

CHAPTER 8
ELECTRICAL

8.1	GENERAL	3
8.2	REQUEST FOR PROPOSAL DEVELOPMENT	3
8.3	DESIGN DEVELOPMENT	3
8.3.1	CONCEPT (30%) DESIGN SUBMITTAL REQUIREMENTS	3
8.3.1.1	<i>Concept Design Analysis</i>	3
8.3.1.1.1	Design Criteria	3
8.3.1.1.2	Interior Electrical Distribution System.....	3
8.3.1.1.3	Service Entrance.....	3
8.3.1.1.4	Equipment Data.....	3
8.3.1.1.5	Lighting.....	4
8.3.1.1.6	Emergency and Exit Lighting.....	4
8.3.1.1.7	Conduit and wiring.....	4
8.3.1.1.8	Special Items	4
8.3.1.1.9	Hazard Classes	4
8.3.1.1.10	Grounding	4
8.3.1.1.11	Cathodic Protection.....	4
8.3.1.1.12	Metering.....	4
8.3.1.1.13	Special Systems.....	5
8.3.1.1.14	Exterior Electrical Distribution System Design Narrative.....	5
8.3.1.1.15	Field Trip Report.....	6
8.3.1.1.16	Miscellaneous Information.....	6
8.3.1.2	<i>Concept Drawings</i>	6
8.3.1.2.1	Interior Electrical.....	6
8.3.1.2.2	Exterior Electrical	6
8.3.1.2.3	Characteristics	7
8.3.1.2.4	Capacity	7
8.3.1.2.5	Communications	7
8.3.1.3	<i>Concept Specifications</i>	7
8.3.2	INTERIM (60%) DESIGN SUBMITTAL	7
8.3.2.1	<i>Interim Design Analysis</i>	7
8.3.2.1.1	Interior Electrical Work.....	7
8.3.2.1.2	Lighting	7
8.3.2.1.3	Exterior Electrical Work	7
8.3.2.2	<i>Interim Drawings</i>	7
8.3.2.2.1	Interior Drawings	7
8.3.2.2.2	Exterior Drawings	8
8.3.2.3	<i>Interim Specifications</i>	8
8.3.3	FINAL (90%) DESIGN SUBMITTAL	8
8.3.3.1	<i>Final Design Analysis</i>	8
8.3.3.2	<i>Final Calculations</i>	9
8.3.3.3	<i>Final Drawings</i>	9
8.3.3.3.1	Interior Systems.	9
8.3.3.3.2	Exterior Systems	10
8.3.3.3.3	Checking	10
8.3.3.4	<i>Final Specifications</i>	10
8.3.4	CORRECTED FINAL (100%) DESIGN SUBMITTAL.....	10
8.4	TECHNICAL REQUIREMENTS	11
8.4.1	APPLICABLE PUBLICATIONS.....	11
8.4.2	BASIS OF DESIGN	11
8.4.3	SYSTEM SELECTION	11
8.4.4	LIGHTING SYSTEM.....	11
8.4.5	SURGE PROTECTIVE DEVICE.....	11
8.4.6	LIGHTNING PROTECTION SYSTEM.....	11

8.1 GENERAL

This chapter gives general guidance for the preparation of drawings, specifications, and design analyses as related to electrical aspects of military construction projects. 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 applicable publications.

The USACE proponent for Chapter 8, Electrical, of the Louisville District Military Design Guide is Tina Beavin, (502)315-6260, Christina.F.Beavin@usace.army.mil.

8.2 REQUEST FOR PROPOSAL DEVELOPMENT

The Request for Proposal 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, or portion involved 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 of building or known use of building.

The Request of the Proposal should also 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 hazardous/classified (NEC) areas.

8.3 DESIGN DEVELOPMENT

8.3.1 CONCEPT (30%) DESIGN SUBMITTAL REQUIREMENTS

8.3.1.1 Concept Design Analysis

The electrical design shall include a Design Analysis that shall include the following:

8.3.1.1.1 Design Criteria

Include a list that will be used for all electrical systems, including communications systems.

