Preparing Activity: NASA Superseding
UFGS-26 55 53.00 40 (November 2014)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 55 53.00 40

SECURITY LIGHTING

08/23

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 QUALITY CONTROL
1.3.1 Standard Products
1.4 PROJECT/SITE CONDITIONS

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION
2.1.1 Lighting System
2.1.1.1 Electrical Requirements
2.1.1.2 Unusual Service Conditions
2.1.1.3 Hazardous Locations
2.1.2 System Design
2.2 EQUIPMENT
2.2.1 Interface Lighting System and Power Distribution
2.2.2 Aerial Cable Hardware
2.2.3 Cable Splices and Connectors
2.2.4 Cable Boxes
2.2.5 Manholes, Handholes, and Pullboxes
2.2.6 Conduit, Ducts and Fittings
2.2.6.1 Conduit, Rigid Steel
2.2.6.2 Conduit Coatings
2.2.6.3 Conduit Fittings and Outlets
2.2.6.4 Non-Metallic Duct
2.2.7 Fixtures
2.2.7.1 Accessories
2.2.7.2 Special Fixtures
2.2.7.3 In-Line Fuse
2.2.8 Transformers
2.2.8.1 Outdoor Dry-Type Lighting Transformers
2.2.8.2 Buck-Boost Transformers

2.2.9 Wireway, Raintight, Support
2.2.10 Nameplates
2.2.11 Spare Parts
2.3 COMPONENTS
2.3.1 Protection of Security Lighting System Components
2.3.1.1 Components and Conductors
2.3.1.2 Tamper Provisions
2.3.2 Cable
2.3.2.1 Insulated Cable
2.3.2.2 Messenger Cable
2.3.2.3 Bare Copper Conductors
2.3.3 Electrical Enclosures
2.3.3.1 Interior Enclosures
2.3.3.2 Exposed-to-Weather Enclosures
2.3.3.3 Corrosion Resistant Enclosures
2.3.3.4 Hazardous Environment Enclosures
2.3.4 Illumination
2.3.4.1 General Lighting
2.3.4.2 Roadway Lighting
2.3.5 Lamps and Ballasts, High Intensity Discharge (Hid) Sources
2.3.5.1 High-Pressure Sodium
2.3.5.2 Mercury Vapor
2.3.5.3 Metal-Halide
2.3.6 Lamps, Incandescent
2.3.7 Lamps, Fluorescent
2.3.8 LED Lighting
2.3.9 Luminaire Components
2.3.10 Photometric Distribution Classification
2.3.11 Luminaires, Floodlighting
2.3.11.1 HID and Incandescent
2.3.11.2 Fluorescent
2.3.12 Searchlights
2.3.13 Fresnel-Lens Luminaires
2.4 MATERIALS
2.4.1 Corrosion Protection
2.4.1.1 Aluminum Materials
2.4.1.2 Ferrous Metal Materials
2.4.1.3 Finishing

PART 3 EXECUTION

3.1 PREPARATION
3.1.1 Current Site Conditions
3.1.2 Existing Equipment
3.2 INSTALLATION
3.2.1 Enclosure Penetrations
3.2.2 Prevention of Corrosion
3.2.2.1 Aluminum
3.2.2.2 Steel Conduits
3.2.2.3 Cold Galvanizing
3.2.3 Cable Installation
3.2.3.1 Splices
3.2.3.2 Installation in Duct Lines
3.2.4 Direct Burial
3.2.4.1 Trenching
3.2.4.2 Requirements for Installation in Duct
3.2.4.3 Location of Cable Splices
3.2.4.4 Markers
3.2.4.5 Warning Tape

3.2.5 Messenger Cable
3.2.5.1 Installation
3.2.5.2 Grounding and Bonding Connections
3.2.5.3 Grounding Conductors and Electrodes
3.2.5.4 Ground Resistance Testing
3.2.6 Aerial Cable Splices
3.2.7 Lashing Wire
3.2.8 Stress Loops
3.2.9 Connections to Buildings
3.2.10 Duct Lines
3.2.10.1 Requirements
3.2.10.2 Treatment
3.2.10.3 Concrete Encasement
3.2.10.4 Non-encased Direct-Burial
3.2.10.5 Installation of Couplings
3.2.10.6 Concrete
3.2.10.7 Duct Line Markers
3.2.11 Handholes
3.2.11.1 Construction
3.2.11.2 Appurtenances
3.2.11.3 Cable Pulling-in Irons
3.2.11.4 Ground Rods
3.2.12 Lighting
3.2.12.1 Lamps
3.2.12.2 Fixture Installation
3.2.13 Transformer Installation
3.2.14 CCTV Alarm Interface
3.3 FIELD QUALITY CONTROL
3.3.1 Test for CCTV Assessment Lighting
3.3.2 Operating Test
3.3.3 Ground Resistance Measurements
3.4 CLOSEOUT ACTIVITIES
3.4.1 Operations and Maintenance Manuals
3.4.2 Record Drawings

-- End of Section Table of Contents --

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USACE / NAVFAC / AFCEC / NASA	**UFGS-26 55 53.00 40 (August 2023)**

Preparing Activity: NASA	**Superseding** **UFGS-26 55 53.00 40 (November 2014)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023

****

SECTION 26 55 53.00 40

SECURITY LIGHTING
08/23

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NOTE: This guide specification covers the requirements for lighting for security and closed circuit television (CCTV) area illumination.

Use and coordinate UFGS Section 26 09 23.00 40 LIGHTING CONTROL DEVICES for control devices (includes tailoring for exterior lighting) with this section.

Use and coordinate UFGS Section 26 56 13.00 40 LIGHTING POLES AND STANDARDS for pole or standard, including mounting and base accessories of exterior fixtures with this section.

Use and coordinate UFGS Section 26 56 19.00 40 ROADWAY LIGHTING for roadway and street lighting with this section.

Use UFGS Section 26 56 36.00 40 FLOOD LIGHTING for facility and grounds flood lighting.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

PART 1 GENERAL

****

NOTE: This guide specification does not include provision for high-mast roadway and parking lot lighting (poles over 18.3 meters (60 feet)). Add requirements for materials and procedures for special or unusual design as necessary for specific projects. Standard details, and quality of illumination will conform to HREF=http://www.wbdg.org/ccb/DOD/UFC/ufc_3_550_01.pdf>UFC 3-550-01, "Exterior Electrical Power Distribution" and may be modified to suit project conditions.

Do not use Incandescent lamps, Fluorescent lamps, and Mercury Vapor Lamps for CCTV area illumination, nor tungsten lamps other than infrared lamps.

Two types of infrared luminaires are currently available: fixtures with special lamps utilizing optical dichroic mirror coatings that produce only infrared light, and fixtures that use conventional lamps that pass the light output through infrared filters. Special lamps have the advantage of operating cooler and not requiring a cooling fan, thus operating quieter and requiring less maintenance.

The major disadvantages are high lamp replacement cost due to short bulb life (2000 to 4000 hours) and special lamp design. The 2000 hour lamps produce more infrared light energy and are preferred over the 4000 hour lamps. Another disadvantage is the limited variety of wattages available, but this is normally resolved by fixture placement during site lighting system design. Conventional lamps utilizing special power supplies and infrared filters have the advantages of low bulb replacement cost and bulb life ranging from 1700 to 18000 hours. (Note: Special power supplies reduce current flow to the bulb and allow it to operate at a lower filament temperature to shift light output more into the near infrared (NIR) light spectrum and requires less filtering. This has the additional advantage of extending bulb life.) A variety of bulb sizes are available and no special bulbs are required. The main disadvantage of using a conventional bulb is the heat generated utilizing an infrared filter which requires cooling by a cooling fan. Fans require maintenance and the loss of the fan will destroy the filter. Filters are expensive.

