CHAPTER A-5

Revised July 2020

ELECTRICAL POWER, LIGHTING, GROUNDING, COMMUNICATIONS AND ALARM SYSTEMS

INDEX

CHAPTER A-5

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5.1 GENERAL

This chapter gives general guidance for the preparation of drawings, specifications, and design analyses of electrical systems, including but not limited to normal power, emergency power, lightning protection, grounding, lighting, telecommunications, electronic security, audio/visual, public address, fire alarm and mass notification systems. The purpose is to provide guidance for preparing accurate and complete electrical designs that are cost effective, energy efficient and inherently reliable and safe. The design of electrical systems shall be in accordance with UFC 3-501-01 (Electrical Engineering), and other applicable publications.

5.2 APPLICABLE CRITERIA

The most current editions of the criteria applicable at the time of contract issuance or otherwise defined in the contract shall be used. The criteria listed below includes commonly referenced criteria. The listed criteria in not all-inclusive.

5.2.1 Unified Facilities Criteria (UFC)

UFC 1-200-02	High Performance and Sustainable Building Requirements
UFC 1-300-07A	Design Build Technical Requirements
UFC 3-490-06	Elevators
UFC 3-501-01	Electrical Engineering
UFC 3-520-01	Interior Electrical Systems
UFC 3-520-05	Stationary and Mission Batteries
UFC 3-530-01	Design: Interior and Exterior Lighting and Controls
UFC 3-540-01	Engine-Driven Generator Systems for Prima and Standby Power Applications
UFC 3-550-01	Exterior Electrical Power Distribution
UFC 3-570-01	Cathodic Protection
UFC 3-575-01	Lightning and Static Electricity Protection Systems
UFC 3-580-01	Telecommunications Building Cabling Systems Planning and Design

UFC 3-600-01	Fire Protection Engineering for Facilities
UFC 4-010-01	DoD Minimum Antiterrorism Standards for Buildings
UFC 4-010-05	Sensitive Compartmented Information Facilities Planning, Design, and Construction
UFC 4-010-06	Cybersecurity of Facility-Related Control Systems
UFC 4-021-01	Design and O&M: Mass Notification Systems
UFC 4-021-02	Electronic Security Systems
UFC 4-510-01	Design: Military Medical Facilities

5.2.2 Army Criteria

AR 190-11	Physical Security of Arms, Ammunition, and Explosives
TC I3A	Technical Criteria for Installation Information Infrastructure Architecture (Outside Plant Only)
SIPRNET TC	Secret Internet Protocol Router Network (SIPRNET) Technical Implementation Criteria (FOUO; contact USACE Project Manager for access.)

5.2.3 USACE Engineering and Construction Bulletin (ECB) Criteria

ECB 2018-17	New Requirements for Visual Notification for Mass Notification Systems

5.2.4 Committee on National Security Systems Criteria

CNSSAM TEMPEST/1-13	Red/Black Installation Guidance (FOUO; contact USACE Project Manager for access.)
CNSSI 7003	Protected Distribution Systems

5.2.5 National Counterintelligence and Security Center

IC Tech Spec For ICD/ICS 705	Technical Specification for Construction and Management of Sensitive Compartmented Information Facilities (SCIF)

5.2.6 Industry Criteria

ANSI C2	National Electrical Safety Code

ASHRAE 90.1	Energy Standard for Buildings Except Low- Rise Residential Buildings
IES G-1	Guide for Security Lighting for People, Property, and Critical Infrastructure
IES HBK	Lighting Handbook Reference and Application
IES RP-1	Recommended Practice for Office Lighting
IES RP-3	American National Standard Practice on Lighting for Educational Facilities
IES RP-7	Recommended Practice for Lighting Industrial Facilities
IES RP-8	Recommended Practice for Lighting Roadway and Parking Facilities
IES RP-33	Lighting for Exterior Environments
NACE SP0169	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NFPA 70	National Electrical Code
NFPA 72	National Fire Alarm Code
NFPA 101	Life Safety Code
NFPA 780	Standard for the Installation of Lightning Protection Systems
TIA 568.0-D	Generic Telecommunications Cabling for Customer Premises
TIA 568.1-D	Commercial Building Telecommunications Cabling Standard
TIA 568.2-D	Balanced Twisted-Pair Telecommunications Cabling and Components Standard
TIA 568.3-D	Optical Fiber Cabling Components
TIA 569-D	Telecommunications Pathways and Spaces
TIA 606-C	Administration Standard for Telecommunications Infrastructure
TIA 607-C	Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
TIA 758-B	Customer-Owned Outside Plant Telecommunications Infrastructure Standard

UL 96A	Installation Requirements for Lightning Protection Systems
USAB	Uniform Federal Accessibility Standards (UFAS)
USGBC LEED v4	Building Design and Construction (BD&C)

5.3 PRECONCEPT SUBMITTAL REQUIREMENTS

There are no electrical requirements for this submittal.

5.4 CODE 3 DESIGN REQUIREMENTS

Project specific requirements will be provided with specific instructions to the contract or delivery order.

5.5 CONCEPT (35%) DESIGN SUBMITTAL REQUIREMENTS

5.5.1 Concept Design Narrative

5.5.1.1 Design Criteria. Provide a comprehensive list of applicable criteria for all electrical systems included in the scope of work.

5.5.1.2 General

Briefly describe the electrical scope of work for the project, including but not limited to normal power, emergency power, lightning protection, grounding, lighting, telecommunications, electronic security, audio/visual, public address, fire alarm and mass notification systems.