8.3.1.1.2 Interior Electrical Distribution System

Indicate electrical characteristics (phases, voltage and number of wires) of electrical system. Indicate the type and phase of all transformers and where they will be located. For renovation projects, determine the adequacy of existing distribution system and indicate plan of action if upgrade is required.

8.3.1.1.3 Service Entrance

- a. Describe service entrance and service equipment selected.
- b. Provide an estimate of total connected load (kVA) and the resulting demand load (kVA), transformer size, and service size.

8.3.1.1.4 Equipment Data

Describe basic characteristics of panelboards, protective devices, switchboard or switchgear, motor control center, generator, UPS or other major equipment to be provided.

8.3.1.1.5 Lighting

Provide a brief description of the lighting system(s) to be used for major areas. Include a concept lighting fixture schedule showing room type, target lighting intensity, type of fixture, voltage, wattage, mounting (wall or ceiling), mounting height, and basis of design such as I.E.S., etc. Include description of lighting control, such as the use of day lighting, occupancy sensors, digital controls, etc. Provide criteria used for light intensities and uniformity.

8.3.1.1.6 Emergency and Exit Lighting

Provide a brief description of the emergency and exit lighting system, which shall be in accordance with NFPA 101. Include the type of fixtures and provide foot-candle values for the systems.

8.3.1.1.7 Communications and CATV System

- a. 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, and all instructions received from the Network Enterprise Command (NEC) (Army) or the Base Communication Office (BCO) (Air Force).
- b. Describe the data system requirement including the type of cable, type of instruments, and the size of the installation, including stations, trunk size, connection to and location of switch, and all instructions received from NEC (Army) or BCO (Air Force). Indicate if SIPRNET is required.
- c. Describe the cable television system if required. Indicate where the main equipment will be located and include a description of the infrastructure required. State the installation's existing system, what will be required to interface with the existing system and if the system is to remain or be expanded. Note what entity will make the final terminations. The DOR shall coordinate with the local provider the point of connection and installation requirements.

8.3.1.1.8 Conduit and wiring

State the type of conduit, such as rigid conduit, intermediate metallic conduit, electrical metallic tubing, cable tray, and wiring system or type, such as nonmetallic sheathed cable, copper conductors, etc., and the conditions where each type will be used.

8.3.1.1.9 Special Items

Provide paragraph describing proposed addition and alterations of special items of design, such as, specialized equipment, special receptacles, physically disabled (ADA), and seismic requirements, etc., include description, type, and location of special power outlets and circuits (volts, phase, and amps). Reference pertinent NEMA or any recognized standards to identify the type receptacles selected. Include documentation of the source of the criteria.

8.3.1.1.10 Hazard Classes

Define any hazardous area by class, division and group as defined in the National Electrical Code (NFPA 70) and indicate type of equipment required for use in the area.

8.3.1.1.11 Grounding

Describe grounding system to be installed per NFPA 70 and any additional grounding systems that may be required based on the use of the building, i.e., communications, static grounding points, grounding bars for testing equipment, etc.

8.3.1.1.12 Cathodic Protection

Describe the cathodic protection system to be installed if required. State the standards to be used in design and calculations.

8.3.1.1.13 Metering

Describe electrical metering equipment to be provided and whether the outputs are to be

transmitted to the Base EMCS system, as applicable, and the method of transmission. Metering requirements shall be coordinated with the installation.

8.3.1.1.14 Fire Alarm and Mass Notification Systems

Describe class and type of fire detection and notification and system, including mass notification. Include a list of required devices. Include any compatibility issues that may occur when connecting to the installation system. If an existing base fire alarm system is being expanded, the construction contractor does not normally supply the central station receiver module. However, any equipment supplied must be fully compatible with the existing system equipment, and if a receiver module is supplied it must be physically as well as electrically compatible. Determine the make and model of existing equipment and include sufficient information in the specifications and plans to insure compatibility of the completed system.

Where installations have central fire alarm receiving stations that are dependent upon a unique coding scheme, transmission to the central station fire alarm status panel at each project facility may be by a transmitter unique to the system and will, therefore, require that proprietary equipment be specified. Consult with the PE/A before the Concept Design to insure that proper procedures to specify this equipment are available.