****

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in

the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.
****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	(2003; R 2021) Standard Specification for Gray Iron Castings
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A575	(2020) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A576	(2017) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B2	(2013) Standard Specification for Medium-Hard-Drawn Copper Wire
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM D1654	(2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ILLUMINATING ENGINEERING SOCIETY (IES)

ANSI/IES RP-8	(2018; Addenda 1 2020; Errata 1-2 2021) Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C2	(2023) National Electrical Safety Code
IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C135.1	(1999) Standard for Zinc-Coated Steel Bolts and Nuts for Overhead Line Construction
IEEE C135.30	(1988) Standard for Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI ANSLG C78.42	(2009; S 2022) For Electric Lamps: High-Pressure Sodium Lamps
ANSI C78.40	(2011) American National Standard for Mercury Lamps--Specifications
ANSI C80.1	(2020) American National Standard for Electrical Rigid Steel Conduit (ERSC)
ANSI C82.4	(2017; R 2022) Lamp Ballasts - Ballasts for High- Intensity-Discharge and Low-Pressure Sodium Lamps
ANSI C119.1	(2016) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C136.2	(2015) American National Standard for Roadway and Area Lighting Equipment: Luminaires Voltage Classification
ANSI C136.3	(2020) Roadway and Area Lighting Equipment - Luminaire Attachments
ANSI C136.6	(2004) American National Standard for Roadway Lighting Equipment - Metal Heads

	and Reflector Assemblies - Mechanical and Optical Interchangeability
ANSI C136.9	(2003) American National Standard for Roadway and Area Lighting Equipment - Socket Support Assemblies for Metal Heads - Mechanical Interchangeability
ANSI C136.11	(2011; R 2016; STBL 2021) Roadway Lighting Equipment - Multiple Parallel Wired Sockets
ANSI C136.15	(2020) American National Standard for Roadway and Area Lighting Equipment - Luminaire Field Identification
ANSI/ANSLG C78.43	(2013) American National Standard for Electric Lamps - Single-Ended Metal-Halide Lamps
ANSI/NEMA OS 1	(2013; R 2020) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 6 & 8	(2020) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
NEMA TC 9	(2020) Standard for Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-232	(1997f; R 2012) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

UNDERWRITERS LABORATORIES (UL)

UL 6	(2022) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL 44	(2018; Reprint May 2021) UL Standard for Safety Thermoset-Insulated Wires and Cables

UL 98	(2016; Reprint Jan 2022) UL Standard for Safety Enclosed and Dead-Front Switches
UL 467	(2022) UL Standard for Safety Grounding and Bonding Equipment
UL 486A-486B	(2018; Reprint May 2021) UL Standard for Safety Wire Connectors
UL 506	(2017; Reprint Jan 2022) UL Standard for Safety Specialty Transformers
UL 514A	(2013; Reprint Jun 2022) UL Standard for Safety Metallic Outlet Boxes
UL 514B	(2012; Reprint May 2020) Conduit, Tubing and Cable Fittings
UL 514C	(2014; Reprint Feb 2020) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 651	(2011; Reprint May 2022) UL Standard for Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL 651A	(2023) UL Standard for Safety Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit
UL 854	(2020; Reprint Jan 2022) Standard for Service-Entrance Cables
UL 870	(2016; Reprint Mar 2019) UL Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings
UL 1029	(1994; Reprint Jul 2022) UL Standard for Safety High-Intensity-Discharge Lamp Ballasts
UL 1203	(2013; Reprint Apr 2022) UL Standard for Safety Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations
UL 1449	(2021; Reprint Dec 2022) UL Standard for Safety Surge Protective Devices
UL 1598	(2021; Reprint Jun 2021) Luminaires

1.2 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification

technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting System[; G[, [____]]]

Detail Drawings[; G[, [____]]]

SD-03 Product Data

Equipment and Materials[; G[, [____]]]

Spare Parts[; G[, [____]]]

LED Lighting[; G[, [____]]]

Interface Lighting System And Power Distribution[; G[, [____]]]

Aerial Cable Hardware[; G[, [____]]]

Cable Boxes[; G[, [____]]]

Manholes, Handholes, And Pullboxes[; G[, [____]]]

Cable Splices And Connectors[; G[, [____]]]

Conduit, Ducts And Fittings[; G[, [____]]]

Fixtures[; G[, [____]]]

Transformers[; G[, [____]]]

Wireway, Raintight, Support[; G[, [____]]]

Nameplates[; G[, [____]]]

Tamper Provisions[; G[, [____]]]

Cable[; G[, [____]]]

Electrical Enclosures[; G[, [____]]]

Illumination[; G[, [____]]]

Lamps, Incandescent[; G[, [____]]]

Lamps, Fluorescent[; G[, [____]]]

Luminaire Components[; G[, [____]]]

Photometric Distribution Classification[; G[, [____]]]

Luminaires, Floodlighting[; G[, [____]]]

SD-06 Test Reports

CCTV Assessment Lighting[; G[, [____]]]

Operating Test[; G[, [____]]]

Ground Resistance Measurements[; G[, [____]]]

SD-07 Certificates

CCTV Assessment Lighting Test Procedures[; G[, [____]]]

Operating Test Procedures[; G[, [____]]]

SD-10 Operation and Maintenance Data

Operations and Maintenance Manuals[; G[, [____]]]

SD-11 Closeout Submittals

Record Drawings[; G[, [____]]]

1.3 QUALITY CONTROL

1.3.1 Standard Products

Provide materials and equipment which are the standard products of manufacturer regularly engaged in the manufacture of such products, and

which essentially duplicate equipment that has been in satisfactory use at least two years prior to bid opening.

1.4 PROJECT/SITE CONDITIONS

Lighting equipment that is usable in their original configuration without modification may be reused with Government approval. Perform a field survey, including testing and inspection of existing lighting equipment and control lines intended to be incorporated into the lighting system, and furnish a report to the Government. For those items considered nonfunctioning, provide specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency with the report. As part of the report, include the scheduled need date for connection to all existing equipment.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Lighting System

Provide all lighting system components. Include all fixtures, hardware, poles, cables, connectors, adapters and appurtenances needed to provide a fully functional lighting system.

[a Design Requirements for CCTV Assessment Lighting

****

NOTE: Coordinate the type of CCTV light fixture used with the spectral sensitivity of the CCTV camera installed at each assessment zone. Provide a sufficient lighting level to meet the minimum faceplate illumination requirements of each camera. Provide a light ratio of not greater than 6 to 1 (highlight to shadow) between the perimeter fences or in the CCTV assessment zone. In addition, the security at some sites may require lighting in areas not normally viewed by the CCTV cameras.

Omit this paragraph if the lighting system is not used for CCTV assessment.

****

Configure the CCTV Assessment Lighting system as specified and shown. Ensure equipment conforms to NFPA 70 and IEEE C2. Provide sufficient light for optimum CCTV assessment of each zone in the configuration. Include all fixtures, hardware, poles, cables, connectors, adapters, and appurtenances needed to provide a fully functional lighting system.