5.5.1.3 Site Power

a. Coordination. Provide documentation demonstrating coordination with the Army DPW, Air Force BCE or privatized utility as applicable. Provide names, phone numbers and email addresses for all people contacted and guidance received. Address the adequacy of the existing primary service and identify the point of connection. Where the primary service is determined to be inadequate, address measures to correct the deficiency. Where the primary service is owned and/or maintained by a privatized utility, clearly define the demarcation point between the responsibilities of the utility and the contractor, and describe the roles of the utility and the contractor in extending service to the facility.

b. Primary Power Characteristics. Identify the primary power characteristics (voltage, phase, and number and size conductors) of Government owned lines. Indicate all demolition, relocation or addition to the primary lines.

c. Secondary Power Characteristics. Identify the secondary power characteristics (voltage, phase, and number and size conductors). Indicate all demolition, relocation or

addition to the primary lines. State the basis for the selected service voltage (480Y/277 or 208Y/120). Indicate if the secondary conductors will be aerial or underground.

d. Conductor Material. Identify the conductor material (e.g., copper or aluminum) to be used for both primary and secondary services. Where materials are mixed, explain why they are being mixed and identify where each material will be used.

e. Estimated Loads. Estimate the kVA demand load for the building service, and provide the basis for the estimates. Indicate type, number, and kVA capacity of transformer installation proposed. State the primary and secondary connection of transformers (i.e. 12470 to 480Y/277 volts, delta-wye.

f. Generator Power. Identify the requirements for generator power. Indicate if the generator will be permanently installed or if provisions will be made for a GFGI portable generator. Indicate the purpose for the generator, such as complete building coverage or isolated loads, and identify applicable code requirements (e.g., NEC Article 700, 701 or 702). Confirm CFCI generators are authorized by the project DD Form 1391.

5.5.1.4 Site Lighting

a. Coordination. Provide documentation demonstrating coordination with the Army DPW, Air Force BCE or privatized utility as applicable. Provide names, phone numbers and email addresses for all people contacted and guidance received. Address installation specific lighting requirements. Where site lighting is owned and/or maintained by a privatized utility, clearly define the responsibilities of the utility and the contractor.

b. Description. Provide a statement describing roadway, security, parking, and walkway lighting requirements. Indicate luminaire types, pole types, pole heights and proposed lighting intensities. Identify the ASHRAE 90.1 Exterior Lighting Zone for the project.

c. Controls. Indicate the proposed site lighting controls and identify the governing criteria (e.g., ASHRAE 90.1).

5.5.1.5 Site Communications

a. Coordination. Provide documentation demonstrating coordination with the Army Network Enterprise Center (NEC) or Air Force Base Communication Office (BCO) as applicable. Provide names, phone numbers and email addresses for all people contacted and guidance received. Address the adequacy of the existing lines and identify the point of connection. Where the communication lines are determined to be inadequate, address measures to correct the deficiency. Address installation specific site communication requirements.

b. Description. Indicate if new lines will be aerial or underground and indicate the copper pair and/or fiber strand quantities. Provide the basis for the quantities.

5.5.1.6 Site Cable Television (CATV)

a. Coordination. Provide documentation demonstrating coordination with the installation CATV service provider. Provide names, phone numbers and email addresses for all people contacted and guidance received. Address new infrastructure requirements and clearly define the responsibilities of the CATV service provider and the contractor.

b. Description. Identify the location of new head-end equipment. Indicate if final terminations will be made by the CATV service provider or the contractor.

5.5.1.7 Cathodic Protection

Address corrosion control for underground metallic structures, piping, fittings, and valves. Where cathodic protection is required by criteria or project instructions, inform the Savannah District project manager if resistivity measurements are necessary and specify the testing methods, testing locations, ground rod lengths, and other information required for the resistivity measurements. Savannah District Soils Section will perform all resistivity measurements required to design corrosion control and grounding systems. For additional information, see Chapter A-0-2, SOILS.

5.5.1.8 Interior Electrical Systems

a. Service Equipment. Describe the selected service entrance equipment (e.g., switchboard, panelboard) and provide justification for the selection. Estimate the ampere rating of the service entrance equipment and estimate the size and quantity of service entrance conductors.

b. Special Power Requirements. Provide a brief description of special items of design such as dc power systems, 400 Hz power systems, Uninterruptible Power Supplies (UPS), motor control centers or special purpose receptacles. Identify the associated electrical characteristics (e.g., volts, phase, and amps). Reference the applicable NEMA configuration or other recognized standards to identify special receptacles.

c. Conduit and Wiring. Indicate the proposed type of conduit and wiring system (e.g., RMC, IMC, EMT and NMC) and indicate where each type is intended to be used.

d. Lighting. Provide a brief description of the lighting systems. Include a list of lighting parameters for each room, identifying the room name and number and the corresponding lighting control space type per ASHRAE 90.1. The list shall include the proposed luminaire type, target illumination level, target illumination basis (e.g., IES Handbook, UFC) and special requirements (e.g. A/V interface, daylight harvesting, NSF rating). Light sources shall typically be solid state (LED). Provide justification for any spaces in which other light sources are proposed.

e. Emergency and Egress Lighting. Provide a brief description of the emergency lighting systems. Identify proposed emergency lighting sources (e.g., generator, inverter, emergency driver). Address NFPA 101 requirements for interfacing the egress lighting controls with the building fire alarm system.

f. Hazardous (NEC Classified) Locations. Identify hazardous locations by class, division and group as defined in NFPA 70. Indicate the boundaries of the hazardous locations and identify equipment proposed to be located in the locations.

g. Seismic Design. Indicate the seismic design category as defined in UFC 3-301-01, and address seismic bracing and anchors applicable to electrical conduit, cable trays and equipment. (Seismic design categories for which seismic protection is not required are addressed in General Note, Part 1, UFGS Section 26 05 48.00 10.)