8.3.1.1.15 Special Systems

Describe any additional electrical requirements such as public address, access control, intrusion detection, CCTV, or electronics requirements.

- a. Describe public address system, where it is required and the source of requirement, such as user request, COS requirement, etc.
- b. Describe access control system.
- c. Describe the intrusion detection system and include CCTV requirements. Unless specifically funded on the project's DD Form 1391, only conduit and boxes shall be provided for Intrusion Detection Systems. Equipment to be connected to the conduit and box layout will be provided by the Using Activity. Design information on conduit, type of conduit, box locations and sizes will be furnished by the Using Activity.
- d. Describe any special security system infrastructure that will be required by the end user. Indicate conduit type and any specialized outlet boxes required.
- e. Describe any special areas, such as Secure Areas, (i.e., Sensitive Compartmented Facility, TEMPEST requirements.)

8.3.1.1.16 Exterior Electrical Distribution System Design Narrative

- a. Primary Source and Point of Connection - Contact the DPW/BCE to obtain information relative to the adequacy of the primary supply at the point of takeoff. If the primary source is inadequate, state measures proposed to correct the deficiency in the design. Verify a point of connection with the installation. If the electrical utility on the installation is privatized, delineate what the contractor's and the utility's responsibilities will be.
- b. Primary Service - Indicate the primary distribution voltage and whether this service will be run aerial or underground and state the basis for this selection.
- c. Secondary Service - Provide electrical characteristics of power supply from the service point to the main service equipment (voltage, phase, preliminary size of overcurrent protection, number and size of conductors). Indicate whether this service will be run aerial or underground. State the basis for selection of distribution voltage i.e., 480Y/277V versus 208Y/120V.
- d. Conductors - State the type of conductor, such as copper or aluminum, and where they are proposed to be used. Indicate for both the primary and secondary service.
- e. Connected Load - Narrate assumptions and conclusions related to the estimated total connected load and estimated kVA demand load. Indicate type, number, and kVA

ELECTRICAL

- capacity of transformer installation proposed. State the primary and secondary connection of transformers (i.e. 12470 to 480Y/277 volts, delta-wye).
- f. Exterior Lighting - Provide a statement describing street lighting, security, parking lot lighting, or sidewalk lighting requirements. Types of fixtures, pole type, pole heights, and proposed lighting intensities are to be included. Describe whether the lighting will be on photocell, motion sensors, or time clock. Coordinate with the installation the type of light fixtures, poles, finishes etc. to be specified.
 - g. Cathodic Protection - Where cathodic protection is required by the project criteria or other instructions provide recommendations for the need and type of system to be employed.
 - h. Lightning Protection - Perform a Lightning Hazard Risk Assessment per NFPA 780 to determine if lightning protection is recommended. Recommendation will be based on this assessment. If system is required or recommended describe it. State if LPS is not required or recommended.
 - i. Grounding - Describe grounding system to be installed, if required. If a counterpoise, grid, etc., is to be used, state the standards to be used in design and calculations.
 - j. Communication System – Describe the voice and data system to be installed. Indicate whether cables shall be run aerial or underground and provide the point of connection (POC) with the existing installation infrastructure. Provide support for whether the type of cable is fiber optic or copper or both. Provide all instructions received from the Network Enterprise Center (NEC) (Army) or the Base Communication Office (BCO) (Air Force).
 - k. CATV - Describe the cable television system if required. Indicate where the main equipment will be located and include a description of the infrastructure required. State the installation's existing system and what will be required to interface with the existing system. Note what entity will make the final terminations. State where line on delineation is between contractor and utility.
 - l. Integrated Commercial Intrusion Detection System (ICIDS) – Describe where ICIDS is required to be installed if required. Typical areas requiring ICIDS include Arms Vaults and SIPRNET Rooms, and SCIFS. The installation shall be coordinated with the local ICIDS administrator.
 - m. If requirement for a generator is authorized, it will be noted as a line item on the 1391. If a generator is authorized, provide requirements, such as purpose, emergency back-up load, length of time back-up power is required, type of fuel.
 - n. Describe type of renewable energy when required.

