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CHAPTER A-5

ELECTRICAL POWER, LIGHTING, GROUNDING, COMMUNICATIONS AND ALARM SYSTEMS

5.1 GENERAL

This chapter gives general guidelines for the preparation of drawings, specifications and design analysis as related to power, lighting, grounding, communications and alarm systems.

5.2 APPLICABLE CRITERIA

5.2.1 Unified Facilities Criteria (UFC)

Unified Facilities Criteria (UFC) documents replaced many subjects that were formerly Agency-specific documents. Army, Navy, and Air Force projects shall comply with UFC documents unless other indicated (UOI). A complete list of UFC documents can be found at http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4. A list of commonly referenced UFC documents can be found below.

UFC 3-520-01 Interior Electrical Systems

UFC 3-530-01 Design: Interior and Exterior Lighting and Controls

UFC 3-550-03N Power Distribution Systems

UFC 3-570-02A Cathodic Protection

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 4-021-01 Design and O&M: Mass Notification Systems

5.2.2 Army Criteria

All Army projects shall also comply with Additional Army Criteria. A list of Additional Army Criteria can be found below.

AR 190-11 Physical Security of Arms, Ammunition, and Explosives (where applicable)

Technical Guide for Installation Information Infrastructure Architecture (I3A)

Technical Guide for the Integration of Secret Internet Protocol Router Network (SIPRNET) (where applicable)

5.2.2.1 Army Medical Facilities Design Criteria

All Army Medical Facilities shall comply with UFC 4-510-01 (Design: Medical Military Facilities), as well as any additional criteria provided by the Tri-Service Medical Agency (TMA).

5.2.3 Air Force Criteria

Air Force projects shall comply with UFC documents. In addition, unique Air Force projects may also require Air Force specific criteria. These criteria can be found at http://www.wbdg.org/ccb/browse_org.php?o=33.

5.2.4 Industry Criteria

In addition to Military Criteria, all projects shall comply with the Applicable Industry Criteria. The most current editions of the criteria (as of the date of the contract issue) shall be used. This list is not intended to include all criteria that may apply.

ANSI C2 National Electrical Safety Code

ASHRAE 90.1 Energy Standard for Buildings Except Low- Rise Residential Buildings

EIA/TIA 568-B Commercial Building Telecommunications Cabling Standards

EIA/TIA 569-A Commercial Building Standard for Telecommunications Pathways and Spaces

J-STD EIA/TIA 607 Commercial Building Grounding and Bonding Requirements for Telecommunications

Energy Policy Act of 2005 (Public Law 109-58)

IESNA RP-1 Office Lighting

IESNA RP-8 Roadway Lighting

IESNA Lighting Handbook Reference and Application

NACE RP0169 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

UL 96A Installation Requirements for Lightning Protection Systems

Uniform Federal Accessibility Guidelines (UFAS)

USGBC LEED-NC Green Building Rating System for New Construction & Major Renovations Version 2.2

5.2.5 MILCON Transformation Criteria

MILCON Transformation projects shall comply with the MILCON Transformation Criteria. A listing of the MILCON Transformation Criteria can be found in Section 01 10 00, Paragraph 4.0, Applicable Criteria of the Sample MILCON Transformation RFP, which is located at https://ff.cecer.army.mil/rfp_wizard/docs/refs/CTYPEsampleRFP.pdf.

5.3 PRECONCEPT SUBMITTAL REQUIREMENTS

There are no electrical requirements for this submittal.

5.4 CODE 3 DESIGN REQUIREMENTS

Submittal content and format shall be as described in UFC 3-710-01A.

5.5 CONCEPT (35%) DESIGN SUBMITTAL REQUIREMENTS

5.5.1 Design Narrative

5.5.1.1 General. Briefly describe the electrical scope of work on the project.

5.5.1.2 Interior Work. Indicate the electrical characteristics (phase, voltage, and number of wires) of the electrical system. Indicate any special systems or unique

requirements of the project (generator, UPS, SIPRNET, SCIF, Arms Vault, hazardous locations, special power outlets, etc.)

5.5.1.3 Exterior Work. Identify if the existing electrical and communication utilities are adjacent to the site and if they contain sufficient capacities for the project.

5.5.1.4 Design Charrette Electrical Minutes. Include all electrical minutes from the Design Charrette. This should include any functional or technical requirements identified at the meeting, as well as any special requirements or criteria identified by the Facility Users. It should include information obtained from the Privatized Utilities (primary electrical power, exterior lighting, CATV, etc.) or Installation agencies (DOIM, Fire Department, Security office, etc.).

5.5.2 Design Analysis

5.5.2.1 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.

5.5.2.1 Lightning Protection. Perform a Lightning Protection Risk Assessment in accordance with NFPA 780. Include all formulae, input variables, dimensions, and coefficients used throughout the calculation in the design analysis.

5.5.3 Design Drawings

5.5.3.1 Electrical Site Plan. Provide a dedicated electrical site plan showing the existing and proposed electrical & communications lines, as well as the proposed transformer location(s). 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.

