CHAPTER A-5

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ELECTRICAL POWER, LIGHTING, GROUNDING, COMMUNICATIONS AND ALARM SYSTEMS

INDEX

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

5.2.1 Air Force Manuals, Regulations, and Instructions

AFI 32-1044	Visual Air Navigation Systems
AFI 32-1054	Corrosion Control
AFI 32-1063	Electrical Power Systems
AFM 32-1076	Design Standards for Visual Navigation Facilities
AFM 32-1123(I)	Airfield and Heliport Planning and Design
AFM 32-1080	Electrical Power Supply and Distribution
AFM 88-9	Electrical Design Lightning and Static Electricity Protection

5.2.2 Architectural and Engineering Instructions.

Design Criteria

Installation Support

5.2.3 Engineer Technical Letter (ETL), Manual (EM), and Regulations (ER).

(AF) ETL 02-12	Communications and Information System Criteria for Air Force Facilities
(AF) ETL 83-3	Interior Wiring Systems
ETL 1110-3-403	Electrical Power Systems for Non-Linear Loads
ETL 1110-3-412	Transformer Application Guidance
ETL 1110-3-474	Cathodic Protection

ETL 1110-9-10(FR) Cathodic Protection System Using Ceramic Anodes

ER 1110-345-700 Design Analyses, Drawings and Specifications

5.2.4 Military Handbook, Manual and Standard.

EM 385-1-1 Safety Manual

COE STD 40-06-04 Lighting Fixture Standard. Standard light fixture details for numerous fixtures are available in the USACE Standard Details 40-06-04 dated October 1997. The details are available on the internet at the following Web site: http://cadlib.wes.army.mil/ (Once at the Web site, select "CADD Details" from the top menu, search "Electrical" from the discipline list, and select "USACE Standard Details 40-06-04 from the types list.) If not available, the details can be obtained from Savannah District by contacting the Project Manager.

MIL-HDBK 1191	Medical and Dental Treatment Facilities, Design and Construction Criteria, Department of Defense
MIL-HDBK 1691	Construction and Material Schedule for Military Medical and Dental Facilities
UFAS 1	Uniform Federal Accessibility Standards
MIL-HDBK 1012/3	Telecommunications Premises Distribution Planning, Design, and Estimating

5.2.5 Medical Design Guide.

Medical Design Guide

5.2.6 Department of the Army Technical Manuals (TM).

TM 5-811-1	Electric Power Supply and Distribution
TM 5-811-3	Electrical Design, Lightning and Static Protection
TM 5-811-5	Army Aviation Lighting
TM 5-811-6	Electric Power Plant Design
TM 5-811-7	Electrical Design, Cathodic Protection
TM 5-823-4	Marking of Army Airfield-Heliport Facilities
TM 5-853-4	Security Engineering - Electronic Security Systems

5.2.7 American National Standard Institute (ANSI).

ANSI/EIA/TIA-568 Commercial Building Telecommunications Cabling Standard

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

ANSI/EIA/TIA-606 Administration Standard for the Telecommunications Infrastructure

5.2.8 Institute of Electrical and Electronic Engineers (IEEE).

IEEE C2 National Electrical Safety Code

IEEE 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems – IEEE Green Book

IEEE 299 Standard for measuring the effectiveness of Electromagnetic Shielding Enclosures

IEEE C57.12.00 Standard General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers

IEEE C57.12.28 Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity

IEEE C57.91 Guide for Loading Mineral-Oil-Immersed Transformers

IEEE C62.41 IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

5.2.9 National Association of Corrosion Engineers (NACE).

NACE RP0169 Control of External Corrosion on Underground or Submerged Metallic Piping Systems

5.2.10 National Fire Protection Association (NFPA).

NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection

NFPA 70 National Electrical Code

NFPA 70E Electrical Safety, Requirements for Employee Workplaces

NFPA 72 National Fire Alarm Code

NFPA 101 Life Safety Code

NFPA 780 Standard for the Installation of Lightning Protection Systems

5.2.11 Department of the Army, Technical Instructions (TI)

TI 800-01 Design Criteria

TI 810-90 Elevator Systems

TI 811-16 Lighting Design

5.2.12 Unified Facilities Criteria (UFC).

UFC 1-200-01 Design: General Building Requirements

UFC 1-300-05A Installation Support

UFC 1-300-07A Technical Requirements: Design Build

UFC 3-260-01 Airfield and Heliport Planning and Design

UFC 3-400-01 Design: Energy Conservation

UFC 3-501-03N Electrical Engineering Preliminary Design Considerations

UFC 3-510-01ANF Design: Foreign Voltages and Frequencies Guide

UFC 3-520-01 Design: Interior Electrical Systems

UFC 3-530-01AN Interior and Exterior Lighting and Controls

UFC 3-535-01 Visual Air Navigation Facilities

UFC 3-550-03N Design: Power Distribution Systems

UFC 3-555-01N Design: 400 Hz Medium Voltage Conversion/Distribution at Voltage Utilization System

UFC 3-570-02N Design: Electrical Engineering Cathodic Protection

UFC 3-600-01 Design: Fire Protection Engineering for Facilities

UFC 4-010-01 Design: DoD Minimum Antiterrorism Standards for Buildings

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

UFC 4-150-01 (MIL-HDBK-1191) Design: Medical Military Facilities

UFC 4-152-01 Design: Piers and Wharves

UFC 4-211-01 Design: Aircraft Maintenance Hangars: Type I and Type II

UFC 4-214-02 Army Tactical Equipment Maintenance Facilities (TEMF)

UFC 4-610-01N Design: Administration Facilities

UFC 4-740-14 Design: Child Development Centers

UFC 4-740-16 Design: Military Recreation Facilities

UFC 4-750-02N Design: Outdoor Sports and Recreation Facilities

5.2.13 National Electrical Manufacturers Association (NEMA)

NEMA C12.1 Electric Meters, Code for Electricity Metering

NEMA C12.4 Registers, Mechanical Demand

NEMA C12.10 Physical Aspects of Watthour Meters

5.2.14 Specifications, Unified Facilities Guide Specifications (UFGS).

The internet address for UFGS specifications is: http://www.hnd.usace.army.mil/techinfo/ Specifications are updated on a regular basis. Instructions on retrieving and editing UFGS specifications are discussed in Chapter A11, Specifications.

5.2.15 Additional Publications

ADAAG Americans with Disabilities Act Accessibility Guidelines

Air Force FIPS-PUB-176 Residential and Light Telecommunications Wiring Standard

I3A: Installation Information Infrastructure Architecture (I3A) Design and Implementation Guide

Installation Design Guides

DA Pamplet 368-64 Ammunition and Explosives Safety Standards

Design-Build Instructions (DBI) for Military Construction

5.3 PRECONCEPT (Code 3 Submittal) SUBMITTAL REQUIREMENTS. No requirements for this section.

5.4 CODE 3 DESIGN REQUIREMENTS.

5.4.1 Submittal. Submittal content and format shall be as described in TI 802-01, "Technical Instructions for Code 3 Design with Parametric Estimating". Any Base or project specific requirements are to be furnished by specific instructions to contract or delivery order.

5.5 CONCEPT/EARLY (35 PERCENT) PRELIMINARY DESIGN SUBMITTAL REQUIREMENTS.

5.5.1 Concept Design Analysis. The Concept Design Analysis shall include estimated connected load schedule (Exhibit A-5-1), all data and calculations to support design decisions, and estimates at this stage of design. The analysis shall include a concept lighting schedule which is to be in accordance with Exhibit A-5-2 and catalog cuts of all commercial fixtures proposed that are not in the COE Lighting Fixture Standard Drawing No. 40-06-04. Special outlets shall be identified and included in the special power outlet schedule (Exhibit A-5-3).