8.3.1.1.16 Field Trip Report

A field trip report should be furnished. This report should contain records of meetings held with facility personnel, including participant lists. Any agreements or understandings reached with facility personnel, any unforeseen site/building conditions and photographs, should be documented in the report.

8.3.1.1.17 Miscellaneous Information

Additional information or material required to complete the design shall be listed, or a statement shall be made that none is needed.

8.3.1.2 Concept Drawings

8.3.1.2.1 Interior Electrical

Provide interior electrical drawings showing only special purpose power outlets, locations of telephone backboards, electrical service equipment, service entrance, and preliminary single line diagram. Also, show demolition work, if any.

8.3.1.2.2 Exterior Electrical

Provide a separate electrical site plan indicating all existing and proposed support utility lines and

equipment required to serve the project including electrical power lines, communication cables, cable television cable, all roads and driveways, parking areas, and other items necessary for functional and operating adequacy. Indicate the extent of any demolition to be done. If extensive, provide separate drawings with independent legend for new work.

8.3.1.2.3 Characteristics

Provide preliminary electrical characteristics (voltage, ampacity and phase) for the primary and secondary lines at the point of delivery and/or any extension. Indicate characteristics and standards of design for aerial or underground lines.

8.3.1.2.4 Capacity

Indicate the type, number, location, kVA capacity, primary and secondary voltage of the transformer installation proposed. Identify the primary and secondary connections of the transformer(s).

8.3.1.2.5 Communications

Identify any existing and new communications service connections, both aerial and underground. Indicate characteristics and standards of design for aerial or underground communication lines.

8.3.1.3 Concept Specifications

List the Unified Facilities Guide Specifications (UFGS) that will be used.

8.3.2 INTERIM (60%) DESIGN SUBMITTAL

8.3.2.1 Interim Design Analysis

The Design Analysis shall be an entirely updated analysis (not amendments to 30% submittal) to permit verification that the design complies with the criteria furnished and the approved 30% design phase and approved review comments. Information required at the 30% design phase shall be included with more detail.

8.3.2.1.1 Interior Electrical and Communications Work

Determine estimated demand loads. Provide a breakdown, by category, of the estimated loads (kVA). Include lighting, convenience outlet, mechanical equipment, special operating equipment, user equipment, system's furniture, and miscellaneous load categories. Provide estimated sizes of feeders, service entrance, and transformers. Individual circuit load tabulations and interior voltage drop calculations are not required for this submittal. Include fire alarm and mass notification analysis stating the basis behind the equipment chosen. Include locations and requirements for communications systems, cable television outlets, video teleconferencing (VTC), public address systems, entry control systems, etc.

8.3.2.1.2 Lighting

Include catalog cut sheets of light fixtures proposed.

8.3.2.1.3 Exterior Electrical Work

Determine and state the estimated primary and secondary wire sizes, transformer sizes, communication cable sizes (copper and fiber optic cable), type of parking lot and street lighting systems. State whether road bores or open road cuts are required for underground utilities. Coordinate with the local DPW or BCE.

8.3.2.2 Interim Drawings

8.3.2.2.1 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 or other drawings.

- a. Show service drop connection location.
- b. Panelboards, motor control center, switchboard, switchgear equipment and all utilization

ELECTRICAL

equipment shall be located. Dedicated electrical space shall be provided around and above panelboards, switchboards, transfer switchboards, transformers, transfer switches, motor control centers and similar major items of electrical equipment. Define this space as stated in NEC.

- c. Show the location and type of lighting fixtures to be installed in each area.
- d. Lighting fixture schedule shall be included.
- e. All demolitions and relocations, if any, must be shown. If demolitions and relocations are extensive, separate plans are required.
- f. A complete symbol legend for all devices or equipment shall be shown on the plans.
- g. Show the locations of receptacles, communication outlets, mechanical equipment, etc.
- h. Include special features such as under floor raceways, bus duct, communication facilities, kitchen layout, additional security requirements etc.
- i. Interior wiring need not be shown on 65% electrical plans.
- j. Define the limits of all hazardous areas and indicate the Class, Division, and Group, which applies per the NEC, Article 500 Hazardous Locations.
- k. Show location of all devices and equipment for fire alarm and mass notification systems on the floor plans. Show location of devices to be interconnected, e.g. show duct-mounted smoke detectors, hood fire suppression systems contacts for fire alarm system input, etc.