]2.1.1.1 Electrical Requirements

Provide equipment which operates from a voltage source as shown; plus or minus 10 percent, and at 60 Hz, plus or minus 2 percent.

a. Power Line Surge Protection

****

NOTE: Indicate circuits requiring additional transient voltage surge suppression. Provide

requirements on the drawings or in a table.
****

Provide transient voltage surge suppressors for all electronic equipment, meeting the requirements of IEEE C62.41.1 and IEEE C62.41.2, and UL listed as tested in accordance with UL 1449. Select surge suppressor ratings [as indicated] [[_____] volts rms, operating voltage; [50] [60] Hz; [1-phase] [3-phase]; [2] [3] [4] wire with ground; transient suppression voltage (peak let-through-voltage) of [_____] volts]. Do not use fuses as surge suppression.

b. Interface CCTV Lighting and CCTV System

****
NOTE: Delete this paragraph if infrared lights are not used for CCTV assessment.
****

Interface infrared lights to the CCTV system and provide automatic, alarm actuated call-up of the light associated with the alarm zone.

[2.1.1.2 Unusual Service Conditions

****
NOTE: If normal service conditions prevail, omit this subparagraph. Unusual service conditions for altitude start above 1 kilometer (3300 feet) for most apparatus. Ambient temperature is generally 40 degrees C, although in some cases 30 degrees C applies. Frequency is generally 60 Hz, although 50 Hz may also be standard. Take any unusual service conditions or atmospheres into consideration and adjust the specifications accordingly.
****

Provide equipment and materials furnished under this section suitable for the following unusual service conditions: altitude [_____] m feet, ambient temperature [_____] degrees C F.

][2.1.1.3 Hazardous Locations

****
NOTE: Designer identifies hazardous areas and shows them on the drawings. Delete this paragraph if there are no hazardous issues involved in the project.
****

[Provide wiring conforming to NFPA 70 for Class [I] [II] [III], Division [1] [2] hazardous locations, and suitable equipment for [Group [_____]] [operating temperature of [_____] degrees C F].] [Provide wiring and equipment of the classes, groups, divisions indicated, and suitable for the indicated operating temperature.]

]2.1.2 System Design

Submit detail drawings for the complete system and for [poles,] [lighting fixtures,] [bracket arms,] [cable boxes,] [handholes,] [transformers,] [controllers,] [and] [_____]. [Detail drawings for precast handholes

include a design analysis to determine that strength is equivalent to indicated cast-in-place concrete handholes.] [Indicate in drawings bonding method for concrete encasement.] [Include in drawings design calculations showing adequate strength of screw foundations.] [For CCTV lighting, include in date:

a. Infrared light call-up response time.

b. Lamp strike and restrike times.

c. System startup and shutdown operations.

d. Manuals for CCTV Assessment Lighting equipment.

e. A typical zone layout showing light locations, isolux patterns, and lighting ratios.]

Submit data published by the manufacturer of each item on the list of equipment and material, to permit verification that the item proposed is of the correct size, properly rated or applied, or is otherwise suitable for the application and fully conforms to the requirements specified.

2.2 EQUIPMENT

2.2.1 Interface Lighting System and Power Distribution

****

NOTE: Include the secondary power panel only for a backup generator as specified in another section. Determine the site requirements for a backup generator.

****

Provide conductors [including all conductors extending from the load side of the primary and secondary power panels that serve assessment lighting equipment] [and] [as indicated].

2.2.2 Aerial Cable Hardware

****

NOTE: Include this paragraph only when aerial cable is being used.

****

Provide zinc coated aerial cable hardware conforming to IEEE C135.1, with steel hardware material conforming to ASTM A575 and ASTM A576, hot-dip galvanized in accordance with ASTM A153/A153M.

2.2.3 Cable Splices and Connectors

Provide cable splices and connectors conforming to UL 486A-486B. Provide underground splices and connectors conforming to the requirements of ANSI C119.1.

2.2.4 Cable Boxes

Provide cable boxes and covers made of cast iron with zinc coated or aluminized finish, of the sizes indicated on drawings. Provide minimum inside dimensions of not less than 304.8 mm 12 inches square by 152.4 mm 6

inches deep and not less than required to house the cable splice. Install a suitable gasket between the box and cover for a watertight seal. Install a sufficient number of screws to hold the cover in place along the entire surface of contact. Provide grounding lugs.

2.2.5 Manholes, Handholes, and Pullboxes

****

NOTE: Actual strength figures may need to be adjusted to accommodate various manufacturers of glass reinforced polymer boxes.

Cast iron should generally be specified for wheel loadings up to 7,258 kPa (16,000 pounds); cast steel may be used at the Contractor's option. Handhole covers and frames will generally conform to the details of HREF=http://www.wbdg.org/ccb/DOD/UFC/ufc_3_550_01.pdf>UFC 3-550-01, "Exterior Electrical Power Distribution" Specify cast steel for areas that require heavier loadings, such as airports or other concentrated load applications. When cast steel is required, revise the specification to indicate the wheel load, tire or wheel contact area, and tire pressure.

Use tamperproof bolts for handholes that are in a non-secure area but serve security and CCTV lighting systems.

****

Provide manholes, handholes, pullboxes,and related frames and covers as indicated, with strengths conforming to the requirements of IEEE C2. Provide precast concrete manholes with the required strength established by ASTM C478. Provide frames and covers for manholes made of [gray cast iron] [or] [cast steel]. Provide a machine-finished seat to ensure a matching joint between frame and cover. Cast iron is to comply with ASTM A48/A48M, Class 30B, minimum. Provide handholes for low voltage cables installed in parking lots, sidewalks, and turf areas made from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least [69] [_____] MPa [10,000] [_____] psi and a flexural strength of at least [34.5] [_____] MPa [5,000] [_____] psi. Provide pullbox and handhole covers in parking lots, sidewalks, and turf areas of the same material as the box. [Provide concrete pullboxes consisting of precast reinforced concrete boxes, extensions, bases, and covers.] [Install a sufficient number of tamperproof bolts to hold the cover firmly in place along the entire surface of contact; and include a tool for the tamperproof bolts.]

2.2.6 Conduit, Ducts and Fittings

2.2.6.1 Conduit, Rigid Steel

Provide rigid steel conduit conforming to ANSI C80.1 and UL 6.

2.2.6.2 Conduit Coatings

Coat underground metallic conduit and fittings with a plastic resin system conforming to NEMA RN 1, Type 40. Epoxy systems may also be used.

2.2.6.3 Conduit Fittings and Outlets

a. Boxes, Metallic Outlets

ANSI/NEMA OS 1 and UL 514A.

b. Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

ANSI/NEMA OS 1 and UL 514C.

c. Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 1203.

d. Boxes, Switch (Enclosed), Surface Mounted

UL 98.

e. Fittings for Conduit and Outlet Boxes

UL 514B.

f. Fittings for Use in Hazardous (Classified) Locations

UL 1203.

g. Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.2.6.4 Non-Metallic Duct

****

NOTE: Only polyvinyl chloride and high-density polyethylene conduits are presently covered by UL 651, which includes a temperature rating clause. Other plastic materials are covered by NEMA Standards, which do not provide a temperature rating clause. All options will be permitted and the temperature certification required until these materials are covered by an industry temperature rating clause.

****

Provide non-metallic duct lines and fittings utilized for underground installation suitable for the application, consisting of thick-wall, single, round-bore type, using material of one type. Provide acrylonitrile-butadiene-styrene (ABS) duct conforming to NEMA TC 6 & 8 and NEMA TC 9, with high-density conduit conforming to UL 651A. Provide Schedule 40 polyvinyl chloride (PVC) conforming to UL 651. Provide schedule 40 polyvinyl chloride (PVC) conforming to UL 651.

Provide all plastic utility duct and fittings manufactured without a UL label or listing with a certification as follows: "The materials are suitable for use with 75 degree C 167 degree F wiring. No reduction of properties in excess of that specified for materials with a UL label or listing will be experienced if samples of the finished product are operated continuously under the normal conditions that produce the highest temperature in the duct."