5.5.2 Interior Electrical System Design Narrative. The interior electrical design shall be a narrative presentation and shall include the following data:

5.5.2.1 Indicate the electrical characteristics (phase, voltage and number of wires) of the electrical system. Provide a justification for the type of system proposed (Economical or Special Condition).

5.5.2.2 Provide a brief description of the lighting system(s) to be used for major areas. Include a concept lighting schedule showing room name and/or number, lighting intensity, type of fixture (by standard drawing number or three manufacturers' catalog cut sheets), voltage, and basis of design such as I.E.S. criteria, definitive, etc.

5.5.2.3 State the type of wiring system, such as, rigid conduit or intermediate conduit, electrical metallic tubing, nonmetallic sheathed cable, etc. proposed and where it is intended to be used.

5.5.2.4 Provide a paragraph describing the proposed addition and alterations of special items of design, such as, specialized equipment, special receptacles, handicapped and seismic requirements, etc. Include a description and location of special power outlets and circuits (volts, phase, and amps). Reference pertinent to NEMA or other recognized standards to identify type receptacles selected.

5.5.2.5 Identify any hazardous area by class, division and group as defined in the National Electric Code and indicate type of equipment proposed for use in the area. State the source of any criteria, such as safety officer or some other recognized official. Include documentation of the source of the criteria.

5.5.2.6 Describe the lightning protection system proposed and if none, state the rational or reason for not proposing a lightning protection system. As a minimum, the designer

shall perform the "Risk Assessment" analysis as described in NFPA 780. (Reference TM 5-811-3 entitled "Electrical Design, Lightning and Static Electricity Protection.")

5.5.2.7 Describe the grounding system to be installed, if required. If a counterpoise, grid, etc. is to be used, state standards to be used in the design.

5.5.2.8 Describe the basic characteristics of the panelboards, protective devices, switchgear, motor control centers or other major equipment to be provided. Short circuit and voltage drop calculations in the final design analysis must support the equipment selected. Federal specifications, NEMA, ANSI or other recognized standards are to be referenced to identify equipment construction and design. Indicate equipment interrupting rating and short circuit withstand current. Evidence shall be included to support that the equipment is manufactured or can be manufactured and supplied by at least three reliable manufacturers and that the space is adequate for the manufacturer's equipment having the greatest dimensions.

5.5.2.9 List Corps of Engineers' Guide Specifications that will be used. If the specification sections for which there are no OCE guides are already developed, such as sections which are to be tailored from other projects, untailored copies shall be included or attached.

5.5.2.10 Provide a firm statement that no brand names or proprietary items will be used in final plans and specifications. Any exception to this must have prior approval of the Chief of the Electrical Section, Corps of Engineers, Savannah (See ER-1110-345-720).

5.5.2.11 Describe any electrical metering equipment to be provided. If the facility has an EMCS system, coordinate metering requirements with Chapter A-7, Energy Analysis, Economic Analysis, Control Systems, and EMCS.

5.5.2.12 Provide a statement that coordination with other disciplines has occurred to ensure that no duct or liquid piping shall pass over panelboards or switchboards in accordance with N.E.C.

5.5.2.13 Identify any additional information or material required to complete the design or provide a statement that none is needed.

5.5.2.14 Provide a statement reflecting coordination with the local communication-electronics officer.

5.5.2.15 Provide samples of panelboard and fixture schedule to be used in the Final Design.

5.5.2.16 If the expansion or alteration of any existing system(s) is contemplated, then verify that the system(s) can accommodate the changes.

5.5.2.17 Describe any communication, alarm detection, or electronics requirements anticipated in the design.

5.5.2.18 Describe type of fire detection and alarm systems.

5.5.2.19 Describe the intrusion detection system. (Unless specifically funded on the project's 1391, only conduit and boxes will be provided for intrusion detection systems. Equipment to be connected to the conduit and box layout will be provided by the using service. Design information on conduit and box locations and sizes will be furnished by the using service.)

5.5.2.20 Describe the telephone system requirements. Provide a narrative description of the type system describing 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 Director of Information Management (DOIM) or the Base Communication Office (BCE). Refer to paragraph TECHNICAL REQUIREMENTS, Telephone/Communication System for additional information.

5.5.3 Exterior Electrical Distribution System Design Narrative. The exterior electrical design shall be a narrative presentation and shall include the following data:

5.5.3.1 Contact the DPW or DPWE (Army) or Base Civil Engineer (Air Force) with reference to documentation relative to the adequacy of the primary supply at the point of takeoff. If primary source is inadequate, state measures proposed to correct the deficiency in the design. Reference photographs of any existing substation components, pole line structures, etc. and include the photographs in the field trip report.

5.5.3.2 Provide electrical characteristics of power supply from the service point to the main service equipment (voltage, phase, number, and size of conductors).

5.5.3.3 Narrate conclusions in the design analysis as related to the total connected load and resulting kVA demand load. Indicate type, number, kVA capacity of transformer installation proposed. State the primary and secondary connections of transformers (i.e., 12,470 to 480Y/277 volts, Delta-wye) in accordance with ANSI C57.12.00.

5.5.3.4 State basis for the selection of the secondary distribution voltage, i.e., 480Y/277 vs. 208Y/120 using life-cycle analysis.

5.5.3.5 State type of conductor, such as copper or aluminum, where proposed to use, and a justification for the choice made.

5.5.3.6 Provide a statement describing the standards of design (i.e., primary and secondary voltage drop) and the physical characteristics of the overhead or underground circuits. If underground, state the basis for the selection. State actual primary voltage drop for the size of primary distribution conductors proposed to serve the load. Reference applicable conclusions and/or calculations in the design analysis. State short circuit current available at the project site if it can be obtained from the user. If not, state so.

5.5.3.7 Provide a statement describing street lighting, security, parking lot lighting, or sidewalk lighting requirements. Types of fixtures, pole heights, and proposed intensities are to be included. A life-cycle evaluation is required to justify the type of illumination selected. The design analysis must support decision(s).

5.5.3.8 Provide a list of guide specifications that will be used. Listing shall be included with interior guide specification list.

5.5.3.9 Provide a statement that no brand names or proprietary items will be used in the final plans and specifications without approval from COE, Chief of the Electrical Section. ER 1110-345-720, CONSTRUCTION SPECIFICATIONS, shall be consulted for directions, respecting the use of trade names and proprietary items. The designer shall submit a list of the proprietary items proposed for inclusion in the final plans and/or specifications and shall prepare the appropriate wavier request documentation.

5.5.3.10 Where a cathodic protection system is required, provide the name of the licensed corrosion engineer or NACE specialist along with the following information on the cathodic protection system:

5.5.3.10.1 A statement clearly defining the area(s) of the structure or component within the soil or the water to be protected.

5.5.3.10.2 A description of the type of systems considered, a comparison of the systems relative to cost, maintenance, etc.

5.5.3.10.3 Calculations on all of the systems that are considered showing all their relevant information and descriptions.

5.5.3.10.4 A summary of the data required is in paragraph 5.9.13.4, Description of Analysis Work.

5.5.3.11 Provide a statement describing the extent of any exterior work such as telephone lines, television (TV) distribution cables, etc., whether they are aerial or underground and if underground whether direct burial or duct bank, and all instructions received from the Director of Information Management (DOIM) or the Base Communication Engineer (BCE).

5.5.4 Field Trip Report. The electrical engineer responsible for the design is required as part of his contract to visit the site and furnish a trip report with his concept submittal. During the site visit the responsible electrical engineer shall coordinate with the appropriate Director of Public Works (and Environment), DPW, DPWE, PWBC, or Base Civil Engineering personnel concerning the following: (a) availability of adequate power; (b) power connection points; (c) power system characteristics; (d) communications support items such as duct banks and manholes; (e) fire alarm reporting system requirements; (f) intrusion detection and security systems where required; and (g) any other items necessary for the design of supporting services to the facility. The report shall include names and titles of persons contacted and a brief description of all guidance information or

instructions received. Also, photographs showing all field conditions influencing the design, especially system connections, shall be provided.