5.5.1.9 Lightning Protection System

Perform an NFPA 780 Lightning Risk Assessment and indicate if the assessment recommends a lightning protection system. State if a lightning protection system will be provided. Provide justification for providing a lightning protection system when not recommended by the assessment, or for not providing a lightning protection system when recommended by the assessment.

5.5.1.10 Metering

Describe electrical metering equipment to be provided, indicate if the outputs are to be transmitted to the Base EMCS system and the method of transmission. Address LEED and ASHRAE 90.1 metering requirements as applicable. As a minimum, metering shall be provided in compliance with LEED EA Prerequisite: Building Level Energy Metering.

5.5.1.11 Fire Alarm and Mass Notification System

a. Coordination. Provide documentation demonstrating coordination with the installation Fire Department. Provide names, phone numbers and email addresses for all people contacted. Document any special guidance received.

b. Describe the type of fire alarm and detection system and the mass notification system. Include a list of required devices. Include any compatibility issues that may occur when connecting to the installation system. Indicate if the mass notification system will be used for public address.

5.5.1.12 Interior Communications

a. Coordination. Provide documentation demonstrating coordination with the Army Network Enterprise Center (NEC) or Air Force Base Communication Office (BCO) as applicable. Provide names, phone numbers and email addresses for all people contacted. Address installation specific communication requirements.

b. Voice. Describe the telephone system requirements including the type system, the type of instruments and the size of the installation including stations, trunk size, connection to and location of switch.

c. Data. Describe the data system requirements including the type of cable, type of instruments, and the size of the installation, including stations, trunk size, connection to

and location of switch. Identify SIPRNET requirements and other secure or specialized network requirements.

5.5.1.13 Interior Cable Television (CATV)

a. Coordination. Provide documentation demonstrating coordination with the CATV service provider and the Army Network Enterprise Center (NEC) or Air Force Base Communication Office (BCO) as applicable.

b. Description. Describe the CATV system. Indicate the proposed location of the head-end equipment and include a description of the infrastructure required. Identify all requirements for the facility system to interface with the existing installation system. Indicate if final terminations will be made by the CATV service provider or the contractor.

5.5.1.14 Special Systems

a. Coordination. Provide documentation demonstrating coordination with the installation Physical Security Office. Provide names, phone numbers and email addresses for all people contacted and guidance received.

b. Description. Describe all special systems, including public address, access control, intrusion detection, door monitor, video surveillance and intrusion detection systems. Indicate which systems include equipment and which are limited to infrastructure.

5.5.1.15 Renewable Energy Systems

Address the life-cycle cost effectiveness of providing on-site renewable energy. Where provided, describe the proposed renewable energy systems and indicate the anticipated power generation. Identify the interface with the utility system where applicable. Provide documentation demonstrating coordination with the Army DPW, Air Force BCE or privatized utility as applicable. Provide names, phone numbers and email addresses for all people contacted and guidance received.

5.5.1.16 Renovation and Additions

a. Field Trip Report. Describe the extent of the renovation, detailing all electrical material proposed to be re-used. Provide a Field Trip Report with photographs documenting the condition of existing equipment and identifying all equipment intended for reuse. Include records of meetings held with facility personnel, including participant lists. Document all agreements or understandings reached with facility personnel, and identify any unforeseen site/building conditions.

b. Expansion. Identify all existing systems proposed to be expanded or altered, and verify the system can accommodate the proposed changes.

c. Existing Loads. Address the methodology used to determine existing loads. Reference as-built drawings or historic demand data as applicable, and address NFPA 72 constraints on the use of historic data.

5.5.1.17 Sustainability

Describe the project sustainability requirements. Army projects typically require LEED certification, whereas Air Force projects typically require third party certification under Guiding Principles .For projects requiring LEED v4 certification, indicate which credits will be attempted by the electrical design. As a minimum, address the following prerequisites and credits: SS Credit Light Pollution Reduction, EA Prerequisite Minimum Energy Performance, EA Prerequisite Building-Level Energy Metering, EA Credit Advanced Energy Metering, EA Credit Demand Response and EQ Credit Interior Lighting. For additional information, see Chapter A-14, SUSTAINABLE DESIGN.

5.5.1.18 Cybersecurity

Describe the cybersecurity requirements for all facility-related control systems. Typical systems to be addressed include Fire Alarm & Mass Notification Systems (FA/MNS), Heating Ventilation & Air Conditioning Systems (HVAC), Electronic Security Systems (ESS) and Lighting Control Systems. For each system, indicate the Confidentiality, Integrity and Availability (C-I-A) impact levels (Low, Moderate or High). Identify the Authorizing Official and System Owner, and provide names, phone numbers and email addresses for all people contacted and guidance received.

5.5.1.19 Unique Requirements

Describe the electrical requirements of all special areas with unique electrical features, such as Sensitive Compartmented Facilities (SCIFs), Server Rooms and Arms Rooms.

