533, *Raceways and Boxes for Electrical Systems*.

POLE ERECTION

* + 1. Do not erect poles without luminaires, unless luminaire may be damaged during erection.
		2. Use fabric web slings to raise and set poles.
		3. Use leveling nuts or shims to make poles plumb. When leveling nuts are used, set the lower nuts not more than 1 inch from the concrete foundation.
		4. Tighten anchor bolt nuts and other pole hardware to torque recommended by manufacturer.
		5. After pole is leveled, pack non-shrink grout between anchor base and concrete foundation to provide a full bearing surface. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout; arrange to drain condensation from interior of pole.
		6. Set embedded poles to depth indicated on the Drawings, but not less than 1/6 of pole length below finish grade.
			1. Auger holes large enough to permit the use of tampers the full depth of the hole.
			2. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of the undisturbed earth.

GROUNDING

* + 1. Install grounding for exterior lighting using materials and methods as shown on drawings.

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Delete the following if ground rods are not required. Rods are not needed at poles with drill-in foundations; the steel pier provides adequate grounding.

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* + 1. Install a 10 foot long, minimum 5/8-inch diameter copper-clad ground rod at each pole. At metal poles mounted on reinforced concrete foundations, the rebar in the concrete foundation will be the grounding electrode. Attach a 4 AWG copper conductor to the rebar with a NRTL listed connector and leave enough copper extending above the concrete to connect to the grounding lug in the pole.

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Edit the following to match project requirements.

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* + 1. Connect ground lug of metal pole to ground rod using a 6 AWG copper conductor.
		2. Connect ground lug of metal pole to concrete encased electrode with a 4 AWG copper conductor.
		3. Connect ground lug of metal pole to circuit equipment grounding conductor.
		4. Ground metallic components of lighting unit with non-metallic pole to grounding electrode.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*Edit the following to match project requirements. Security, parking area, and storage area lighting systems typically use a control system as described herein. Roadway lighting systems typically use luminaire-mounted photo controls.

If fuses are not needed at the base of poles, delete article 3.10.

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LigHting Control System

* + 1. Install exterior lighting control system components in accordance with the manufacturers’ instructions. Have installation instructions available at the construction site.
		2. Install a HAND-OFF-AUTO selector switch in the control system to allow for testing of luminaires.
		3. Provide separate control of exterior lighting system as follows:
			1. Safety, security, pedestrian walkway, and roadway lighting: “ON” at dusk, “OFF” at dawn.
			2. Parking facility and landscape lighting: “ON” at dusk, “OFF” at predetermined time. Approximately 10 percent of parking lot lighting shall remain on until dawn for personnel security.

Fuses and Fuse holders

* + 1. Install fuse(s) and fuse holders in pole hand hole or transformer base for each luminaire.
			1. Install fuse holder and fuse in each phase conductor.
		2. Orient breakaway fuse holders so no energized conductors will be exposed in the event of a pole knockdown.
		3. Install insulator boots over fuse holders and tape wrap where conductor enters boot.

Raceways And Boxes

* + 1. Install conduit system for exterior lighting using materials and methods specified in Section 26 0533, *Raceways and Boxes for Electrical Systems*.

Building Wire

* + 1. Install wiring for exterior lighting using materials and methods specified in Section 26 0519, *Low Voltage Electrical Power Conductors and Cable*s.

FIELD QUALITY CONTROL

* + 1. Inspect each installed lighting unit for damage. Replace, or repair, damaged luminaires, poles, and components.
		2. Test installed luminaires for proper operation.
			1. Replace or repair malfunctioning luminaires and components then re-test.
			2. Repeat procedure until all luminaires operate properly.
		3. Replace inoperative lamps or luminaires.

ADJUSTING AND CLEANING

* + 1. Clean each luminaire, including plastics and glassware. Use methods and materials recommended by manufacturer.

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Edit the following to match project requirements

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* + 1. Aim adjustable luminaires to provide required light intensities as indicated on the Drawings or as directed by the LANL STR or PIC.
		2. Adjust exterior lighting controls to obtain the following performance unless otherwise indicated on the Drawings or directed by the LANL STR:
			1. Safety, security, pedestrian walkway, and roadway lighting: “ON” when ambient lighting becomes less than 1.6 times the illuminance design level or 1.5 foot-candles, whichever is higher; “OFF” when ambient lighting exceeds approximately 5 foot-candles.
			2. Parking facility and landscape lighting: “ON” when ambient lighting becomes less than 1.6 times the illuminance design level or 1.5 foot-candles, whichever is higher; “OFF” at 10:00 p.m.

END OF SECTION

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Do not delete the following reference information \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification is based on LANL Master Specification Section 26 5600 Rev. 6, dated September 2, 2020.