5.5.5 Energy Conservation Design Narrative. Energy conservation measures shall be indicated. The electrical designer shall be a team member of energy budget preparation and shall provide necessary information to the architect and mechanical designers for inclusion in the energy budget. (Reference Chapter A-7, Energy Analysis, Economic Analysis, Control Systems, and EMCS). The narrative shall describe measures and techniques that are proposed in the electrical design that will conserve energy. Support all recommendations as required in Chapter A-7.

5.5.6 Concept/Early Preliminary (35 Percent) Design Drawings. All CADD drawings shall be prepared in accordance with Chapter A-10.

5.5.6.1 Interior Electrical. Provide interior electrical drawings showing only special purpose power outlets, a communication system one line diagram, and a plan identifying the location and size of any communication wiring closet(s) and main or intermediate distribution frames.

5.5.6.2 Exterior Electrical.

5.5.6.2.1 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, telephone and other communication lines. The plan shall also show all roads and driveways, parking areas, and any 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.

5.5.6.2.2 Provide electrical characteristics (voltage, phase, number, and size of conductors) for the primary and secondary lines at the point of delivery and/or any extensions. Indicate characteristics and standards of design for overhead or underground line.

5.5.6.2.3 Indicate the number, location, kVA capacity, type, primary and secondary voltages of the transformer (i.e., three-phase, pad-mounted, 150kVA, delta-wye, 12,470-480Y/277 volts) installation proposed.

5.5.6.2.4 Indicate intensity and type of exterior lighting proposed (street lighting, security lighting, or parking lot lighting).

5.5.6.2.5 Show guy leads and guy strengths on the plans.

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

5.5.7 Removal or Demolition. All items requiring removal and/or demolition shall be discussed in the narrative shown on the drawings.

5.5.8 Additional Criteria. Any additional criteria, deviations concerning criteria, questions or problems shall be listed in the design narrative.

5.6 **PRELIMINARY (60 PERCENT) SUBMITTAL REQUIREMENTS**. No requirements for this section.

5.6 **PRELIMINARY (60 PERCENT) DESIGN SUBMITTAL REQUIREMENT**.

5.7.1 Preliminary Design Analysis. This stage of the design analysis shall be an entirely updated analysis (not amendments to concept submittal) to permit verification that the design complies with the criteria furnished and the approved Concept Design. When only Concept/Early Preliminary and Final Design submittals are required, the Final Design Analysis will contain all information developed in the Concept/Early Preliminary narrative, organized as outlined in Concept/Early Preliminary (35%) Design Submittal Requirements of this chapter under paragraph 5.5.1 entitled Concept Design Analysis, as well as that identified in this Section and paragraph 5.7, the Final (100%) Design Submittal Requirements.

5.7.1.1 Interior Electrical Work. Determine estimated loads, provide sizes for significant feeders, the main switch, service entrance and transformers and include photometric calculations. (Individual circuit load tabulations and interior voltage drop calculations are not required for the preliminary design analysis.)

5.7.1.2 Exterior Electrical Work. Determine estimated primary and secondary wire sizes and transformer sizes.

5.7.2 Preliminary Design Drawings. All CADD drawings shall be prepared in accordance with Chapter A-10. The Preliminary drawings shall show all information given on the Concept/Early Preliminary drawings but in greater detail. In addition, the Preliminary drawings shall contain the following:

5.7.2.1 Interior Electrical.

5.7.2.1.1 A complete symbol legend for all devices or equipment shall be shown on the plans except that legend for aerial and/or underground exterior electrical work may be separate and shown on the exterior plans.

5.7.2.1.2 The interior electrical drawings shall include the designations of all rooms and work areas by name as shown on architectural or other drawings.

5.7.2.1.3 Define the limits of all hazardous areas and indicate the Class, Division, and Group which applies per the NEC.

5.7.2.1.4 Drawings shall be thoroughly checked by the designer before submittal for discrepancies and conflicts, particularly between disciplines and various systems above dropped ceilings.

5.7.2.1.5 All removals, if any, must be shown. If removals are extensive, separate demolition plans are required.

5.7.2.1.6 Show the location and type of lighting fixtures to be installed in each area.

5.7.2.1.7 Completed fixture schedule shall be included on the drawings. See Exhibit A-5-4.

5.7.2.1.8 Show the attachment point of service drop.

5.7.2.1.9 Panelboards, motor control centers, switchgear equipment and all utilization equipment shall be located with schedules and physical layout arrangement completed.

5.7.2.1.10 Location, electrical characteristics, and horsepower (if applicable) of electrical driven equipment shall be indicated on the drawings.

5.7.2.1.11 Power riser diagram for the typical building shall be essentially complete except for finalization of conduit and wire sizes.

5.7.2.1.12 Interior wiring need not be shown on preliminary electrical plans; however, provide notes indicating the type of wiring system (conduit, EMT, nonmetallic sheathed cable) proposed and whether wiring system is exposed or concealed.

5.7.2.1.13 Special features such as underfloor raceways, clock system, fire alarm system, exit lighting, bus duct, communication facilities, etc. shall be included on the drawings.

5.7.2.1.14 Provide an interior telephone system layout including backboards, cabinets, outlets, etc. as required by criteria.

5.7.2.1.15 Provide details of telephone outlets, telephone backboard arrangement, etc.

5.7.2.1.16 Show location of all devices and equipment for signal systems on the floor plans. Show location of devices to be interconnected, (i.e., show duct-mounted smoke detectors, hood fire suppression system contacts for fire alarm system input, etc.).

5.7.2.1.17 Provide complete riser diagrams for fire detection and alarm system, intrusion detection conduit system, public address system, telephone/communication system, etc. Risers should show the location of the various components and any interconnections with other systems such as HVAC controls and fire suppression system connections to fire alarm panels, etc. Conduit, wire size, and wire counts should not be shown on the riser diagrams for fire alarm system since these vary by manufacturer. The only exception is the AC power to the control panel and the conduit to the telephone backboard for remote reporting circuits.

5.7.2.1.18 Verify implementation of the concept annotated comments.

5.7.2.2 Exterior Electrical.

5.7.2.2.1 Exterior electrical layout plans are required and shall be separate from water, sewage, and other utility plans. Other new or existing utilities shall be shown only as required to prevent conflicts with the electrical work.

5.7.2.2.2 All exterior electrical shall be completed in plan with poles and other pertinent components detailed. Details shall include the transformer's location, type of construction, kVA, voltage and phase characteristics and conductor type, size and number. If manholes are required for underground, utilize typical manhole from TM 8-511-1. Manholes shall be detailed on the final drawings submittal. Neither handholes nor pullboxes shall be used with high or medium voltage primaries.

5.7.2.2.3 Show accurate location and sizes of existing lines including poles and transformers from which power is to be obtained.

5.7.2.2.4 Indicate type of new construction (i.e., aerial or underground) and type of primary or secondary (i.e., copper or ACSR) conductors.

5.7.2.2.5 Indicate poles and equipment to be relocated or removed. Clearances from buildings shall be in accordance with the National Electric Safety Code.

5.7.2.2.6. Indicate new location of any relocated electrical items.

5.7.2.2.7 On large projects where underground systems are used the designer shall furnish prints of the site showing the communication service connection points for each building, manholes and final connection to the existing system.

5.7.2.2.8 Where cathodic protection has been recommended and approved at the Concept Design stage, the extent and layout of the system shall be indicated.

5.7.3 Outline Specifications.

5.7.3.1 Prepare outline specifications based on applicable guide specifications. The outline specifications previously submitted for Concept/Early Preliminary phase shall be revised, updated, further developed and resubmitted in accordance with CHAPTER A-11, SPECIFICATIONS.