8.3.2.2.2 Exterior Drawings

Exterior electrical, cable television, and communication layout plans are required and must be separate from water, sewage, and other utility plans. Show other new or existing utilities only as required to prevent conflicts with the electrical work. Indicate separation between the different utility systems and include depth requirements.

- a. Complete all exterior electrical plans with poles, manholes, and other pertinent components indicated. Include transformer location, estimated kVA, voltage and phase characteristics.
- b. Indicate location and type (aerial or underground) of all new communications, cable television, primary and secondary lines, service drops, and transformers. If cables are run underground, indicate whether concrete encased or direct buried.
- c. Indicate poles, manholes, and equipment to be relocated or removed. Clearances from buildings shall be IAW the National Electric Safety Code, most current edition.
- d. Indicate new location of any relocated electrical items.
- e. Show accurate location and sizes of existing lines including poles and transformers from which power is to be obtained.
- f. Provide layout of lighting for parking lots, sidewalks and streets.
- g. On large projects where underground systems are used, furnish prints of the site showing communication service connection points of each building, manholes and final connection to the existing system.

8.3.2.3 Interim Specifications

Update listing of UFGS and Louisville District Guide specifications based on any changes. If edits to the UFGS or Louisville District Guide specifications have been made before the interim design submittal, submit the edited specifications. Where a UFGS or Louisville District specification section template is not available to cover an element of work, the A-E shall develop and submit an outline specification.

8.3.3 FINAL (90%) DESIGN SUBMITTAL

8.3.3.1 Final Design Analysis

- a. Submit an entirely updated design analysis (not amendments to previously submitted design analysis) to support this submittal. Implement previous submittal approved comments.
- b. Trade names are not allowed on the contract plans and specifications. However, for

equipment such as lighting fixtures, equipment such as motor control centers, switch gear, bus duct, transformers (where special features are required), special receptacles, etc., include the current manufacturer and catalog number in the Design Analysis for future reference for field personnel to understand the basis of the design.

- c. Provide "Engineering Considerations for the Field Personnel" as necessary for electrical aspects of the construction. Considerations should address special inspections or tests for systems, unusual features of the systems, or other information that could mitigate risk during construction.

8.3.3.2 Final Calculations

Provide design calculations and supporting documentation to support design considerations. Calculations shall be computed and checked by separate individuals, one of which must be a registered electrical engineer. Indicate the names or initial of these individual on the page or insert carrying the calculations. Supporting documentation shall be clear, and formulas and references shall be identified. Assumptions and conclusions shall be explained and cross-referencing shall be clear. When a commercial computer program is used, name the program. Ensure that inputs and outputs, of all computer programs, are labeled as appropriate for the project. Include calculations and data for the following in the analysis:

- a. Lighting calculations.
 - Provide calculations for standard and emergency/egress lighting. Calculations shall verify that the target lighting levels are achieved and not significantly exceeded.
- b. Short-circuit calculations, including protective interrupting rating.
- c. Protective device-time current coordination study.
 - The DOR is responsible for contacting and obtaining all utility data required to complete the relay coordination study.
- d. Arc flash analysis.
- e. Voltage drop calculations.
- f. Existing loading data where connections are made to existing transformers or load centers including method of determining the availability of sufficient capacity for the additional loads.
- g. Load Analysis.
 - Include calculations of all connected loads, demand factors, and demand loads by circuit number for each panel and switchboard. Show amp-interrupting circuit ratings for each switchboard and panelboard.
- h. Calculations for cathodic protection, if applicable.
- i. Generator sizing calculations.
- j. Lightning Hazard Risk Assessment per NFPA 780 requirements.

8.3.3.3 Final Drawings

The final drawings are an extension of the approved 60% drawings. Incorporate any previous approved comments.