2.2.7 Fixtures

****
NOTE: Carefully review and select fixtures from Standard Detail No. 40-06-04. Then enter sheet numbers which show the fixture types selected in this paragraph.
****

Provide standard fixtures as detailed on [Standard Detail No. 40-06-04, Sheet Nos. [_____]][_____] which accompany and form a part of this specification. Provide special fixtures as indicated on the drawings. Illustrations shown on these sheets or on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar design, equivalent light distribution and brightness characteristics, equal finish and quality is acceptable as approved.

2.2.7.1 Accessories

Provide accessories such as straps, mounting plates, nipples, or brackets for proper installation.

2.2.7.2 Special Fixtures

The types of special fixtures are designated by letters and numbers. For example, SP-1 denotes special Type 1.

2.2.7.3 In-Line Fuse

Provide an in-line fuse for each fixture, consisting of a fuse and a UL approved waterproof fuse holder rated [at 30 amperes, 600 volts] [as indicated], with insulated boots. Provide a fuse rating of [600 volts] [as indicated].

2.2.8 Transformers

****
NOTE: In corrosive atmospheres, specify transformers with PVC coating on exterior metallic surfaces. Consult transformer manufacturers about derating that might result from the application of additional protective coatings.
****

Provide transformers conforming to UL 506. Provide rust-inhibiting treatment and standard finish by the manufacturer on all exterior transformer cases.

2.2.8.1 Outdoor Dry-Type Lighting Transformers

****
NOTE: Provide transformers in the security lighting system to serve 12O volt incandescent or quartz lamps from distribution systems of higher voltages.
****

Provide single phase, 60 Hz, two winding, with two wire secondary and with

a [240] [480] [_____] volt primary to 120 volt secondary, [1] [_____] kVA transformers.

2.2.8.2 Buck-Boost Transformers

****

NOTE: Select a kVA rating for the buck-boost transformer of not less than 125 percent of the required load (as determined by multiplying the current by the boost voltage). In order to keep conductor size to a minimum, use buck-boost transformers in security and CCTV lighting circuits that have excessive voltage drop due to the circuit lengths. See American Electrician's Handbook, Ninth Edition, for diagrams.

****

Provide transformers suitable for outdoor installation, with a 150 degree C 302 degree F insulation system for an 80 degree C 176 degree F rise; 60 Hz with 4 windings, 2 for primary and 2 for secondary, with all leads brought out to permit parallel or series connections of primary and secondary windings. Provide voltage ratings, kVA ratings, percent of boost and/or buck, and connections as indicated on drawings.

2.2.9 Wireway, Raintight, Support

Provide raintight wireway conforming to UL 870. When used for supporting floodlights on wood poles, provide[[101.6 by 101.6] [_____] mm [4 by 4] [_____] inches wide by [1.8] [_____] m [6] [_____] feet long] wireway[as indicated].

2.2.10 Nameplates

Provide each major component of equipment with a nonferrous metal or engraved plastic nameplate which shows, as a minimum, the manufacturer's name and address, the catalog or style number, the electrical rating in volts, and the capacity in amperes or watts.

2.2.11 Spare Parts

Submit spare parts data for each different item of material and equipment specified, after approval of detail drawings for materials and equipment, and not later than 4 months before the date of beneficial occupancy. Include in data a complete list of parts, special tools, and supplies, with current unit prices and sources of supply.

2.3 COMPONENTS

2.3.1 Protection of Security Lighting System Components

2.3.1.1 Components and Conductors

****

NOTE: Bury Security and CCTV lighting system conductors in areas where the likelihood of damage to the conductors is slight. In areas where subsurface utilities are congested and in areas where the chance of accidental or intentional damage is great, place the security and CCTV lighting

system conductors in ducts.
****

Protect Security lighting system conductors from damage. Install lighting system conductors in raceways or by means of direct burial, as shown. Where the conductors leave the underground systems, encase the conductors in rigid steel conduit of the indicated size. Provide wire guards to protect security lighting luminaries mounted below 6.1 m 20 feet. House exterior group-located electrical equipment such as time switches, safety switches, and magnetic contactors in a NEMA ICS 6, Type 4 enclosure. Provide an individual enclosure where only one piece of equipment is provided at a location.

[2.3.1.2 Tamper Provisions

****
NOTE: When an Intrusion Detection System (IDS) is to be provided or is already in place, tamper switches or welded covers are required. When an IDS is not required, delete this paragraph.
****

Provide enclosures, cabinets, housings (other than luminaire housings), boxes, raceways, conduits, and fittings having hinged doors or removable covers, and which contain any part of the security lighting system (including power sources), with corrosion-resistant tamper switches, connected to an Intrusion Detection System (IDS), that initiates an alarm signal when the door or cover is opened or moved. Make tamper switches inaccessible until the switch is activated. Conceal switch leads and mounting hardware from the exterior of the enclosure. For pull or junction boxes which contain no splices or connections the covers may be protected by 6.4 mm1/4 inch tack welds on four sides of each cover rather than by tamper switches. Affix labels to indicate they contain no connections. Do not indicate on labels that the box is part of the security system.

]2.3.2 Cable

Provide all wire and cable not indicated as government furnished equipment, capable of withstanding the jobsite environment for a minimum of 20 years.

2.3.2.1 Insulated Cable

****
NOTE: Select insulation thickness of column B when approximately 0.381 to 0.508 mm 15 to 20 mils more insulation is desired and column A when even thicker insulation is necessary. Do not specify for small installations or for limited amounts of one AWG size on large installations, since cable is manufactured to order.
****

Provide USE type cable conforming to UL 854, with copper conductors and type RHW or XHHW insulation conforming to UL 44, including green ground conductor. Provide cable with insulation of a thickness not less than that given in column [A] [B] of TABLE 15.1 of UL 854, rated 600 volts. Provide parts of the cable system, such as splices and terminations, rated

not less than 600 volts. The size and number of conductors and the number of cables are as indicated. Strand conductors larger than No. 8 AWG.

[2.3.2.2 Messenger Cable

****
NOTE: Include this paragraph only for aerial cable. Coordinate with the site to determine acceptable locations and heights for aerial cables. For security reasons, aerial cables do not cross perimeter fencing.
****

Provide a messenger cable system to support aerial cable, including guys, hardware and appurtenances needed to install the messenger cable, and capable of supporting the weight of the lighting system cable with the required messenger cable tensioning without exceeding 30 percent of its breaking strength under 16 degrees C 60 degrees F conditions of no ice and no wind. Size the messenger so that ice and wind loading normally encountered at the site does not cause the messenger to exceed 50 percent of its breaking strength. Size appurtenances, guys, and hardware to exceed the rated breaking strength of the messenger cable. Provide galvanized zinc coated steel or aluminum clad steel messenger cables.

]2.3.2.3 Bare Copper Conductors

Provide medium-hard-drawn copper conductors conforming to ASTM B2 and ASTM B8.

2.3.3 Electrical Enclosures

****
NOTE: Show on the drawings which specific type of enclosure is needed.
****

Provide metallic enclosures as needed to house the [security] [and] [CCTV] lighting equipment conforming to NEMA ICS 6 and NEMA 250. Provide enclosures with lockable or padlock handles. Deliver keys for lockable enclosures to the Contracting Officer. Provide enclosures as specified or as shown on the drawings.

[2.3.3.1 Interior Enclosures

Provide enclosures to house lighting equipment in an interior environment meeting the requirements of a NEMA 12 enclosure as defined in NEMA 250.