5.7.3.2 Indicate types of cables and conductors to be used.

5.7.3.3 Describe major items of equipment with sufficient clarity to permit a definite selection from catalog data for estimating purposes.

5.7.3.4 Where no guide specification sections or standard specification sections are provided, prepare a new outline specification from available criteria and instructions giving all pertinent material characteristics.

5.7.4 Additional Criteria. Any additional criteria, deviations concerning criteria, questions or problems shall be listed in the design narrative.

5.8 **FINAL (100 PERCENT) DESIGN SUBMITTAL REQUIREMENTS**.

5.8.1 Final Design Analysis.

5.8.1.1 The Final Design Analysis will be an entirely updated design analysis (not amendments to previously submitted design analysis) to support this submittal and shall contain all the information called for in paragraphs 5.5 and 5.8 of this chapter, even when preliminary submittal is not required. The Final Design Analysis will address previous submittal annotated comments.

5.8.1.2 General Description. A description of the general parameters, functional and technical requirements, and objectives and provisions of the design shall be described. A summary of economic factors influencing the choice of lighting, power, fire alarm and detection, and communications systems used in the project will be provided.

5.8.1.3 Design calculations and supporting documentation shall be provided to substantiate design considerations. Calculations will 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 and subsequent computation sheets shall bear the names or initials of these individuals. Supporting documentation will be clear and legible with a tabulation showing all design loads and conditions. The source of loading conditions, formulas, and references will be identified. Assumptions and conclusions will be explained and cross-referencing will be clear. When a computer program is used which is not a Corps-approved program (the DAPPER program for power system design and the Lighting Technologies Lumen Micro, Cooper Luxicon and USI LightPro program series for lighting system design are Savannah District approved programs but their listing is not intended to restrict designers from using other design software), the program will be named and described and will include a flow chart showing how the program reaches solution. This description must be sufficient to verify the validity of methods, assumptions, theories, and formulas, but should not include source code documentation which would compromise proprietary programs. Calculations and data for the following shall be included in the analysis:

a. Lighting calculations used to determine maintained footcandle (fc) levels in all areas shall be performed. Method of computation for interior areas shall normally be the point by point method as described in the I.E.S. handbook, current edition. Other methods for specific applications shall be used when necessary for the particular design. Exterior area lighting, flood lighting, and security lighting computations shall follow accepted methods described in the I.E.S. handbook current edition. All parameters necessary to properly specify and apply the floodlights shall be determined in the design analysis. When the

lighting design is not based on luminaries contained in the 40-06-04 standards, then catalog cuts of all lighting fixtures and luminaries upon which the design is based shall be included in the design analysis along with manufacturer's name and catalog number of two additional fixtures which will meet the design requirements. Where required by specific instructions, a life cycle cost analysis shall be done to support the choice of illumination sources, otherwise the designer shall provide supporting economic data for the choice of fixtures and luminaries. Supporting data may include references to standard literature, manuals, or short cut methods which consider first cost, energy cost, maintenance and replacement cost.

b. Short-circuit calculations shall be made to determine the rating of all protective equipment and bus bracing. In all cases, available symmetrical short-circuit current at the service equipment shall be indicated. (If more accurate data is not available, assume infinite bus on the primary and also consider motor contribution to fault current.) Short-circuit calculations shall be carried out to the point where all protective elements are demonstrated to be properly rated to withstand potential faults and/or safely interrupt faults as required. Protective system selectivity and coordination shall be demonstrated by use of time-current characteristic curve plots in designs of complex systems. Ground fault protection coordination shall be determined and time-current settings shall be calculated in all cases where ground fault interruption is required.

c. Voltage drop calculations shall be done for the service, all feeders and on worst-case branch circuits. The combined voltage drop from the service transformer to the utilization equipment shall not exceed 5 percent. Tables, curves, and short-cut methods obtained from accepted sources such as Industrial Power Systems Data Book by General Electric or Architects and Engineers Data Book by Westinghouse may be used. The source of the data must be referenced.

d. Existing loading data shall be furnished where connections are made to existing transformers or load centers including method of determining the availability of sufficient capacity to carry the additional loads.

e. Calculations of all connected loads, demand factors, and demand loads by circuit number for each panel and switchboard shall be provided. This includes spare circuits. The following shall be considered in the development of panelboards and switchboards.

(1) A summary of panel and switchboard demand loads, feeder sizes, diversity between panels, main switch fuse or circuit breaker trip size, service entrance size or service drop size, and transformer size.

(2) Each motor feeder and motor protective devices shall be computed in accordance with the requirements of the National Electrical Code (NEC).

(3) In computing sizes of feeders and transformers, demands shall be applied to the connected loads and appropriate diversities between the demands shall be applied to determine a realistic diversified demand. Where the nature of loading cycles are known, oil

filled transformer ratings shall be based on ANSI Standard C57.91 rating factors to allow for the most economical design.

(4) Ambient-temperature or conductor grouping factors considered in the selection of equipment and/or conductor sizes shall be indicated. Weight and dimensions of each major items of equipment (supported by manufacturer's names and catalog/model numbers) shall be provided.

f. Calculations for cathodic protection shall include surface area of protected surface, current density requirements, number, size and type of anodes to be used, size of all conductors, size of rectifier and branch circuit calculations for the circuit serving the rectifier. Any pertinent catalog information or technical requirements references shall be included.

g. On projects involving electrical power line construction using No. 4/0 copper or 336 MCM ACSR or larger, the designer shall show in the design analysis calculations for guy strengths, sag, and stringing tensions based on maximum loading tension per conductor of 13 kilonewtons. The guy strengths, sag, and stringing tensions shall be tabulated on the drawings. Where double circuit lines are required, guy attachment points at poles shall be shown on construction details. Calculations for guys shall be made for all aerial construction and the required strength indicated on the drawings.

h. In TV distribution designs the designer shall provide calculations showing db losses through the proposed system to each outlet. A riser diagram shall be provided showing each amplifier, line splitter, tap off, outlet and cable. The type of cable used shall be identified. The calculation shall be made assuming 0-db signal on the load side of the antenna.

i. In alarm system designs the designer shall conduct sound loss (db loss) analysis to assure adequate signal transmission to occupants within the facility.

j. Trade names are not allowed on the contract plans and specifications; however, for lighting fixtures and other equipment such as motor control centers, switch gear, bus duct, transformers, special receptacles, etc., (where special features are required) the current manufacturer and catalog number of the equipment shall be indicated in the Design Analysis.

5.8.2 Final Design Drawings. All CADD drawings shall be prepared in accordance with Chapter A-10. Final plans will be the refinement and completion of Concept/Early Preliminary and Preliminary drawings. All comments from this office relating to Concept/Early Preliminary and Preliminary design shall be incorporated in the Final drawings.

5.8.2.1 All details for the final package shall be on the drawings. Congested areas where there can be interference with various electrical systems, cable trays, piping, ducts, etc., shall be thoroughly detailed by expanded scale drawings. Savannah District has prepared details and placed them in "cell libraries" that can be made available upon request. These

details were prepared in the Intergraph MicroStation PC format and can only be furnished in that format. These library(s) are not all encompassing of all design situations and do not relieve the designer of his responsibility for the design.