8.3.3.3.1 Interior Systems.

- a. Details - Include all details for final package on drawings. For congested areas that might interfere with various electrical systems, cable trays, piping, ducts, etc., thoroughly detail by expanded scale drawings. At a minimum include enlarged plan views of the communications and electrical rooms, and elevation views of switchboards/switchgear and communication racks.
- b. Lighting Systems - Include wiring details, location of emergency lights, and exit lights. Provide switch locations, details of control systems, light fixture schedule and light fixture details.
- c. Power Systems - Include locations, type, size and details for any specialized outlets. Include wiring and conduit types, sizes and details for all electrical equipment. Provide a

- detailed one-line diagram indicating all required information.
- d. Riser Diagrams - Provide complete and separate riser diagrams for fire detection and alarm and mass notification system, intrusion detection conduit system, cable television system, public address system, telephone/communication system, etc. Riser should show the location of the various components and interconnections with other systems such as elevator, HVAC and hood fire suppression connections to fire alarm panels, etc. Conduit and wire size and the quantity of wire should not be shown on the riser diagrams, for the fire protection system, since these vary between manufacturers and the minimum size requirements are in the UFGS specifications.
 - e. Communication Systems - Show an interior telephone and data system consisting of the conduits, cable trays, cabinets, outlets, etc. as required by criteria.
 - f. Electrical requirements for mechanical equipment - Show locations, electrical characteristics, kW (if applicable) of electrically driven equipment on the drawings. Ensure that the requirements are coordinated with HVAC and plumbing drawings.
 - g. Panel Schedules - Provide detailed panel schedules indicating phase loads, panel rating, A.I.C. rating. Room numbers of the loads shall be included.
 - h. Lightning Protection - Provide a detailed lightning protection plan and grounding plan if required. Indicate counterpoise, air terminals, ground connections, conductor sizes, etc.
 - i. Include Arc Flash Hazard rating labels.

8.3.3.3.2 Exterior Systems

Include all plans and details for final package on drawings. Include any lighting pole configurations, power pole configurations, duct bank details, pole foundation details, manhole details, switch details, conduit stub-up details, pad mount equipment and grounding details, etc. Details that include multiple pieces of equipment are to indicate the dimensional spacing between the equipment.

8.3.3.3.3 Checking

Thoroughly check the drawings for discrepancies, for compatibility between drawings and specifications, and for compatibility between disciplines. Drawings shall be computed and checked by separate individuals. Indicate the names or initials of these individuals on the drawings. Provide the appropriate Design Quality Control Checklists as are contained in Appendix A. Checklists shall be edited for the project. Electrical Design Checklists shall be initialed by an Electrical Engineer.

8.3.3.4 Final Specifications

All choices shall be made and blank areas shall be completed. Delete inapplicable publications and text/paragraphs. Add publication references, paragraphs, phrases, words, and sentences for items not adequately covered by specifications.

Do not specify proprietary items unless prior approval has been obtained. However, specifying products by naming acceptable commercial products followed by the words "or equal" is permitted under the following conditions:

- a. There is no Government or commercial standard or specifications for the item.
- b. The item is a minor part of the construction project, and
- c. The item cannot be adequately described because of the technically involved construction or composition.

8.3.4 CORRECTED FINAL (100%) DESIGN SUBMITTAL

The 100% submittal is not considered a formal design level and is provided in those cases in which the approved comments require revision due to error or omission. Incorporate the approved comments generated during the final review into the Final Design Analysis (not amended sheets), specifications, and drawings before they are submitted as 100% Design Documents.

8.4 TECHNICAL REQUIREMENTS.

8.4.1 APPLICABLE PUBLICATIONS.

The most current editions of the publications listed below constitute an addendum to this chapter wherever referenced or applicable.

- a. Air Force Manuals and Regulations.
- b. Engineer Technical Letters (**ETL**) and Engineering Regulations (**ER**).
- c. Military Handbooks, Manuals, and Standards.
- d. Unified Facilities Criteria (**UFC**).
- e. Engineering Construction Bulletins (**ECB**).
- f. Technical Criteria for the Installation Information Infrastructure Architecture (**I3A**).
- g. American National Standard Institute (**ANSI**).
- h. National Fire Protection Association (**NFPA**).
- i. Unified Facilities Guide Specifications (**UFGS**).
- j. AMC-R 385, Safety Manual
- k. National Electrical Safety Code (**IEEE C2**)
- l. Army Central Metering Program
- m. Installation/Local Guidance and Criteria

8.4.2 BASIS OF DESIGN

Avoid designing based on a single manufacturer's product. Multiple manufacturers must be able to compete to provide specified equipment. During design, verify that at least three manufacturer's provide equipment meeting specified requirements. Develop a justification and obtain approval through the PE/A for any equipment or system that must come from a single source unless approval or authorization through the PE/A has already been obtained.