][2.3.3.2 Exposed-to-Weather Enclosures

Provide enclosures to house lighting equipment in an outdoor environment meeting the requirements of a NEMA 4 enclosure as defined in NEMA 250.

][2.3.3.3 Corrosion Resistant Enclosures

Provide enclosures to house lighting equipment in a corrosive environment meeting the requirements of a NEMA 4X enclosure as defined in NEMA 250.

][2.3.3.4 Hazardous Environment Enclosures

Install equipment within a hazardous environment as described in paragraph Hazardous Locations.

]2.3.4 Illumination

****
NOTE: Insert appropriate sheets from CE Standard Detail 40-06-04 into these specifications. Add references used in 40-06-04 to paragraph REFERENCES. Delete paragraphs not required.
****

2.3.4.1 General Lighting

Provide luminaires, ballasts, lamps, and control devices required for [general area] [and] [_____] lighting [, including floodlighting] in accordance with [sheet] [sheets] [_____] of Standard Detail No. 40-06-04, attached to these specifications.

2.3.4.2 Roadway Lighting

Provide luminaires, ballasts, lamps, and control devices required for roadway lighting in accordance with [sheet] [sheets] [_____] of Standard Detail No. 40-06-04, attached to these specifications.

2.3.5 Lamps and Ballasts, High Intensity Discharge (Hid) Sources

****
NOTE: Production of required lumen output within 3 minutes after primary or emergency power is applied is required of lighting system.

Incandescent lamps may be used to provide required light output during periods of restart.
****

2.3.5.1 High-Pressure Sodium

Provide lamps conforming to ANSI ANSLG C78.42, and ballasts conforming to ANSI C82.4, or UL 1029. Provide clear high-pressure sodium lamps.

2.3.5.2 Mercury Vapor

****
NOTE: To save energy, only use mercury vapor fixtures when matching existing fixtures.
****

Provide lamps conforming to ANSI C78.40, and ballasts conforming to ANSI C82.4.

2.3.5.3 Metal-Halide

Provide lamps made by a manufacturer with not less than 5 years experience in making metal-halide lamps, conforming to ANSI/ANSLG C78.43, with ballasts conforming to ANSI C82.4 or UL 1029.

2.3.6 Lamps, Incandescent

Provide incandescent lamps conforming to UL 1598 and rated for 120 volt operation unless otherwise specified.

2.3.7 Lamps, Fluorescent

Provide fluorescent lamps with standard cool-white color characteristics which do not require starter switches. Provide rapid-start type lamps.

2.3.8 LED Lighting

Provide LED lighting of the wattage and type indicated. LED luminaries are to have a minimum service life of 20,000 hours of operation. Provide LED lamps with [2700K] [3000K] [4000K] [5000k] color temperature. Provide [floodlights] [wall packs] [canopy lights] [pole mounted parking lot lights] as indicated in the drawings. Housings are to be [anodized aluminum] [powder coated aluminum] [powder coated steel] [manufacturers standard finish]. Provide all mounting poles, brackets, wiring and hardware for a complete, functioning installation.

[2.3.9 Luminaire Components

****
NOTE: Include the following paragraph if UFGS Section 26 56 19.00 40 ROADWAY LIGHTING is not included in the project.
****

Provide luminaire components conforming to the following:

a. Attachments, ANSI C136.3;

b. Voltage classification, ANSI C136.2;

c. Field identification marking, ANSI C136.15;

d. Interchangeability, ANSI C136.6 and ANSI C136.9; and

e. Sockets, ANSI C136.11.

]2.3.10 Photometric Distribution Classification

Provide photometrics conforming to ANSI/IES RP-8.

2.3.11 Luminaires, Floodlighting

2.3.11.1 HID and Incandescent

Provide HID lighting fixtures conforming to UL 1598. Provide incandescent lighting fixtures conforming to UL 1598.

2.3.11.2 Fluorescent

Provide fluorescent lamps conforming to [_____].

2.3.12 Searchlights

Provide special type [_____] searchlights [304.8 mm 12-inch] [457.2 mm

18-inch] [609.6 mm 24-inch] nominal size, and built with weatherproof, dust-tight, corrosion-resistant construction. Include with each searchlight a housing and hinged door, two reflectors, a receptacle, a trunnion, and a base. Provide searchlights which operate at [120 Vac] [[_____] Vdc].

Provide each searchlight with a range for observing objects the size of an automobile at [243.8] [365.8] [457.2] [609.6] m [800] [1200] [1500] [2000]-feet on a clear night. Searchlights are to be [hand-controlled, with pedestal base and slip rings] [pilot-house controlled, with low base and slip rings]. Provide with housing and hinged door made of nonferrous metal. Provide gaskets and mount, to form a weatherproof seal, a heat-resistant, clear, smooth cover glass tempered to withstand sudden changes in temperature to the door. Mount a parabolic reflector of silver-mirrored glass or aluminum approximately 6.4 mm 1/4-inch thick at the back of the housing, and also mount a spherical auxiliary reflector designed to permit relamping in front of the lamp, with a permanent, non-tarnishing, nonabsorptive aluminum oxide reflecting surface. Provide receptacle of proper size to receive the lamp and install in a manner to ensure accurate positioning of the light center. Arrange searchlights for horizontal and vertical adjustment. Provide standard, two-conductor, weatherproof, flexible cable out of the housing through a weatherproof entrance bushing. Optically arrange searchlights to provide a horizontal and vertical beam spread of [2.5] [3.5] [4.5] [5.5] [6.5] [7.5] [8.5] [_____] degrees. Make provisions for tilting searchlights to any position within 45 degrees above and below the horizontal. Provide the searchlights with slip rings to permit continuous horizontal rotation. [Include with each searchlight installation a [_____] 12 volt [_____] kVA transformer conforming to UL 506.]

[Searchlight installation on guard towers Nos. [_____] is also to include a manually operated, two-pole, enclosed transfer switch, a 200 ampere-hour, 12 volt, lead-acid, flat pasted positive plate design storage battery, and an automatic battery charger. Provide a silicon type, full wave battery charger, with high and low charging rate, arranged to go on high rate after resumption of power and emergency discharge, and return to low rate automatically when battery has reached full charge. Provide an ammeter in the charging circuit to indicate rate of charge.

]2.3.13 Fresnel-Lens Luminaires

Provide special type [_____] luminaires consisting of mounting bracket, head, socket, reflector, and fresnel-lens assembly for multiple circuit, with weatherproof, dust tight, and insect proof luminaire. Provide a mounting bracket for [crossarm] [[38.1] [50.8] mm [1-1/2] [2] in slip fitter] [wood-pole] [pipe] mounting. Provide readily accessible means to permit horizontal adjustment and locking of the luminaire within a 30 degree arc each side of the center, and tilting and locking the luminaire within a 30 degree arc each side of vertical. Make the length of the mounting bracket such that the center of the luminaire, when hanging vertically, is not less than 200 mm 8-inches nor more than 600 mm 2-feet from the surface of the pole or cross-arm. [Provide luminaire with a 300 watt incandescent lamp that produces an average candela not less than 3000.] [Provide luminaire with a 500 watt incandescent lamp that produces an average candela of not less than 5000.] Provide the unit with an auxiliary reflector of white glossy-type porcelain enamel or aluminum reflecting surface. Provide a completed assembly, consisting of a 180 degree cylindrical fresnel lens and a semicylindrical reflector housing, which produces a horizontal beam spread of approximately 180 degrees, and

a vertical beam spread of approximately 15 to 25 degrees.

2.4 MATERIALS

2.4.1 Corrosion Protection

2.4.1.1 Aluminum Materials

[Do not use aluminum material if in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, use fittings conforming to UL 486A-486B.] [Do not use aluminum.]