5.8.2.2 Thoroughly check the drawings for discrepancies, for compatibility between drawings and specifications, and for compatibility between disciplines. Check the following, as a minimum, but do not limit checking to these items.

a. Verify that the legend and/or symbols are complete and consistent with the drawings. (Electrical symbols shown on civil site plans shall be consistent with the legend shown on electrical drawings.)

b. Verify that the electrical site plans show all of the duct banks, manholes, cable size, splicing points and any other information required to bring the telephone/communication service to the buildings.

c. Verify that the exterior electrical drawings show clearances among the different systems, clearances between circuits of same voltage and circuits of different voltages, and clearances from transformers to other equipment or building components.

d. Verify that the designation of all rooms and areas are as shown on architectural and other drawings.

e. Verify that all hazardous areas are clearly identified.

f. Verify consistency between electrical and other disciplines (equipment locations, reflected ceiling plans, motor voltage and horsepowers, etc.) and ascertain that no conflicts exist on the electrical drawings.

g. Verify that motor control center, switchboard, switchgear and panelboard schedules and risers agree with home runs and other information on the plans. Panelboard schedules shall be in the format of Exhibit A-5-5 or similar panelboard formats providing the odd/even numbering arrangement and consistent with industry standards and practices.

h. Verify that proper and practical circuitry practices are used regarding the determination of the number of conductors and conduit sizes.

i. Verify that complete riser diagrams for telephone, public address, intercom and other communications systems are provided and agree with the plans.

j. Where additions to existing systems are made (i.e., fire alarm, public address, and remote control systems, etc.), the designer shall have verified that the existing system are expandable and can accommodate the additions. This verification shall include an on site survey of the system and contacts with the manufacturer to ensure that expansion modules, etc., are available. Information on manufacturer, model number, etc. of the existing equipment shall be included in the plans and specifications.

k. Verify adequacy of details.

l. Verify that the fixture types indicated on the drawings agree with the fixture schedule (Exhibit A-5-4).

m. Assure design complies with design analysis and criteria.

5.8.3 Specifications. Typed project specifications shall be submitted in accordance with CHAPTER A-11, SPECIFICATIONS.

5.8.3.1 Read thoroughly and comply with the instructions in each set of guide specifications.

5.8.3.2 Cross out inapplicable index items, publications, paragraphs, phrases, words, and sentences. Fill in blanks as applicable.

5.8.3.3 Add publication references, paragraphs, phrases, words, and sentences for items not adequately covered by specifications.

5.8.3.4 Do not specify proprietary items unless prior approval per paragraph 5.5.3.9 is obtained. When proprietary products are incorporated into the specifications or plans, the designer shall identify the product(s), the specification paragraph or plan in which the proprietary item(s) is addressed, and the document granting authority to use said proprietary product. The designer shall provide this information by typed notes attached to the cover page of the specification in question (and if on the plans, by typed notes attached to the cover page of the specification most closely identified with that product). A copy of the granting authority documentation shall follow the cover page.

5.8.3.5 Ascertain that major or special types of equipment are available commercially.

5.8.3.6 For design whose demand load is 500 kVA and above or is for a processing system that would be undesirable for the system to cease functioning, the specifications shall require the Contractor to provide a system short circuit study and coordination curves for the equipment to be furnished. The study and curves shall be approved prior to approval of shop drawings for the equipment.

5.8.3.7 If the design is predominately exterior overhead or underground with a small amount of information required that is contained in the interior electrical specification, the design specifications may include excerpts from the interior specifications in either the overhead or underground specification and the title changed to "Electrical." This procedure must have prior approval from the Chief of the Electrical Section, Corps of Engineers, Savannah District Office.

5.8.3.8 All light fixture details shall be included on the drawings and shall not be incorporated into the specifications. The designer shall edit each detail as appropriate for specific application. For each luminaire of the Lighting Fixture Schedule, for which there is no corresponding (exact duplicate) drawing from the Drawing No. 40-06-04, provide a

detail with specification on the drawings having criteria similar to that contained on the 40-06-04 drawings. Savannah District has prepared fixture details and placed them in "cell libraries," that can be made available upon request of the project manager. These details were prepared in the Intergraph MicroStation PC format and can only be furnished in that format. This library(s) is not all encompassing of all design situations and does not relieve the designer of his responsibility for the design.

5.9 **CORRECTED FINAL DESIGN SUBMITTAL REQUIREMENTS**. The corrected final submittal is not to be considered a normal design level and will be provided in those cases in which the review comments require revision due to error or omission. The comments generated during the Final Review shall be incorporated into the completed design analysis (not amended sheets), specifications, and drawings before they are submitted as Corrected Final Design. All of the requirements of the Final Design Submittal apply for each subsequent submittal.

5.10 **REQUIREMENTS FOR DESIGN/BUILD RFP PACKAGES.** To be furnished with specific instructions to contract or delivery order.

5.11 **TECHNICAL REQUIREMENTS**.

5.11.1 Metering.

5.11.1.1 Air Force Projects. Reference Air Force Engineering Technical Letter (ETL) 94-2: Utility Meters in New and Renovated Facilities. Metering equipment shall be installed if required by the guidance provided in ETL 94-2, on all main energy supplies for all buildings to be constructed. Where upgraded existing or new buildings are served by their own energy generation plant or system, alternate methods to determine usage may be employed. Watt-hour meters shall meet ANSI C12.1 and C12.10, except that the numbered terminal wiring sequence and case size may be the manufacturer's standard. Watt-hour meters shall be of the drawout switchboard type having a 15-minute, cumulative form, demand register meeting ANSI C12.4 and provided with not less than two and one-half stators. Watt-hour demand meters shall have factory-installed electronic pulse initiators meeting the requirements of ANSI C12.1. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within the watt-hour demand meter enclosure, shall be capable of operating up to speeds of 500 pulses per minute with no false pulses, and shall require no field adjustments. Initiators shall be calibrated for a pulse rate output of one pulse per 1/4 disc revolution of the associated meter and shall be compatible with the indicated equipment. It shall not provide less than one pulse per kWH.

5.11.1.2 Army Projects. Installation of permanent utility meters for both new construction and alteration, rehabilitation and modernization projects shall be as follows:

a. Electrical meters of the kilowatt-hour and 15-minute kilowatt demand type with a kWH pulsing device will be provided on:

(1) Each main post and large area substation or switching station and each circuit leaving such station.

(2) Feeders serving major areas, such as barrack complexes.

(3) Typical large or unique structures on each installation, such as field houses, commissaries, medical facilities, administrative buildings, barracks, dining facilities, and major non-appropriated fund facilities.

b. Electrical meters of the kilowatt demand type will be provided on distribution substations having capacities of 500 kVA or larger which serve more than one structure. Permanent utility meters will be installed with provisions to isolate and remove meters for calibration and maintenance, and will be suitable for operation in conjunction with an energy monitoring and control system.

5.11.2 Salvageable Material. The salvageable material resulting from a demolition design and not reincorporated in the design remains property of the U.S. Government. The debris will be disposed of as directed by the Contracting Officer. A typical removal paragraph is given below.

5.11.2.1 Removals. Where indicated, existing equipment and materials shall be removed and shall remain the property of the Government. Salvageable equipment and materials shall be delivered to the Contracting Officer for storage on the base as directed. Materials and debris considered unsalvageable by the Contracting Officer shall be disposed of as directed.

5.11.3 Special Items. The following items will be included in each submittal where applicable:

a. Corps of Engineers guide specs must be used in preparing contract specifications for diesel-electric generators. Unless application requires otherwise, provide brushless type generators.

b. Army and Air Force facilities requiring design for the handicapped shall be designed in accordance with the Uniform Federal Accessibility Standard (UFAS). These instructions cover such items as switch heights, adequate lighting at ramps, exit lights, etc.

c. Egress lighting must comply with life safety code NFPA 101. In the concept and final design analysis write up, reference paragraph and chapter that the design is based upon.

d. Aerial Systems. Construction details for aerial construction shall be consistent with modern practices. Pole framing details shall generally follow those employed by the power company serving the general locale of the installation. All designs shall be consistent with the requirements of ANSI C2, National Electrical Safety Code.

e. Underground Systems. All underground primary conductors shall be installed in concrete encased ducts unless indicated otherwise in the Specific Instructions or other detailed criteria for the project.

f. Provide both green grounding conductors and driven electrodes for exterior lighting poles.

g. Seismic Protection. All projects will include appropriate provisions for protection of electrical equipment, lighting fixtures, raceways, and underground utilities against seismic events in accordance with TM 5-809-10 (AFM 88-3, Chapter 13), Seismic Design for Buildings. Generally, these requirements can be satisfied by inclusion of guide specifications CEGS 13080 SEISMIC PROTECTION FOR MISCELLAENEOUS EQUIPMENT and/or 16070 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT in the contract specifications.

h. This subparagraph is included to emphasize the requirements of the AEI, Chapter 12, paragraph 2. g., Maintenance and Operation. The requirements of the AEI for a separate space for electrical equipment shall be followed, unless instructed otherwise by the Chief, Electrical Section. Dedicated electrical space shall be provided around and above panelboards, switchboards, transformers, transfer switches, motor control centers and similar major items of electrical equipment. This space shall be defined as follows:

(1) The space in front of the equipment shall be as defined in Table 110-16(a) of the NEC. This area of space shall be extended to the ceiling to define a volume of dedicated space through which no pipes, ducts, or equipment foreign to the electrical equipment shall be permitted to be installed in, enter, or pass through.