5.5.4 Specifications List

Include a listing of all Specifications to be used in the project. Unless otherwise indicated, utilize only Unified Facilities Guide Specifications (UFGS).

5.6 PRELIMINARY (60%) SUBMITTAL REQUIREMENTS

5.6.1 Review Comments.

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

5.6.2 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 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. Light levels calculations shall be performed to provide maintained foot-candle (fc) levels in accordance with the Applicable Criteria. Calculations for all interior rooms and exterior areas shall be included. The point-by-point computation method shall be used to perform the calculations. In addition to the maintained foot-candle levels, the maximum level, minimum level, and the maximum-to-minimum ratios for each room and area shall be included.

5.6.4 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 showing all of the symbols used throughout the electrical drawings.

5.6.4.3 Electrical Site Plans. The electrical site plans shall meet all of the requirements of the concept (35%) submittal, except it shall be updated to reflect any revised or updated information. For large projects or where required for clarity, provide dedicated plans for power, communications, and lighting

5.6.4.4 Interior Lighting Plans. Provide dedicated lighting plans showing the locations and types of light fixtures.

5.6.4.5 Lighting Fixture Schedule. Provide a light fixture schedule describing the salient features of each light fixture shown on the drawings.

5.6.4.6 Interior Power Plans. Provide dedicated power plans showing the locations of all mechanical equipment, receptacles, and power panels.

5.6.4.7 Interior Fire Alarm Plans. Provide dedicated fire alarm plans showing the locations of all fire alarm & detection devices, as well as the location of the fire alarm control panel.

5.6.4.8 Interior Communication Plans. Provide dedicated communication plans showing the locations of all telephone, data, and CATV outlets.

5.6.4.9 Interior Special Systems Plans. Provide dedicated special systems plans showing the locations of all special systems devices (mass notification, public address, intrusion detection, access control, etc.).

5.6.5 Specifications

Provide a copy of the Specifications outlined in the Concept Submittal. These Specifications shall be edited in accordance with Chapter A-11, Specifications.

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. The design process does not stop at this submittal.

5.7.2 Design Narrative.

There are no requirements for this submittal.

5.7.3 Design Analysis.

There are no requirements for this submittal.

5.7.4 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 Design Analysis.

5.8.2.1 General. The Final Design Analysis shall include all of the requirements of the previous submittals and shall include any revised or updated information. 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. The cover sheet of the design analysis shall bear the names of the designer and the checker. Calculations and data for the following shall be included in the analysis:

5.8.2.2 Lighting Calculations. Include all of the required information from the Preliminary (60%) Design submittal, except it shall be updated to reflect any revised or updated information. In addition, provide catalog cuts of all lighting fixtures upon which the design is based. Ensure that no proprietary light fixtures are specified. (Upon request, be able to provide (3) manufacturer's names and catalog numbers for each light fixture).

5.8.2.3 Interior Lighting Power Allowance Calculations. Calculations shall be performed in accordance with ASHRAE 90.1. 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 does not exceed the total interior lighting power allowance.

5.8.2.4 Exterior Lighting Power Allowance Calculations. Calculations shall also be performed in accordance with ASHRAE 90.1. Calculations shall follow the steps indicated in ASHRAE 90.1, and shall clearly show that the total exterior lighting power allowance does not exceed the sum of the individual lighting power densities permitted in ASHRAE 90.1 plus the additional unrestricted allowance of 5% of that sum. Note that the Light Pollution Reduction credit for LEED certification has more stringent exterior lighting power allowance requirements than ASHRAE 90.1. When claiming the Light Pollution Reduction credit, calculations shall be provided to demonstrate compliance with the more stringent requirements.

5.8.2.5 LEED Light Pollution Reduction Credit. Demonstrate compliance when claimed on the LEED project checklist. The calculations for the lighting exterior power allowance requirements may be combined with the ASHRAE 90.1 exterior lighting power allowance calculations. (See Paragraph 5.8.2.4). In addition, provide point-by-point lighting calculations that meet the site boundary illumination requirements for the project's LEED zone classification.

5.8.2.6 EPACK 2005. New federal buildings are required to achieve energy consumption levels at least 30% below the levels established in ASHRAE 90.1, 2004. Lighting systems data from the Building Energy Analysis shall be submitted in the electrical design analysis for all buildings in the project.

5.8.2.6.1 ASHRAE 90.1, Table G3.1 offers two ways to claim credit for automatic lighting controls that exceed the controls required by ASHRAE 90.1
(1) Where the proposed design lighting schedules are modified from the

baseline lighting schedules, both sets of schedules (including technical documentation to justify the modifications) shall be submitted in the design analysis. (2) Where the proposed design lighting power is reduced in accordance with ASHRAE 90.1, Table G3.2, it shall be clearly noted in the design analysis.

5.8.2.6.2 For projects utilizing daylighting controls, describe the daylighting control scheme and include all daylighting parameters inputted into the building simulation model.

5.8.2.6.3 Energy Consumption Summaries shall be submitted indicating the yearly lighting systems energy consumption (kWh) of both the baseline and proposed design models.