2.4.1.2 Ferrous Metal Materials

a. Hardware

Provide hot-dip galvanized ferrous metal hardware in accordance with ASTM A153/A153M and ASTM A123/A123M.

b. Equipment

****

NOTE: Specify a 120 hour test in a non-corrosive environment and a 480 hour test in a corrosive environment.

****

Provide equipment and component items, including but not limited to metal poles and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, with corrosion-resistant finishes which withstand [120] [480] hours of exposure to the salt spray test specified in ASTM B117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm 1/16-inch from the test mark, with a scribed test mark and test evaluation rated not less than 7 in accordance with TABLE 1, (procedure A) of ASTM D1654.

Coat cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel with a zinc rich paint conforming to the manufacturer's standard.

2.4.1.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, are as specified in Section 09 90 00 PAINTS AND COATINGS.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Current Site Conditions

Verify that site conditions are in agreement with the design package. Report all changes to the site or conditions that will affect performance of the system to the Government. Do not take any corrective action without written permission from the Government.

3.1.2 Existing Equipment

Connect to and utilize existing lighting equipment and devices as shown. Make written requests and obtain approval prior to disconnecting any control lines and equipment, and creating equipment downtime. Proceed with such work only after receiving Government approval of these requests. If any device fails after work has commenced on that device, diagnose the failure and perform any necessary corrections to the equipment. The Government is responsible for maintenance and repair of Government equipment.

3.2 INSTALLATION

Install all system components, including government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2, and contract documents. Furnish necessary hardware, fixtures, cables, wire, connectors, interconnections, services, and adjustments required for a complete and operable system.

3.2.1 Enclosure Penetrations

Make enclosure penetrations from the bottom unless the system design requires penetrations from other directions. Seal all penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures with rubber silicone sealant to preclude the entry of water. Terminate the conduit riser in a hot-dipped galvanized metal cable terminator. Fill the terminator with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

3.2.2 Prevention of Corrosion

3.2.2.1 Aluminum

Do not use aluminum in contact with earth or concrete, and where connected to dissimilar metal, protect with approved fittings and treatment.

3.2.2.2 Steel Conduits

Do not install steel conduits within concrete slabs-on-grade. Field wrap steel conduits installed underground or under slabs-on-grade, or penetrating slabs-on-grade, with 254 micrometers 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlap, or provide with a factory-applied plastic resin, epoxy coating. Zinc coating may be omitted from steel conduit which has a factory-applied epoxy coating.

3.2.2.3 Cold Galvanizing

Coat field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc. with a cold galvanized paint containing at least 95 percent zinc by weight.

3.2.3 Cable Installation

****

NOTE: Bury security and CCTV lighting system conductors in areas where the likelihood of damage to the conductors is slight. In areas where subsurface utilities are congested and in areas

where the chance of accidental or intentional damage is great, place the security and CCTV lighting system conductors in ducts.
****

Provide cable and all parts of the cable system, such as splices and terminations, rated not less than 600 volts, with the size and number of conductors and the number of cables as indicated. Provide stranded conductors if larger than No. 8 AWG. Identify each circuit by means of fiber or nonferrous metal tags, or approved equal, in each [handhole] [and] [junction box,] and at each terminal.

3.2.3.1 Splices

Make splices below grade with nonpressure-filled resin systems using transparent, interlocking, self-venting, longitudinally split plastic molds. Make splices above grade with sealed insulated pressure connectors and provide insulation and jacket equal to that of the cable. In order to prevent moisture from entering the splice, cut back jackets to expose the required length of insulation between the jacket and the tapered end of the insulation.

3.2.3.2 Installation in Duct Lines

Install [ground] [ground and neutral] conductors in duct with the associated phase conductors. Make cable splices in handholes only.

3.2.4 Direct Burial

Provide minimum cover depth from top of cable to finished grade 750 mm 30-inches for direct buried cable, but not less than the depth of the frost line.

3.2.4.1 Trenching

****
NOTE: Where soil does not contain rocks or abrasive material, delete the requirements for placing protection over the cable. Delete planks if not required.
****

Excavate trenches to the depths required to provide the minimum cable cover, with the bottom of the trench smooth and free of stones and sharp objects. Where the bottom of the trench consists of material other than sand or earth, remove an additional 75 mm 3-inch layer and replace with a 75 mm 3-inch layer of sand or stone-free earth compacted to the approximate density of the surrounding firm soil. Unreel the cables unreeled in place along the side of or in the trench and carefully placed on the sand or earth bottom. Pulling cables into a direct-burial trench from a fixed reel position is not permitted. Where cables cross, provide a separation of at least 75 mm 3-inches, unless the cables are protected by nonmetallic conduit sleeves at the crossing. Make the radius of bends in cables not less than 12 times the diameter of the cable. Do not leave the cables under longitudinal tension. Install the first layer of backfill, 150 mm 6-inches thick, consisting of sand or stone-free earth. Place one-inch untreated planks, not less than 200 mm 8-inches in width, or approved equal protection, end to end along the cable run, approximately 75 mm 3 inches above the cable. Place a 0.127 mm 5-mil,

brightly colored plastic tape not less than 75 mm 3-inchesin width and suitably inscribed at not more than 3 m 10-feet on centers, or other approved dig-in warning indication, approximately 300 mm 12-inches below finished grade levels of trenches. Provide selected backfill of sand or stone-free earth to a minimum depth of 75 mm 3-inches above cables.

3.2.4.2 Requirements for Installation in Duct

Where indicated on drawing, install cable in duct lines. Install ground and neutral conductors in duct with the associated phase conductors. Install segments of direct-burial cable that cross under new railroad tracks, roads, or paving exceeding 1.5 m 5 feet in width, in plastic, or rubber duct encased in concrete in accordance with paragraph DUCT LINES. Pulling of cable into conduit from a fixed reel position is not permitted. At interfaces with direct-burial cable, center the direct-burial cable in the entrance to the duct, using an approved waterproof, nonhardening mastic compound to facilitate the centering. Where crossing existing railroad tracks, install coated rigid steel conduit under the tracks, in lieu of concrete-encased duct, in accordance with paragraph DUCT LINES in accordance with NFPA 70 and the regulations of the railroad.

3.2.4.3 Location of Cable Splices

Splices in direct-burial cable are not permitted in runs of 150 m 500 feet or less or at intervals of less than 150 m 500 feet in longer runs except as required for taps. Where cable splices in shorter intervals are required to avoid obstructions or damage to the cable, the location is as approved. Install cable splices in cable boxes or concrete handholes.

3.2.4.4 Markers

****
NOTE: Markers will be detailed on drawings in accordance with HREF=http://www.wbdg.org/ccb/DOD/UFC/ufc_3_550_01.pdf>UFC 3-550-01, "Exterior Electrical Power Distribution".
****

Locate cable and cable splice markers near the ends of cables, at each cable splice, approximately every 120 m 400 feet along the cable run, and at changes in direction of the cable run. Markers need not be placed along cables laid in relatively straight lines between lighting poles that are spaced less than 120 m 400 feet apart. Place markers approximately 600 mm 2 feet to the right of the cable or cable splice when facing the longitudinal axis of the cable in the direction of the electrical load. Provide concrete markers with a 28 day compressive strength of 17 MPa 2500 psi in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE. Impress the letter "C" in the top of each marker.

3.2.4.5 Warning Tape

Place direct burial cable below a plastic warning tape buried in the same trench or slot. Place a 0.127 mm 5 mil brightly colored plastic tape, not less than 75 mm 3 inches in width and suitably inscribed at not more than 3 m 10 feet on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm 1 mil metallic foil core to permit easy location of the buried cable, approximately 300 mm 12 inches below finished grade.