(2) The ceiling is defined as the structure above. A false ceiling is not to be considered an adequate structure for the purpose of satisfying this criteria.

(3) This dedicated space shall be designated on the electrical and mechanical drawings as a dedicated space by note or by symbol.

i. Electrical service to Army Reserve Centers (ARC's) shall be underground as required in the "Design Guide" for ARC's. The primary will be extended under ground from the property line to a pad-mounted transformer near the mechanical room, and then an underground secondary will be extended into the building. A letter must be furnished (as part of the Concept design analysis) from the power company giving the costs and all their requirements for the complete installation of the underground service. Where an exact cost cannot be furnished, an estimate will be adequate for the Concept. An exact cost, however, must be obtained before the final submittal for inclusion in the specifications as a separate bid item.

j. Fire-Resistant Ceilings. When the false ceiling is used as the fire-resistant ceiling, then the lighting fixtures shall be installed in accordance with Underwriters Laboratories Fire Resistance Directory. The lighting fixture specified shall be classified for fire resistance and will be so noted in the lighting fixture schedule.

k. All air cooled chillers shall be served by a fused disconnect switch. The fuse size shall be as indicated by the name plate on the equipment installed.

l. Electrically Driven Fire Pumps. The designer will ensure that the requirements of NFPA 20 are met in all designs that include fire pumps. In particular, a letter from the installation servicing maintenance engineer agency confirming reliability of the utility service (Para. 6-2.1, NFPA) and calculations that substantiate the starting voltage drop requirements (Para. 6-3.1.3 and 6-3.1.4, NFPA) must be submitted by the designer.

m. The limits of all hazardous areas shall be clearly defined on the drawings. Class, division, and group per the NEC shall be described for each hazardous area. Where different types of hazardous environments are identified within a project design, the designer shall reference each hazardous area to the specific paragraph/article of the NEC appropriate for the treatment of such hazard by note on the drawings. For example, an Army Tactical Equipment Shop would be required to meet the requirements of article 511-Commercial Garages, Repair and Storage. The designers shall also determine where oil-resistant and gasoline-resistant insulation is required within the hazardous area and indicate the requirement for this type of insulation on the drawings as applicable (see article 501-13 of the NEC).

n. In battery storage rooms provide controls that use a sail switch in the exhaust fan airstream and an enclosed contactor to energize the room receptacles only when exhaust air movement is proven.

5.11.4 Fire Detection and Alarm System. The fire detection and alarm system shall comply with the following design guidance where applicable:

a. For Army bachelor enlisted housing, provide detectors (smoke and heat) in accordance with the Architectural and Engineering Instructions Design Criteria

b. The system shall be the type prescribed by the A-E Instructions manual. More specific fire alarm system design guidance is contained in Architectural and Engineering Instructions Design Criteria for Air Force Projects and TM 5-812-1 for Army Projects.

c. Do not show wire sizes or conduit sizes, or the number of conductors in the circuits. These vary among systems and will be shown on shop drawings. The exception to this is the AC power circuit to the control panel and the conduit to the telephone backboard for remote alarm reporting.

d. Show location of all system components on the electrical plans.

e. Provide a Fire Alarm Riser Diagram on the electrical plans showing all the system components and interfaces to other systems (telephone, sprinkler, foam, hood dry chemical, etc.). Unless otherwise directed, fire alarm circuits shall be of the conduit loop system.

f. Individual building fire alarm systems must report to the base fire alarm system over the air waves on an assigned radio transmission frequency, through telephone pairs (provided by others) or through existing fire alarm circuits if a base system is available.

Provide 19 mm (3/4 inch) conduit from fire alarm control panel to the transmitter, telephone backboard or to the fire alarm circuit, as appropriate.

g. The design engineer shall contact the installation personnel responsible for fire protection to determine if the installation has a central fire alarm receiving station that is dependent upon unique coding schemes. The transmission of a fire alarm condition to the central station may require that proprietary equipment be specified. Consult with the Project Manager prior to final design to insure that the proper procedures to specify this equipment are available.

h. Fire alarm control panel primary power shall be from a lockable circuit breaker located in the electrical panel nearest the service entrance. Batteries shall provide the necessary backup power for system reliability.

i. The 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. The designer must determine the make and model of existing equipment and include sufficient information in the specifications and plans to ensure compatibility of the completed system.

5.11.5 Public Address Systems. Public address systems encompass many applications of amplified voice and music used for entertainment and distribution of voice messages. They run the gamut from a speech reinforcement system in a conference room, to a frequency equalized voice and music system for an auditorium, and on to a complex multizone system used for both background music and selective paging by zone with multimedia selectable inputs and area level control with paging override capability. Most systems involve amplifiers, loudspeakers, and a program input. Inputs include microphones, AM/FM tuners, tape decks, and phonographs. Many configurations can be developed using standard equipment to fit any desired operational requirement. Each system is to be designed to meet the user's requirements with the following features considered:

a. In many cases, space limitations dictate the use of wall-mounted amplifiers. Dual voice coil speakers are the preferred type and should be used for background music systems that require voice paging to override the music levels. The use of miniature relays at zone volume controls to override volume control settings for paging should be avoided where possible. In small systems employing relatively short runs of audio bus cable and low power requirements, a 25-volt distribution system should be used. Where long runs with high power requirements are levied on the distribution network, a 70-volt system should be used. The choice of all system components should be based on design calculations. These calculations should begin with the desired sound pressure level to be achieved in each area and be developed through the system to establish component power capacity and wire sizes.

b. Specifications should include sufficient technical data to establish minimum equipment quality levels. This data should include frequency response, distortion, RMS

power capacity, and minimum number and types of controls. Public address systems shall be designed in accordance with guide specification CEGS 16770 RADIO AND PUBLIC ADDRESS SYSTEMS and the EIA standards for sound systems.

c. All-channel paging consisting of paging microphone, push-to-talk switch paging amplifier, and one or more paging relays shall be provided.

5.11.6 Intercom System. Dedicated intercom systems include various combinations of master and slave units with varying quantities of each type unit employed. These systems are called dedicated because their stations and wiring are used only for local intercom voice communication. A contrast is the intercom on the key telephone system which is an auxiliary function of the key telephone equipment. Intercom systems employ two basic types of station selection techniques. One type has rows of switches with each switch dedicated to a particular station that can be called. The other type employs a matrix selection technique where stations are dialed as in a telephone system. The use of dedicated intercom systems is required in some applications but the general guidance furnished to the designer is to attempt to satisfy the user's intercom needs with the administrative telephone system. Many features now available on electronic telephone systems can meet or exceed the user's intercom requirements. When dedicated intercom systems are used, they shall be done in accordance with guide specification CEGS 16721 INTERCOMMUNICATION SYSTEM.