5.5.2 Concept Design Analysis

5.5.2.1 Electrical Load Estimate. Provide an estimate of the total connected load (kVA), total demand load (kVA), transformer size and service size.

5.5.2.2 Lightning Protection. Provide a Lightning Protection Risk Assessment in accordance with NFPA 780, and provide a recommendation regarding the need for lightning protection.

5.5.2.3 Exterior Lighting Calculations. Point-by-point lighting calculations are not required for this submittal. Rule of thumb calculations (i.e. 1:4 pole height-to- pole spacing ratio) may be used.

5.5.3 Concept Design Drawings

5.5.3.1 Site Electrical Plan. Provide a dedicated site electrical demolition plan where applicable, and a dedicated site electrical plan. Show existing to remain, existing to be demolished and new electrical and communications lines and equipment, including manholes, poles, transformers, primary switches and generators, as applicable. Clearly distinguish between the existing and proposed work. Identify the demarcation point(s) between the Contractor’s scope of work and any work provided by the Installation or Privatized Utilities. Provide a layout for any exterior lighting included in the project.

a. Power Lines. Provide electrical characteristics (voltage, phase, number and size of conductors/conduits) for the primary and secondary lines at the points of delivery and/or extensions. Clearly identify the points of connections.

b. Power Equipment. Indicate transformer ratings (e.g., primary and secondary voltages, KVA size) and generator ratings (e.g., voltage, kVA/kW size).

c. Lighting. Provide a luminaire schedule indicating luminaire types, luminaire wattages, pole types and pole heights for all CFCI luminaires.

d. Communication and CATV Lines. Indicate the types and quantities of copper, fiber and CATV cables serving the facility. Clearly identify the points of connections.

5.5.3.2 Interior Communication Plan. Provide dedicated communication plans with legend showing the room names and outlet locations for voice, data, and CATV.

5.5.3.3 Interior Special Systems Plan. Provide dedicated special systems plans with legend showing the room names and proposed locations for special systems devices and head-end equipment. All special systems identified in the project DD Form 1391 (e.g., intrusion detection system (IDS), access control system (ACS), video surveillance system (CCTV), etc.) shall be indicated on the plans and included in the electrical design scope of work. The special systems plan may be combined with the communications plan where clarity is not compromised.

5.5.3.4 Interior Demolition Plan. Provide dedicated demolition plans showing all electrical demolition and relocation where applicable. Demolition may be shown on plans with new work where demolition is minor and clarity is not compromised.

5.5.4 Concept Design Specifications

No specifications are required.

5.6 PRELIMINARY (60%) DESIGN SUBMITTAL REQUIREMENTS

5.6.1 Review Comments.

Evaluate the Concept Submittal review comments and incorporate all approved comments into the design.

5.6.2 Preliminary (60%) Design Narrative

The Preliminary (60%) Design Narrative shall include all of the requirements of the Concept Design Narrative. The narrative shall include any revised or updated information, as well as any additional information obtained at the 35% Review Conference.

5.6.3 Preliminary (60%) Design Analysis

5.6.3.1 General. The Preliminary (60%) Design Analysis shall include all of the requirements of the previous submittals and shall include any revised or updated information.

5.6.3.2 Lighting Calculations. Lighting calculations shall be performed to provide maintained illumination levels in accordance with the Applicable Criteria.

a. Computer generated point-by-point computations shall be provided for all interior spaces, including stairways. Computer models shall be coordinated with the Architect and Interior Designer to ensure surface reflectances and proposed furniture layouts are correctly modeled in the calculations. Workstation partitions, restroom partitions, ceiling height variations and similar features shall be included in the calculations. Computations for each space shall include luminaire types, luminaire light loss factors, luminaire mounting heights, calculation grid plane heights, ceiling heights, surface reflectances, average illuminance, minimum illuminance, maximum illuminance, room name and a graphical representation of the floor plan. Computations for egress paths shall include maximum to minimum illuminance ratios.

b. Computer generated point-by-point computations shall be provided for all site areas requiring illumination, including roadways, parking areas, walkways, athletic areas, exercise areas and security access points. Computer models shall be coordinated with the Site Civil Engineer to ensure surface reflectances (e.g., asphalt, concrete) are correctly modeled in the calculations. Site obstructions such as buildings shall be included in the calculations. Computations for each space shall include luminaire types, luminaire light loss factors, luminaire mounting heights, calculation grid plane heights, surface reflectances, average illuminance, minimum illuminance, maximum illuminance, space name and a graphical representation of the site plan. Computations for walkway egress paths shall include maximum to minimum illuminance ratios.

5.6.3.3 Fire Alarm and Mass Notification Voice Evacuation ADS Layout. Provide a floor plan layout or spreadsheet tabulation identifying all NFPA 72 Acoustically Distinguishable Spaces (ADS), defined as areas intended to have audible occupant notification. Identify which areas require full intelligibility, partial intelligibility, and audibility. The layout or tabulation shall be in addition to and not a substitution for the Interior Fire Alarm and Mass Notification Plan required as part of the Preliminary (60%) Design Drawings.

5.6.3.4 Product Data Sheets. Provide manufacturer data sheets for all project luminaires. Cross reference the data sheets with the luminaire types identified in the Luminaire Schedule. Identify all selected options and accessories on the data sheet by marking the selections on the sheets or by indicating the full catalog number.