3.2.5 Messenger Cable

3.2.5.1 Installation

****
NOTE: Verify local electrical installation requirements to determine if new grounding conductors and electrodes are required at each messenger cable ground connection.
****

Attach messenger to poles with approved clamps,with not less than 15.9 mm 5/8 inch through bolts. Do not exceed 30 percent of messenger cable rated tensioning rated breaking strength under 16 degrees C 60 degrees F conditions of no ice and no wind. Stress messengers to a tension higher than the final tension in order to prestretch the cable, so that when the messenger is dead-ended under its final tension and sag, there is minimum variation from the calculated values.

3.2.5.2 Grounding and Bonding Connections

Ground messengers and guy at corners, dead-ends, and entrances to each facility. Ground at intervals not exceeding 300 m 1000 feet. [Provide new grounding conductors and electrodes at each ground connection.] [Where grounding connections are made in the vicinity of existing grounding conductors and electrodes, the grounding connection may be made by a bolted or welded connection to the existing grounding conductor.] Fusion weld connections below grade. Fusion weld connections above grade or use UL 467 approved connectors.

3.2.5.3 Grounding Conductors and Electrodes

Provide soft drawn copper ground conductors, having a current capacity of at least 20 percent of that of the messenger to which it is connected, no smaller than No. 6 AWG. Connect the ground conductor to a ground rod of [copper clad steel conforming to UL 467] [zinc coated steel conforming to IEEE C135.30] [solid stainless steel] not less than [15.9] [19.1] mm [5/8] [3/4] inch in diameter by [2.4] [3.1] m [8] [10] feet in length. After installation is completed, ensure that the top of the ground is approximately 300 mm 1 foot below finished grade. Protect the ground conductor by half-round wood, plastic, or fiber molding from the ground to a point at least 2.4 m 8 feet above the ground.

3.2.5.4 Ground Resistance Testing

Measure the resistance to ground using the fall-of-potential method described in IEEE 81. The ground resistance must be 25 ohms or less under normally dry conditions. Whenever the required ground resistance is not met provide additional electrodes, [interconnected with grounding conductors] [as indicated], to achieve the specified ground resistance. Provide additional electrodes [up to three [[2.4] [3] m [8] [10] [20] feet] long spaced a minimum of [3 m 10 feet apart for 10 foot long rods] [6 m 20 feet for 20 foot long rods]] [as a single extension type rod, [[15.9] [19.1] mm [5/8] [3/4] inch] in diameter, up to 9.1 m 30 feet long [driven perpendicular to grade] [coupled and driven with the first rod]]. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer immediately.

3.2.6 Aerial Cable Splices

Make splices in aerial cable within 900 mm 3 feet of a pole and place inside a watertight enclosure. Form drip loops at the cable entrance to the enclosure. Place lashing clamps within 300 mm 12 inches of the enclosure.

3.2.7 Lashing Wire

Wind lashing wire tightly around both the communication cable and the messenger cable by machine methods, with a minimum of one turn per 355.6 linear mm 14 linear inches and not less than the number of turns per linear meterfoot that is recommended by the cable manufacturer for the distance between cable support points and the combined ice and wind loading and extreme wind loading shown or normally encountered for the installed location. Place lashing clamps at all poles and splices.

3.2.8 Stress Loops

Form loops in the aerial cable at all points of connection and at all poles to prevent damage from thermal stress and wind loading. Protect aerial cable from chafing and physical damage with the use of spiral cut tubing and PVC tape, or plastic sleeves.

3.2.9 Connections to Buildings

****

NOTE: Where this guide specification is used for installation of a security and CCTV lighting system in an existing facility, delete the reference to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and incorporate pertinent paragraphs from the referenced guide specification.

****

Extend cables into the various buildings as indicated and properly connect to the indicated equipment. [Provide empty] [Empty] conduits to the indicated equipment from a point 1.5 m 5 feet outside the building wall and 600 mm 2 feet below finished grade [are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM]. After installation of cables, seal conduits to prevent moisture or gases from entering the building.

3.2.10 Duct Lines

3.2.10.1 Requirements

Provide the numbers and size of ducts as indicated, laying duct lines with a minimum slope of 100 mm/30 m 4 inches/100 feet. Depending on the contour of the finished grade, the high point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short radius manufactured 90 degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius is 450 mm 18 inches for ducts of less than 80 mm 3 inches in diameter, and 900 mm 36 inches for duct 80 mm 3 inches or greater in diameter; for long sweep bends use a minimum radius of 7.6 m 25 feet for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends,with a maximum curve of 30 degrees using manufactured bends.

Provide ducts with end bells when duct lines terminate in manholes or handholes.

3.2.10.2 Treatment

Keep ducts clean of concrete, dirt, or foreign substances during construction. Make field cuts requiring tapers with proper tools and match factory tapers. Use a coupling recommended by the duct manufacturer when an existing duct is connected to a duct of different material or shape. Store ducts to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Thoroughly clean ducts before installation. Store plastic ducts on a flat surface and protected from the direct rays of the sun.

3.2.10.3 Concrete Encasement

****
NOTE: For crossings of existing railroads and airfield pavements greater than 15.2 m 50 feet in length, use the pre-drilling method or the jack-and-sleeve method.
****

Provide ducts requiring concrete encasements in compliance with NFPA 70, except for electrical duct bank configurations for ducts 150 mm 6 inches in diameter, which are determined by calculation and as shown on the drawings. Provide monolithic construction of duct line encasements. Where a connection is made to a previously poured encasement, bond or dowel the new encasement to the existing encasement. At any point, except railroad and airfield crossings, make tops of concrete encasements not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, encase duct lines with concrete and reinforce as indicated to withstand specified surface landings. Make tops of concrete encasement not less than 1.5 m 5 feet below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, install rigid steel conduit. To protect the corrosion-resistant conduit coating, pre-drilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 15 m 50 feet in length, use the pre-drilling method or the jack-and-sleeve method. Use separators or spacing blocks of steel, concrete, plastic, or a combination of these materials placed not more than 1.2 m 4 foot on centers. Securely anchor ducts to prevent movement during the placement of concrete, and stagger joints at least 150 mm 6 inches vertically.

3.2.10.4 Non-encased Direct-Burial

****
NOTE: Specify cover requirements in accordance with NFPA 70 and ANSI C2. Specify frost line depth.
****

Install top of duct lines below the frost line depth of [_____] mm inches, but not less than [_____] mm inches below finished grade and install with a minimum of 75 mm 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 300 mm 12 inches of earth is required. Grade bottom of trenches toward manholes or handholes, smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches are comprised of materials other than sand, place a 75 mm 3

inch layer of sand first and compact to approximate densities of surrounding firm soil before installing ducts. Vertically stagger joints in adjacent tiers of duct at least 150 mm 6 inches, with the first 150 mm 6 inch layer of backfill cover of compacted sand as previously specified. Backfill and compact the rest of the excavation in 75 to 150 mm3 to 6 inch layers. Hold duct banks in alignment with earth; however, use a wooden frame or equivalent forms to hold ducts in alignment prior to backfilling for high tiered banks.

3.2.10.5 Installation of Couplings

Make joints in each type of duct in accordance with the manufacturer's recommendation for the particular type of duct and coupling selected and as approved. Make duct joints by brushing a plastic solvent on insides of plastic coupling fittings and on outsides of duct ends, then slip each duct and fitting together with a quick 1/4 turn to set the joint tightly.