5.11.7 Telephone/Communication System. Unless otherwise specifically directed, a complete telephone/communication system will be provided in the construction plans and specifications using the following design guidance:

a. USAISC and/or MACOM DCSIM agencies are technically responsible for the design of IS whether the design was performed by the USACE element (AE or in-house) or by the above agencies themselves. ER 1110-3-110 outlines the responsibilities of the various agencies. There is some flexibility regarding who performs the design and whether the complete design will be in an MCA construction contract or in a separate contract. Therefore, the designer will receive instructions, usually in the specific instructions, defining his role in the development of the IS design.

b. Technical criteria for voice/data telephone systems is found in TM 5-811-9. In addition to this guidance, the designer shall consult with the Base Director of Information Management (DOIM) on Army installations or Base Communications Office (BCO) on Air Force installations as to the communication requirements for the particular project.

c. Provide a telephone backboard (TBB), two duplex 120V outlets on separate dedicated 20A circuit breakers and a system ground wire. Locate TBB on electrical drawings and on others if necessary for clarity.

d. The TBB should be located in a separate room from mechanical equipment. Adequate working space shall be provided in front of the board. Coordinate space requirements with the base ITBC, DOIM, or BCO office.

e. Conduit from outlet boxes and TBB may be stubbed out into suspended ceiling areas unless restricted to continuous conduit by the local communications officer or because of space use requirements. Install all conduit, boxes, etc. in accordance with guide specification CEGS 16415, ELECTRICAL WORK, INTERIOR. Include text reference where applicable.

f. Show location of telephone outlets on the electrical plans. Include notation or symbol definition to indicate height above finished floor (A.F.F.). Do not show conduit runs on the electrical floor plans.

g. Show Telephone System Riser Diagram on the electrical plans with sufficient information to define type and quantity of conductors (cable), type of instrument and connector and type and quantity of protector devices throughout the system. Size conduit and outlet boxes according to Exhibit A-5-6. (Note that this exhibit is incomplete and does not provide all the information required in this paragraph.)

h. Normally for Army projects a complete telephone system including the wiring, conduit, backboards, protectors, connections, instruments, etc. will be designed for Contractor installation as in any other electrical system. For Air Force projects, some of the communications wiring (the outside plant components) may not be in the design of the project. Design requirements for data, voice, video and other communications systems are usually complex and require special input from the Base Civil Engineer, Base Communication's Officer (BCO), and the user. Therefore, a prewire checklist has been prepared (See Exhibit A-5-7) to assist the designer in gathering the information necessary for development of the communication system. An equivalent checklist has been developed for Army projects and is presented as Exhibit A-5-8. The designer should become familiar with each item on the checklist and should be prepared to discuss each item at the predesign conference.

i. Underground telephone entrance conduit will be shown on the electrical plans beginning at the point of connection to the existing system (manhole or riser pole) and terminating in the new facility. Coordination with all utilities shall be performed to reduce the amount of rights-of-way clearing without increasing the number or the degree of difficulty in utility systems crossing.

j. When involved with a large complex or building (i.e., hospital, medical center, multibuilding complex, etc.), make a determination as early as possible if a private automatic branch exchange (PABX) is or will be planned. PABX installations require special considerations (e.g., space, additional HVAC, vented exhaust systems for batteries, rated walls, hazardous areas, etc). Often the plans for a PABX may not be stated. State any requirements or anticipated plan for a PABX in the concept design analysis along with all data justifying this need. Where PABX units are used, the wiring (and required conduit) completely changes from that shown in the exhibits.

k. In areas where single instruments are used and it cannot reasonably be expected that conversion to key systems will be necessary in the future, individual circuits should be run to the TBB or to an area terminal block with multipair cables from there to the TBB.

Standard 4X2 single gang boxes may be used to accept commercial outlets at instrument locations (see Exhibit A-5-6). Consideration should also be given to reducing the size of the conduits. It should be noted that the exhibits show conduit plans for key systems which employ 25 pair (and larger) cables to each outlet.

5.11.8 Television.

5.11.8.1 Closed Circuit Security Systems. The video security system, where required, shall be integrated into the purpose of the building and into the overall mission of the area. Placement of cameras must be carefully considered in order to avoid dead zones. Zoom lenses and pan-and-tilt devices shall be considered. The system shall consist of camera and monitor components. Camera components shall include cameras, lenses, fixed and remote control camera accessories, camera housing, and environmental options. Monitoring components shall include monitors and monitor mounts.

5.11.8.2 Master TV Antenna (MATV) Systems. A thorough survey shall be made of the signal strengths of each channel available at the proposed site. The location of amplifiers and boosters shall be indicated to ensure proper signal levels throughout the system. Additional provisions shall be made for radiation-proof installations where leakage might interfere with other circuit transmissions. Channel selection for closed circuit TV operating on a coaxial cable system with a MATV system will be done to ensure there is no interference (adjacent channel, co-channel, etc.) with the MATV channels.

5.11.8.3 Cable Television Systems (CATV). The CATV shall be a prewired system for Air Force projects and a conduit system only for Army projects. A 50 mm (2-inch) empty entrance conduit shall be installed for all projects for future installation of service cable by the using agency. Provide a 19 mm (3/4 inch) plywood backboard with sufficient space for the distribution cable terminations, amplifiers, and splitters. The systems shall include cables from the backboard to each outlet, connectors on outlet plates and sufficient spare cable at backboard for future connection to splitters. All empty conduits shall have pull wires. Specifications will be included in guide specification CEGS 16415, ELECTRICAL WORK, INTERIOR.

5.11.9 Intrusion Detection Systems (IDS). An intrusion detection conduit system, when required, shall be provided using the following design guidance:

a. Only conduit systems, including junction boxes, terminal boxes and related equipment may be considered for construction funding.

b. System layout and requirements will be furnished by the using agency, usually after the concept submittal, for inclusion in the plans and specifications.

c. Unless otherwise noted, sensors, control units, monitors, power supplies, transmitters, receivers, RF filters and tamper switches will all be furnished and installed by the using agency unless specifically funded on the project's 1391.

d. All conduits shall be installed in accordance with CEGS 16415, ELECTRICAL WORK, INTERIOR. Signaling cables may also be installed, but the using agency must supply the wire types and sizes, number of conductors, etc., to the designer along with the other information at the concept submittal.

e. Plans shall show locations of sensor outlets and spaces for the control and monitor panels and be keyed to a legend in the electrical drawings.

f. Proper notations shall be made indicating that the system devices are "not included in this contract."

g. A riser diagram shall be included.

h. If IDS equipment is to be Government-furnished, Contractor-installed, the designer will be required to provide wiring diagrams to show connections of equipment components to each other as detailed in TM 5-6350-264-14/14.

i. A lockable circuit breaker shall be reserved for the IDS system primary power connection in the 120V power panel located nearest the service entrance.

j. If the IDS system requires a data transmission cable to a central monitoring station, a 13 mm (1/2 inch) conduit with pull wire shall be installed from the IDS control panel to the telephone backboard. EMT may be used if both are inside the protected area.

k. All signal conductors outside component enclosures must be enclosed in rigid, heavy wall conduit or intermediate metal conduit (IMC). Power cable from the control unit and the monitor cabinet to their respective junction boxes may be in electrical metallic tubing (EMT).

5.11.10 Hospital Communication Systems. Hospital systems are very special designs, and specific requirements should be provided for each project. Hospital systems include nurse call, central dictation, patient monitoring, radio and public address, CATV or MATV, radio paging, telephone, etc.

5.11.11 Special Grounding Systems.

5.11.11.1 General. Special grounding systems, such as for computer and electronic equipment; for lightning protection of sensitive electronics equipment, such as radios and communication equipment; and for EMI/RFI shielding shall be designed in accordance with project criteria. A common grounding system can be utilized when practical for all grounding needs. When separate ground systems are provided, all grounding systems shall be tied together below grade, unless otherwise directed. The surface area and lateral extent of the ground electrode in the earth, and resistivity of the earth are major factors in determining the effective resistance of the combination, known as the electrode ground resistance. Frequently, a single electrode of even the maximum practical dimensions will not provide acceptable electrode ground resistance. In such cases, additional electrodes must be added, all connected together.