5.6.3.5 Cybersecurity Control List. Provide a Cybersecurity Control List for each facility-related control system. Each list shall include all applicable Designer Control Correlation Identifiers (CCIs) as defined in UFC 4-010-06. The control list shall contain all applicable Designer CCIs for the designated C-I-A classification. A unique Specification Section shall be provided for each facility-related control system. Combining control systems in a single Specification Section is not allowed. UFGS Section 25 05 11 shall be used to create the Specification Section for each facility-related control system, edited and

renumbered as appropriate. Each Section shall address all Designer CCIs applicable for the respective control system.

5.6.4 Preliminary (60%) Design Drawings

5.6.4.1 General. All CADD drawings shall be prepared in accordance with Chapter A-10, Drawings.

5.6.4.2 Legend. Provide a legend on a dedicated drawing(s) showing all symbols used throughout the electrical drawings.

5.6.4.3 Site Electrical Drawings. The site electrical drawings shall meet all of the requirements of the concept (35%) submittal, updated to reflect any revised or updated information. Provide dedicated plans for power, communications, lighting and special systems, except plans may be combined into a single electrical site plan for small projects where clarity is not compromised.

a. Site luminaire locations shown on plans shall be based on photometric calculations. Provide a site luminaire schedule with all luminaires used on the site.

b. Site communication single line diagrams shall be provided, except communication single line diagrams may be omitted for project with minor site communication work for which single-line diagrams provide no additional clarity.

5.6.4.4 Electrical Interior Drawings. The interior electrical drawings shall include the designation of all rooms and work areas by name and room number as shown on the architectural drawings. Where applicable, hazardous (NEC Classified) locations shall be shown on the plans and shall be identified by class, division and group as defined in NFPA 70

a. Interior Lighting Plan. Provide dedicated lighting plans showing the locations and types of light fixtures in all spaces, including exit lights.

b. Interior Receptacle Plan. Provide dedicated power receptacle plans showing the locations and types of power receptacles in all spaces.

c. Interior Mechanical Equipment Plan. Provide dedicated mechanical equipment plans showing the locations of mechanical equipment in all spaces, except mechanical equipment and receptacle plans may be combined into a single power plan for small projects where clarity is not compromised.

d. Interior Electrical Equipment Plan. Show electrical equipment on one or more interior electrical plans. Equipment to be shown includes panelboards, motor control centers, switchboards, switchgear equipment, transformers, transfer switches, UPS equipment and other major items of electrical equipment. Indicate the NEC required dedicated electrical space for each piece of equipment.

e. Interior Communications Plan. Provide updated dedicated communication plans showing the locations and types of voice and data outlets in all spaces. Show locations of racks in communication and server rooms.

f. Interior Special Systems Plan. Provide updated dedicated special systems plans showing the locations and types of special systems devices and the location of head-end equipment.

g. Interior Demolition Plan. Provide updated dedicated demolition plans showing all electrical demolition and relocation where applicable. Demolition may be shown on plans with new work where demolition is minor and clarity is not compromised.

h. Interior Fire Alarm and Mass Notification Plan. Provide dedicated fire alarm and mass notification plans showing the locations of control panels, annunciation panels, initiation appliances and notification appliances.

i. Kitchen Equipment Plan. Where applicable, kitchen equipment shall be shown on dedicated plans or may be shown on other electrical plans where clarity is not compromised.

j. Lightning Protection Plan. Provide dedicated lightning protection plans showing the locations of air terminals, down conductors, ground rods and counterpoise.

k. Interior Luminaire Schedule. Provide a luminaire schedule describing the salient features of each luminaire type shown on the plans. Clearly indicate accessories required for each luminaire type, such as dimming drivers (with dimming range), emergency drivers, integral photocells and integral occupancy sensors.

l. Interior Power Single Line Diagram. Provide a power single line diagram showing the overall structure of the power distribution system. The preliminary single line diagram shall include all distribution equipment (e.g., switchboards, panelboards, transformers, generators, and transfer switches). Conductor and conduit sizes and equipment ratings are not required for this submittal.

m. Interior Communication Single Line Diagram. Provide copper, fiber and conduit single line diagrams showing the extension of the Outside Plant to the main telecommunications room and the interconnection between telecommunication rooms within the facility. For facilities with more than one telecommunications room, provide a communication grounding single line diagram.

n. Interior Fire Alarm and Mass Notification (FA/MNS) Single Line Diagram. Provide a FA/MNS single line diagram to include notification and initiation appliances, elevator interconnections, HVAC interconnections, fire suppression interconnections, base-wide MNS interconnections and egress lighting override.

o. Interior Fire Alarm and Mass Notification Input/Output Matrix. Provide an input/output matrix indicating the required sequence of operation of the fire alarm and mass notification system.

5.6.5 Preliminary (60%) Design Specifications

The concept submitted Unified Facilities Guide Specifications (UFGS) list shall be updated to include any new specifications based on the refined preliminary design. All specifications from the list shall be tentatively marked up, with major edits, and submitted as part of the preliminary (60 percent) submittal. Specifications shall comply with the requirements of Chapter A-11, SPECIFICATIONS. Specifications shall be submitted with red-line edits indicating all deleted/modified text.

5.7 PRELIMINARY (OVER THE SHOULDER) SUBMITTAL REQUIREMENTS

5.7.1 General.
The purpose of this submittal is to check the design progress and the incorporation of the concept review comments without stopping the design process.

5.7.2 Preliminary (Over-the-Shoulder) Design Narrative.

There are no requirements for this submittal.

5.7.3 Preliminary (Over-the-Shoulder) Design Analysis.

There are no requirements for this submittal.