3.2.10.6 Concrete

Provide concrete work as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE, with plain concrete strength of, 17 MPa 2500 psi at 28 days, and reinforced concrete strength of 21 MPa 3000 psi at 28 days. Provide monolithic duct line encasement construction. Where a connection is made to an existing duct line, bond the concrete encasement or dowel to the existing encasement.

3.2.10.7 Duct Line Markers

Provide duct line markers [as indicated] [at the ends of long duct line stubouts or for other duct locations that are indeterminate because of duct curvature or terminations at completely below-grade structures]. In addition to markers, place a 0.127 mm 5 mil brightly colored plastic tape, not less than 75 mm 3 inches in width and suitably inscribed at not more than 3 m 10 feet on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm 1 mil metallic foil core to permit easy location of the duct line, approximately 300 mm 12 inches below finished grade levels of such lines.

3.2.11 Handholes

Determine the exact locations after carefully considering the locations of other utilities, grading, and paving. Secure approval of exact before construction is started.

3.2.11.1 Construction

Construct handholes as indicated on drawings, including appurtenances, with top, walls, and bottom consisting of reinforced concrete. Provide monolithic walls and bottom. Provide 21 MPa 3000 psi concrete at 28 days. Precast concrete handholes having the same strength and inside dimensions as cast-in-place concrete handholes may be used. In paved areas, make the top of entrance covers flush with the finished surface of the paving. In unpaved areas, set the top of entrance covers approximately 13 mm 1/2 inch above the finished grade. Where finished grades are in cut areas, install unmortared brick between the top of handhole and entrance frame to temporarily elevate the entrance cover to existing grade level. Where duct lines enter walls, the sections of duct may be cast in the concrete or may enter the wall through a suitable opening. Caulk the openings around entering duct lines tight with lead

wool or other approved material.

3.2.11.2 Appurtenances

Provide the following appurtenances for each handhole.

3.2.11.3 Cable Pulling-in Irons

Install a cable pulling-in iron in the wall opposite each duct line entrance.

3.2.11.4 Ground Rods

In each handhole, at a convenient point close to the wall, drive a ground rod conforming to paragraph GROUNDING CONDUCTORS AND ELECTRODES, into the earth before the floor is poured; with approximately 100 mm 4 inches of the ground rod extending above the floor after pouring. When precast concrete units are used, the top of the ground rod may be below the floor; bring a No. 1/0 AWG copper ground conductor inside through a watertight sleeve in the wall.

3.2.12 Lighting

****

NOTE: Following a power outage, a minimum of 10.8 lux (1 foot candle) at grade within 30 seconds is required. Requirement may be met by including dual re-strike element lamps for instant re-strike, using incandescent fixtures for backup lighting or by 5 minute UPS to allow standby power to pickup lighting loads. When the asset being protected justifies the additional cost, consider interleaving of power circuits for additional security and reliability. When interleaving is used, the loss of any one circuit should not significantly reduce the visual detection of intruders. Interleaving may also be useful in reducing the power demand for backup power sources.

****

3.2.12.1 Lamps

Deliver lamps of the proper type, wattage, and voltage rating to the project in the original containers and install in the fixtures just before completion of the project.

3.2.12.2 Fixture Installation

Install standard fixtures as detailed on Standard Detail No. 40-06-04, Sheet Nos. [_____] [_____][, which accompany and form a part of this specification]. Provide special fixtures as indicated on drawings. Illustrations shown [on these sheets or] on the drawings are indicative of the general type desired and are not intended to restrict selection of fixtures to any particular manufacturer. Fixtures of similar design, equivalent light-distribution and brightness characteristics, and equal finish and quality are acceptable as approved.

a. Accessories

Install accessories such as straps, mounting plates, nipples, or brackets as required for proper installation.

b. In-Line Fuses

Provide an in-line fuse for each fixture.

c. Special Fixtures

The types of special fixtures are designated by letters and numbers. For example, SP-1 denotes special type 1.

3.2.13 Transformer Installation

Install transformers for lighting fixtures on [aluminum] [or steel] [or concrete] poles in the transformer base. Provide a transformer base for poles that require transformers. Securely mount transformers to steel supporting plates and bolt to wood poles.

3.2.14 CCTV Alarm Interface

****
NOTE: Delete this paragraph if assessment infrared lights are not used. Determine the number of alarm inputs needed for the alarm interface. Calculate the percentage of expansion for future needs, and determine if 10 percent is adequate.
****

Furnish and install an alarm interface with the lighting control system, compatible with the CCTV alarm annunciation system. Monitor alarm closures for processing by the system CPU with the alarm. Provide alarm inputs to the alarm interface by relay contact or through an TIA-232 interface, modular and allowing for system expansion. Configure the alarm interface to be installed at the site to handle [_____] alarm points, with an expansion capability of not less than [10] [_____] percent. Provide an output to actuate a video recorder.

3.3 FIELD QUALITY CONTROL

3.3.1 Test for CCTV Assessment Lighting

****
NOTE: Omit this paragraph if the lighting is not used for CCTV Assessment.
****

Submit CCTV assessment lighting test procedures and reports. After receipt by the Contractor of written approval of the test procedures, schedule the tests. Deliver the final test procedures report after completion of the tests.

Perform site testing and adjustment of the completed CCTV lighting, in conjunction with Section 28 10 05 ELECTRONIC SECURITY SYSTEM ACCEPTANCE TESTING. Provide personnel, equipment, instrumentation, and supplies necessary to perform testing. Give written notification of planned testing to the Government at least 14 days prior to the test. In the test procedures, explain, in detail, step-by-step actions and expected results

demonstrating compliance with the requirements of the specification. Do not give notice until after receiving written approval of the specific test procedures. Use the test reports to document results of the tests. Deliver the reports to the Government within 7 days after completion of each test.

3.3.2 Operating Test

Submit operating test procedures and reports for the operating test to the Contracting Officer for approval. After receipt of written approval of the test procedures, schedule the tests. Deliver the final Operating Test procedures report after completion of the tests.

After the installation is completed and at such time as the Contracting Officer may direct, conduct an operating test for approval, in the presence of the Contracting Officer. Demonstrate that the equipment operates in accordance with the requirements specified. Furnish instruments and personnel required for the test The Government will furnish the necessary electric power.

3.3.3 Ground Resistance Measurements

Submit the measured resistance to ground of each separate grounding installation,in writing, indicating the location of the rods, the resistance of the soil in ohms per millimeter and the soil conditions at the time the measurements were made.

Measure the resistance to ground by the fall-of-potential method described in IEEE 81.

3.4 CLOSEOUT ACTIVITIES

3.4.1 Operations and Maintenance Manuals

Submit a draft copy of the operation and maintenance manuals, prior to beginning the tests for use during site testing. Submit final copies of the manuals as specified bound in hardback, loose-leaf binders, within 30 days after completing the field test. Update the draft copy used during site testing with any changes required, prior to final delivery of the manuals. Identify each manual's contents on the cover. Include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. Provide the manuals with a table of contents and tab sheets. Place tab sheets at the beginning of each chapter or section and at the beginning of each appendix. Include, upon delivery of the final copies, modifications made during installation checkout and acceptance.

3.4.2 Record Drawings

Maintain and keep up to date, a separate set of drawings, elementary diagrams and wiring diagrams of the lighting to be used for "record" drawings, showing all changes and additions to the lighting system. In addition to being complete and accurate, keep this set of drawings separate and do not use for installation purposes. Upon completion of the record drawings, a representative of the Government will review the

as-built work with the Contractor. If the as-built work is not complete, the Contractor will be so advised and complete the work as required.

-- End of Section --