8.4.3 SYSTEM SELECTION

Concept Energy Modeling and Life Cycle Cost Analyses shall be performed and provided to evaluate the HVAC and lighting systems alternatives a part of the basis for HVAC system selection. The electrical designer shall work closely with the mechanical designer and perform the Life Cost Analyses for the lighting system to determine the most cost efficient system.

8.4.4 LIGHTING SYSTEM

Design of the lighting system shall be in accordance with UFC 3-530-01, Design: Interior, Exterior Lighting and Controls. Emphasis shall be placed on quality design, and not only horizontal illuminance values; taking into consideration direct glare, surface luminance, and uniformity. An energy efficient lighting system meeting E pact 2005 and ASHRAE 90.1 shall be provided. Program start ballasts shall be specified for Army and Air Force projects. The use of LED type fixtures is encouraged.

8.4.5 SURGE PROTECTIVE DEVICE

Provide surge protection at the power service entrances per NFPA 780. The circuit breaker for the SPD shall be located in the main panel or main switchboard as close as possible to the incoming feed for most effectiveness. For example, a 3 phase service with the incoming feed at the top of the panel bus, it shall be located in the 1, 3, 5 or the 2, 4, 6 pole position. For a main switchboard configuration, it is typically located in the first cubicle. The SPD shall be located as close to the panel/switchboard as possible to minimize lead lengths to the circuit breaker and to the ground bus. SPDs shall not be installed in the panel or switchboard enclosure. SPD's may be located in a switchboard if it's supplied by a dedicated circuit breaker.

8.4.6 LIGHTNING PROTECTION SYSTEM

Lighting Protection System shall be provided in accordance with NFPA 780 and UFC 3-575-01, Lightning

and Static Electricity Protection Systems. LPS roof penetrations shall be limited and are prohibited on standing seam metal roofing systems. Ensure the LPS system does not compromise the warranty of the roofing system.

8.4.7 FIRE ALARM AND MASS NOTIFICATION SYSTEMS

To clarify the definition of employee work areas per UFC 3-600-01, the following guidance shall be followed in regard to the placement of audio-visual appliances in single office areas:

- a. Air Force projects, audio-visual appliances are required in all offices.
- b. Army projects, audio-visual appliances are required in 10% of all single office spaces per floor for the hearing impaired (i.e., if 20 offices, 2 will be labeled and setup for hearing impaired personnel, or a minimum of one office, whichever is greater). The offices shall be spaced as much as practical to provide diversity within the building. If a private office contains two work spaces it is not considered a single office for an employee work area, but meets the definition for employees work area per ABA and will require audio-visual appliances.

Intelligibility requirements for all areas shall meet UFC 4-021-01, Mass Notification Systems.

8.4.8 COMMUNICATIONS SYSTEMS

Ensure inside plant communications is in accordance with UFC 3-580-01, Telecommunications Building Cabling Systems Planning and Design, and outside plant in accordance with Technical Criteria for the Installation Information Infrastructure Architecture (**I3A**). The DOR shall also coordinate with the local installation and incorporate their technical requirements.

8.4.9 SYSTEM'S FURNITURE

The DOR shall coordinate communications and electrical requirements of the system's furniture with the furniture provider. Included in the design shall be junction box locations, homeruns, and communication's requirements. The furniture installation is typically the last item installed after the electrical contractor has completed their work. The intent is to provide a cohesive design to ensure a seamless installation of the furniture.

8.4.10 METERING

Metering of utilities for projects on army installations shall be incorporated into energy monitoring systems in accordance with the Army Central Metering Program. Per Army Directive, Advanced Metering of Utilities, meters must be connected to the Army Meter Management Data System. The DOR shall coordinate with the installation for compatibility requirements.

----END OF SECTION----