5.7.4 Preliminary (Over-the-Shoulder) Design Drawings.

The design drawings requirements shall match those listed in the Preliminary (60%) Submittal requirements.

5.8 FINAL (100%) DESIGN SUBMITTAL REQUIREMENTS

5.8.1 Review Comments.

Evaluate the review comments from the previous design submittal reviews and incorporate all approved comments into the design.

5.8.2 Final (100%) Design Narrative

The Final (100%) Design Narrative shall include all of the requirements of the Preliminary (60%) Design Narrative. The narrative shall include any revised or updated information, as well as any additional information obtained at the 65% Review Conference.

5.8.3 Final (100%) Design Analysis.

5.8.3.1 General. The design analysis shall be accumulative, incorporating all requirements from previous submittals, revised or updated as appropriate. If a Preliminary (60%) Submittal is not required for a particular project, the submittal requirements for a Preliminary (60%) Submittal shall be included with this submittal. Failure to submit a complete Final Design Analysis is sufficient grounds to require a re-submittal of the Final 100% Design package with no extension to the project deadline.

Calculations shall be computed and checked by separate individuals with the checking accomplished by a Registered Electrical Engineer. Calculations and data for the following shall be included in the analysis:

5.8.3.2 Lighting Calculations. Include all of the required information from the Preliminary (60%) Design submittal, updated to reflect any revised or updated information including changes to luminaire types, room configurations, room surface reflectances and furniture layouts. Ensure that no proprietary light fixtures are specified. (Upon request, be able to provide three manufacturer names and catalog numbers for each light fixture).

5.8.3.3 Emergency and Egress Lighting Calculations. Computer generated point-by-point computations shall be provided to demonstrate compliance with NFPA 101 egress and emergency lighting requirements. Calculations shall be provided for all spaces within the means of egress and all spaces requiring emergency lighting. Computations for each space shall include luminaire types, luminaire light loss factors, luminaire mounting heights, calculation grid plane heights, ceiling heights, surface reflectances, average illuminance, minimum illuminance, maximum illuminance, room name and a graphical representation of the floor plan. Computations for egress paths shall include maximum to minimum illuminance ratios.

5.8.3.4 Interior Lighting Power Allowance Calculations. Calculations shall be provided in accordance with ASHRAE 90.1 and other energy codes as referenced in UFC 1-200-02. Compliance with either the Building Area Method or Space-by-Space Method is permitted. Calculations shall follow the steps indicated in ASHRAE 90.1, and shall clearly show that the total interior lighting power is in compliance with ASHRAE 90.1 and other applicable criteria.

5.8.3.5 Site Lighting Power Allowance Calculations. For CFCI site lighting, calculations shall be provided in accordance with ASHRAE 90.1 and other energy codes as referenced in UFC 1-200-02. Calculations shall follow the steps indicated in ASHRAE 90.1, and shall clearly show that the total interior lighting power is in compliance with ASHRAE 90.1 and other applicable criteria.

5.8.3.6 Short Circuit Calculations. Calculations shall be provided to determine the rating of all protective equipment. Assume an infinite bus on the primary unless more accurate data is available. Short circuit calculations shall account for the peak asymmetrical fault current by de-rating any equipment in which the calculated X/R ratio exceeds the equipment's tested X/R ratio. Clearly identify transformer kVA ratings and percent impedance (%Z).

5.8.3.7 Voltage Drop Calculations. Calculations shall be provided for all services and feeders, dry-type transformers, and worst-case branch circuits. Voltage drop calculations shall meet the requirements of ASHRAE 90.1, Chapter 8.

5.8.3.8 Demand Load Calculations. Calculations for each panelboard and switchboard shall be provided. Calculations shall show the demand factors used for each load category (lighting, receptacles, motors, spare, etc.) and shall be in accordance with the NEC. Where connections are made to existing transformers, switchboards or

panelboards, calculations shall be provided demonstrating the adequacy of the existing equipment to serve the additional loads.

5.8.3.9 Feeder Sizing Calculations. Calculations shall be provided demonstrating the rationale for the selection of the feeder size. Applicable NEC correction factors and adjustment factors shall be identified.

5.8.3.10 Generator Sizing Calculations. Calculations shall be provided demonstrating the rationale for the selection of generator sizes. Address starting kVA constraints.

5.8.3.11 Uninterruptible Power Supply (UPS) Sizing Calculations. Calculations shall be provided demonstrating the rationale for the selection of UPS sizes. See UFC 3-520-01 (Stationary Batteries and Battery Chargers) for additional calculation requirements.

5.8.3.12 Protective Device Time-Current Coordination Studies. The electrical system shall be designed such that any fault in the system will be preferentially isolated by the selective operation of only the overcurrent protective device closest to the faulted condition. Where insufficient information is available at the time of design, a performance specification section shall be provided requiring the construction Contractor to perform the protective device time-current coordination studies based on site conditions and selected equipment. The specification shall require the Contractor to submit the analysis for Government approval as a shop drawing submittal..

5.8.3.13 Arc Flash Hazard Analysis. Calculations shall be provided for all electrical equipment. Calculations shall determine the Arc Flash Boundaries and the required PPE levels for all equipment in accordance with NFPA 70E or IEEE Standard 1584. Where insufficient information is available at the time of design, a performance specification section shall be provided requiring the construction Contractor to perform the arc flash hazard analysis based on site conditions and selected equipment. The specification shall require the Contractor to submit the analysis for Government approval as a shop drawing submittal. The construction documents shall direct the Contractor to label the electrical equipment as required by NEC 70E.