5.8.2.7 Short Circuit Calculations. Calculations shall be performed 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.

5.8.2.8 Voltage Drop Calculations. Calculations shall be performed for all services and feeders, dry-type transformers, and on worst-case branch circuits. Voltage drop calculations shall meet the requirements of ASHRAE 90.1, Chapter 8.4.1.

5.8.2.9 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.

5.8.2.10 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.

5.8.2.11 Cathodic protection shall be provided as required by ETL 1110-3-474. 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.

5.8.3 Final Plans & Specifications

The final plans & specifications shall be the refinement and completion of the concept and preliminary plans & specifications. The final plans & specifications shall

constitute the Final Construction Documents which shall establish in detail the complete requirements of the construction work.

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.

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

5.10.1 General

Unless otherwise indicated, Army RFP's shall be prepared using the MILCON Transformation RFP template and the online RFP "wizard". Contact the SAS Project Manager for access to the RFP "wizard". Unless otherwise indicated, Air Force and all other RFP's shall be based upon "partial" design development as defined by UFC 1-300-07A.

5.10.2 MILCON Transformation RFP's

5.10.2.1 General. Develop a complete RFP using the current MILCON Transformation RFP Template documents and the online "wizard". Follow the MILCON Transformation RFP Implementation Guidelines (located at https://ff.cecer.army.mil/rfp_wizard/docs/refs/RFPImplementationGuidelines.pdf) in developing the RFP.

5.10.2.2 Facility-Specific Functional and Technical Requirements. For Army projects with Center of Standardization (COS) facility types, utilize the standard Paragraph 3 for each building type. For Army projects with non-standard facilities, develop each Paragraph 3 to include functional and technical electrical & communications requirements for each building based on input from the Users, as well as any criteria provided by the Project Manager.

5.10.2.3 Project-Specific Requirements. Coordinate with the facility Users, privatized utilities (primary electrical power, exterior lighting, CATV, etc.), and Installation agencies (DOIM, Fire Department, Security office, etc.) to develop Paragraph 6 and RFP appendices.

5.10.2.4 Deviations. Coordinate with the Installation and provide technical support for Installation requests for deviations from the MILCON Transformation RFP requirements as needed.

5.10.2.5 Draft RFP Submittal Requirements

5.10.2.5.1 For the COS facility types, ensure that the standard Paragraph 3 for each building type is included in the RFP. For non-standard facilities, include the functional and technical electrical & communications requirements developed for each building in Paragraph 3.

5.10.2.5.2 Denote any privatized utilities (primary electrical power, exterior lighting, CATV, etc.) on the Installation and clarify the responsibilities of both the Contractor and the privatized utilities.

5.10.2.5.3 Coordinate with the Installation Directorate of Information Management (DOIM) or other Communications Agency to determine any manhole and cabling tie-in points required. Denote this information either on a dedicated communications site plan or in Paragraph 6. Denote all other Installation-specific communications requirements in Paragraph 6.

5.10.2.5.4 Denote any other Installation specific information provided by the Installation Fire Department, Security Office, etc. in Paragraph 6.

5.10.2.5.5 Include any appendices provided by the privatized utilities or government agencies.

5.10.2.6 Final RFP Submittal Requirements

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

5.10.2.6.2 Verify consistency between the drawings, appendices, and the RFP text.

5.10.2.6.3 Update the RFP to reflect any changes to the MILCON Transformation RFP Template documents as needed during RFP preparation.

5.10.3 "Partial" Design Development RFP

5.10.3.1 General. Prepare the RFP in accordance with UFC 1-300-07A. Develop the functional and technical electrical & communications requirements for each building based on input from the Users, as well as any criteria provided by the Project Manager. Coordinate with the facility Users, privatized utilities (primary electrical power, CATV, etc.), and Installation agencies (DOIM, Fire Department, Security office, etc.) to develop any project specific electrical requirements.

5.10.3.2 Draft RFP Submittal Requirements

5.10.3.2.1 Include the functional and technical electrical & communications requirements developed for each building in the RFP.

5.10.3.2.2 Denote any privatized utilities (primary electrical power, CATV, etc.) on the Installation and clarify the responsibilities of both the Contractor and the privatized utilities.

5.10.3.2.2 Coordinate with the Installation Directorate of Information Management (DOIM) or other Communications Agency to determine any manhole and cabling tie-in points required. Denote this information either on a dedicated communications site plan or in the narrative portion of the RFP. Denote all other Installation-specific communications requirements in the RFP.

5.10.2.5.3 Include any other Installation specific information provided by the Installation Fire Department, Security Office, etc. in the RFP.

5.10.2.5.4 Include any appendices or specifications provided by the privatized utilities or government agencies in the RFP.

5.10.3.3 Final RFP Submittal Requirements.

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

5.10.3.3.2 Verify consistency between the drawings, appendices, specifications, and the RFP text.

5.10.3.3.3 Update the RFP to reflect any changes due to new project criteria or new information obtained during coordination.