5.8.3.14 Photovoltaic (PV) Calculations. Calculations shall be provided to determine the number of photovoltaic modules per string and the number of strings per inverter. Calculations shall take into account the site's lowest recorded low temperature, highest average high temperature, and the corresponding cell temperatures of the photovoltaic modules. Calculations shall demonstrate that the inverter will provide Maximum Power Point Tracking for the full voltage and current ranges expected from the PV array.

5.8.3.15 Cathodic Protection Calculations. Cathodic protection (CP) is a functional requirement for virtually all projects involving new aboveground water tanks, direct buried or submerged structures, or the repair or replacement of similar existing structures. The need for a CP system shall be considered for all projects. A CP system shall be provided where required; see Chapter 3 of UFC 3-570-06. Where provided, the CP system shall comply with UFC 3-570-02A. Provide calculations for the surface area of the protected surface, the current density requirements, the number, size, and type of anodes to be used, the size of all conductors, and the size of the rectifier and branch circuit calculations for the circuit serving the rectifier. Where insufficient information is

available at the time of design, a performance specification section shall be provided requiring the construction Contractor to design the cathodic protection system based on site conditions and selected underground materials. The specification shall require the Contractor to submit the design for Government approval as a shop drawing submittal.

5.8.3.16 LEED Credit and Sustainable Design Documentation. LEED credit and sustainable design documentation shall be provided to demonstrate electrical systems comply with the requirements of LEED credits claimed on the LEED project checklist.

5.8.3.17 Miscellaneous Calculations. See UFC 3-501-01 for additional requirements.

5.8.3.18 Product Data Sheets. Product data sheets shall be provided for all electrical equipment, including luminaires, lighting controls, normal and emergency power distribution equipment, photovoltaic (PV) and other renewable energy equipment, communication and special systems distribution equipment, lightning and surge protection equipment, and grounding equipment..

5.8.3.19 Cybersecurity Control List. Provide an updated Cybersecurity Control List for each facility-related control system reflecting all revised information. Each list shall be tailored for the respective system, indicating which Designer CCIs are not applicable and which are impractical to implement. All applicable CCIs shall be addressed in the respective cybersecurity Specification Section.

5.8.4 Final (100%) Design Drawings

The final (100%) drawings shall be prepared in accordance with Chapter A-10, Drawings. The final (100%) submittal shall include the drawings required for the Preliminary (60%) Submittal, even if a Preliminary (60%) Submittal is not required for the project. The drawings shall be complete and, together with the specifications, shall constitute the Final Construction Documents. In additional to the drawings indicated for the Preliminary (60%) Submittal, the Final (100%) Drawings shall include the following:

5.8.4.1 Site Electrical Plans. Provide dedicated power, lighting, communication and special systems plans, except plans may be combined for small projects where clarity is not compromised.

5.8.4.2 Site Electrical Details. Provide details for all electrical site equipment, including power poles, transformers, switches, manholes, duct lines, conduit stub-ups, equipment foundations, grounding details, luminaires and lighting control devices.

5.8.4.3 Site Electrical Schedules. Provide schedules for site luminaires, site lighting control strategies, site motor feeders and other site electrical equipment as appropriate.

5.8.4.4 Site Electrical Single-Line Diagrams. Provide single-line diagrams for power systems, communication systems and other site electrical systems as appropriate. Separate communication single-line diagrams shall be provided for copper, fiber and conduit, except single-line diagrams may be combined for small projects where clarity is not compromised.

5.8.4.5 Interior Electrical Plans. Provide plans showing locations of all electrical equipment and devices. Feeders and circuits shall be indicated on plans or by schedules. Devices shall include lighting control devices (e.g., sensors, switches) and fire alarm/mass notification initiation and notification appliances. Communication plans shall include but not be limited to devices, conduits, cable trays, cabinets, racks and PDS. Mechanical equipment plans shall show locations of all electrically driven equipment, and shall include electrical characteristics (e.g., HP, kW, kVA). Dedicated plans shall be developed for lighting protection system and the photovoltaic (PV) systems. Lightning protection plans shall include but not be limited to counterpoise, air terminals, roof conductors, ground connections and conductor sizes. Photovoltaic plans shall include but not be limited to photovoltaic modules, inverters, disconnect switches, combiner boxes, meters, and monitoring equipment.

5.8.4.5 Electrical Interior Details. Provide details for all electrical interior equipment, including luminaires, power distribution equipment, building communication equipment, fire alarm and mass notification equipment, special systems equipment, grounding equipment, lightning protection equipment, and other equipment for which a detail will clarify or convey the equipment requirements. Provide wiring diagrams for lighting and receptacle controls. Provide a luminaire detail for each luminaire type, depicting the physical appearance of the luminaire and listing all salient features.

5.8.4.6 Electrical Interior Single-Line Diagrams. Provide single-line diagrams for power systems, communication systems, fire alarm and mass notification systems, access control systems, intrusion detection systems, public address systems and other electrical systems as appropriate. Single-line diagrams shall show the location of the various components and interconnections with other systems.

5.8.4.7 Electrical Interior Schedules. Provide schedules for wire and conduit, panelboards, transformers, luminaires, lighting control strategies, special power outlets, and other electrical equipment as appropriate. Panel schedules shall include panel rating, AIC rating, phase loads, and room numbers for loads.

5.8.4.8 Electrical Interior Lighting Control Documentation. Each unique lighting control scenario shall be represented by a unique lighting control strategy identified on the plans for each room or space. Lighting control strategies shall not be identified by group (e.g., offices). Lighting control strategies shall be clearly conveyed in a tabulated narrative format and shall include a description of operation and specify a list of lighting equipment and devices required to implement the strategy. Strategies shall be labeled and cross-referenced to the applicable rooms on the lighting plans, and shall be supplemented with wiring, functional, or schematic diagrams as appropriate for clarity. As a minimum, provide a typical wiring diagram for each lighting controller (e.g., room controller, lighting control panel, etc.). For projects with programmable control panels, provide lighting control panel relay schedules and channel schedules as appropriate. Show all lighting control system components on the plans.

a. Line voltage dimming shall not be used.

b. Wireless lighting controls shall not be used without written permission from both the Installation and Savannah District Electrical Section (CESAS-EN-DE).

5.8.4.9 Fire Alarm and Mass Notification Input/Output Matrix. Provide an input/output matrix indicating the required sequence of operation of the fire alarm and mass notification system.

5.8.4.10 Enlarged Electrical Plans. Provide enlarged electrical plans for congested areas where interference between various electrical systems, cable trays, piping, ducts, etc., is likely. At a minimum include enlarged plan views of the communications and electrical rooms.

5.8.5 Final (100%) Design Specifications

The final (100%) specifications shall be prepared in accordance with Chapter A-10, Specifications, using the Unified Federal Guide Specifications (UFGS). Referenced codes and standards shall be check to assure the referenced date matches the most current date. Specifications shall be fully edited, choices shall be selected, blank spaces shall be filled, and inapplicable text shall be deleted. All electrical equipment shall be specified. For equipment for which there is no UFGS specification available, provide a specification in UFGS format.

5.8.6 Final (100%) Design Certifications

For projects with Arms Rooms, provide a completed Arms Room Checklist as described in Chapter A-3, Architecture.

5.9 CORRECTED FINAL DESIGN SUBMITTAL REQUIREMENTS

In the Corrected Final Design Submittal, the designer of record finalizes the construction documents. This includes the incorporation of approved comments from the previous design submittal reviews. The Corrected Final Design Submittal requirements shall be the same as the Final Design Submittal requirements. Unless indicated otherwise in the project Specific Instructions, this submittal will not be another review in ProjNet and is only for final backcheck of all comments**.**

5.10 REQUIREMENTS FOR PREPARATION OF DESIGN/BUILD RFP'S.

5.10.1 General

Unless indicated otherwise, the Request for Proposal (RFP) shall comply with the requirements of UFC 1-300-07A. The RFP shall contain adequate information for the design-build contractor to develop a bid package. Information shall include the primary source of power, characteristics of the power supply to the site, and the communications point of connection and requirements. Required demolition work, available power, the source, location, and adequacy of the primary supply should be included. Indicate total connected load and resulting KVA demand load by applying demand (state operating assumptions) and diversity factors based on square footage. Unless indicated otherwise, the A-E shall be furnished an electronic format sample or template for the written technical requirements portion of the RFP to be edited for the specific project.

5.10.2 Project Requirements

The RFP shall identify all known, and any potential, systems and constraints that apply to the project. Systems might include fire alarm, mass notification, IDS, CCTV, Secure areas, SIPRNET, data, telephone, emergency generator, UPS, etc. Constraints might include points of connection for existing systems (e.g. – fiber-optic, telephone, primary electrical); use of overhead or underground distribution; customer-defined requirements or constraints for specific installations; target lighting levels; renovation issues (e.g. adequacy of existing interior electrical distribution system and communications service; potential NEC hazardous/classified areas).

5.10.3 Coordination

Coordinate the functional requirements of the facility with the User Representatives, Privatized Utility Representatives (where applicable), and Installation Agencies. Identify all privatized utilities on the Installation and clarify the responsibilities of both the Contractor and the privatized utilities. Privatized Utilities may include primary power, site lighting and CATV. Installation Agencies may include the Installation Fire Department, the Installation Physical Security Office, and the Network Enterprise Center (NEC). Identify utility connection points and confirm adequacy of existing electric utilities. Where inadequate, provide instructions for upgrading the system. The RFP shall include documentation demonstrating coordination.

5.10.4 Draft RFP Submittal Requirements

5.10.4.1 Design Narrative. Provide a design narrative describing the electrical systems and all functional and technical electrical requirements for the site and buildings. Include any appendices provided by the privatized utilities or government agencies.

5.10.4.2 Design Criteria. Provide a comprehensive list of applicable criteria for all electrical systems included in the scope of work.

5.10.4.3 USGS Specifications. Unless instructed otherwise, the RFP shall require the use of Unified Facilities Guide Specifications (UFGS), and shall require a marked-up version of specifications be provided to clearly identify revisions.

5.10.4.4 Miscellaneous Criteria. Include any appendices or specifications provided by the privatized utilities or government agencies in the RFP.

5.10.4.5 Electrical Site Plan. Provide an electrical site plan show the routing of existing power and communication utilities and the locations of existing electrical equipment. Clearly indicate the point of connection to each utility.

5.10.5 Final RFP Submittal Requirements

5.10.5.1 Review Comments. Evaluate the review comments from the previous design submittal reviews and incorporate all approved comments into the RFP.

5.10.5.2 Consistency. Verify consistency between the drawings, appendices, and RFP text.

*** End of Section ***