5.11.11.2 Qualifications. A design specialist will be required by the Specific Instructions for certain special grounding systems. When so indicated, field work, analysis, and design must be accomplished by or under the direct supervision of an engineer having at least 3 years' experience in the design of special type grounding systems and shall have successfully completed at least 10 projects of similar nature. Proof demonstrating the above shall be submitted. The expert may be a consultant hired especially for the particular project or may be a regular employee of the design firm, but his credentials must be acceptable in the judgment of the Contracting Officer.

5.11.11.3 Description of Analysis Work.

5.11.11.3.1 The designer will conduct measurements in a number of areas to determine the location, number and length of ground rods to provide the required ground resistance.

5.11.11.3.2 The designer shall clearly define areas that could create corrosion problems and necessitate the need for cathodic protection, due to installation of the grounding system.

5.11.11.4 Design of a Ground System. Reference IEEE Std 142 for additional design guidance on grounding systems.

5.11.11.4.1 The specifications and drawings shall completely reflect all of the design requirements. The specifications shall require field tests (in the construction phase) witnessed by the Government, to determine the effectiveness of the grounding system.

5.11.11.4.2 The design must include drawings, showing existing construction. Verification of the validity of any existing drawings and/or any other data furnished by the Government shall be the responsibility of the engineering services firm.

5.11.11.4.3 The designer shall provide a cost estimate of the grounding system. This will include all construction and testing cost related to installation of the grounding system. The estimate shall be a detailed estimate showing equipment, labor, excavation, etc.

5.11.12 Radio Frequency Shielding.

5.11.12.1 General. RF shielding may be required in project criteria for a variety of reasons including TEMPEST, to protect sensitive electronic equipment of unwanted electrical noise, and to protect certain critical electrical/electronic equipment from the electromagnetic pulse (EMP) from nuclear explosions. The application and the criteria for the specific project will determine the type of shielding required. The design of anechoic chambers may also be required and should follow the same guidelines outlined herein.

5.11.12.2 Qualifications. The design of RF shielding is very specialized. The designer shall therefore employ the services of an expert in the area of RF shielding and/or anechoic design. The expert must have at least 3 years of experience in the design and construction of RF shielded facilities and shall have successfully completed at least 10 projects of a

similar nature. Proof demonstrating the above shall be submitted for approval. The expert may be a consultant hired especially for the particular project or may be a regular employee of the design firm.

5.11.12.3 Design Guidance. If not contained in the Project Data Book, the designer will be provided the frequency and attenuation requirements at the predesign conference. Some technical requirements may be contained in classified documents but usually the pertinent information can be extracted and given the designer without requiring access to the documents. If access is required, the designer will be so informed prior to the beginning of the contract.

5.11.12.3.1 All walls, floors, and ceiling in the shielded areas must be shielded.

5.11.12.3.2 All shielded areas shall be clearly shown on plans, elevations, sections, details, etc., as necessary to convey the location and extent of the shielding.

5.11.12.3.3 The consultant shall select the type of shielding materials to be used taking into consideration the shielding criteria, the ease of construction, the architectural and functional features of the facility, and the cost. For facilities having shielding requirements greater than 50 dB, copper or steel foil shall not be used as shielding material. Under no circumstance shall aluminum foil be used.

5.11.12.3.4 The consultant shall coordinate all disciplines having work in the area of the shielding at the earliest possible time so that accommodations can be made for all penetrations of the shield. In this regard, every pipe, wire, door, air conditioning duct, etc., that passes through the shield must be considered and treated at the penetration point with the dielectric connectors outside the shield and wave-guided penetration specified. Every point of penetration shall be planned and indicated on the drawings with typical details of each type penetration.

5.11.12.3.5 The design should limit as much as practical the number of penetrations. For example, if a sprinkler system is required, penetrate with one large pipe and branch within the shield instead of branching outside the shield and having several small penetrations. Minimize the number and size of doors and windows.

5.11.12.3.6 Unless otherwise directed, the shield should be an electrically continuous bonded metallic enclosure electrically isolated from the building safety ground and all other grounds except at a single specified connection point located as near as possible to the power filters. Grounding wire should be a minimum No. 4/0. The shield should be grounded before power is applied to filters.

5.11.12.3.7 Care must be made not to allow nails, screws, or other type of attachment devices to damage the shielding material, which is very often a thin metallic screen or foil. Therefore, the design shall address the mounting or attaching of all fixtures and materials to the RF shielded surfaces. These include conduit, pipes, J-boxes, outlets, switches, light fixtures, etc.

5.11.12.3.8 All shielded construction is to be specified in one section of the specifications, normally under Division 13, Special Construction. In preparing specifications, special care must be taken to ensure that only items that are commercially available as standard equipment are specified. Also at least two manufacturers shall be able to supply each item to avoid sole source claims. Cross references and coordination shall be made between this section and the following sections as required:

a. Electrical Specification. Reference is to be made that all electrical power and wiring for shielded room is to be brought into the room through power line filters which are supplied under Division 16 of the specifications. Also, reference is to be made that dielectric coupling on the conduit is to be used before attaching to the filters. In addition, under the electrical section, reference is to be made that all rooms are to be grounded from the ground stud on the room to the low resistance ground (5 ohms or less).

b. Mechanical Specification. Reference is to be made that all piping to the room is to be brought through wave guide penetrations. Wave guide penetrations will be provided under Division 15 of the specifications. Also, reference is to be made that dielectric couplings are to be used before attaching pipes to wave guide penetrations.

c. HVAC Specification. Reference is to be made that all duct work to the shield room is to be attached to the collars which are provided under Division 15 of the specifications by use of nonmetallic flexible duct connectors. Filtering of control wiring entering the shielded area should also be noted.

d. Door and Hardware Specification. Reference is to be made that doors, hardware and frames in all shielded rooms will be provided under Division 13 of the specifications.

5.11.12.3.9 In addition to the specification of the shielding hardware, tests showing compliance with MIL-STD-285 shall be required. These tests may consist of (1) a qualification test performed prior to the shielding being covered with any additional finishes; (2) acceptance test performed just prior to occupancy by the owner. Tests shall be witnessed by a representative of the Contracting Officer.

5.11.12.3.10 The Contractor providing the materials and services under Division 13 shall provide proof to the Contracting Officer of acceptable qualifications and experience prior to performing the work.

5.11.13 Cathodic Protection.

5.11.13.1 General. It has become increasingly important that metal in soil be protected from corrosion to prevent waste, hazardous conditions, or contamination of soil. Other factors are considered important, such as forecasted life of structures. Coatings, selection of material and cathodic protection are used on underground structures to prevent corrosion.

5.11.13.2 Corrosion Control and Cathodic Protection. For all steel facilities located in the atmosphere, soil, or water electrolytes, corrosion control shall be provided. In all

instances, cathodic protection or approval to omit it shall be provided for metals in soils or water. For small sections of pipe 0-122 m (0-400 ft) or small tanks 15 000 L (4,000 gallons) or less, an abbreviated specification may be used. Coatings are normally provided as corrosion protection in the atmosphere. Some of the facilities requiring cathodic protection are as follows:

Water tanks on or underground
Underground metal tanks, piping and ancillary items
Underground metal lift stations
Underground metal pipes - all types
Treatment plants (components in contact with soil or liquids)
Inside of tanks with fluids

5.11.13.3 Qualifications. Field work, analysis, and design must be accomplished by or under direct supervision of an engineer licensed in corrosion engineering, a technologist, or a specialist certified by NACE. He must be available to answer questions relating to his work.

5.11.13.4 Description of Analysis Work.

5.11.13.4.1 The Corps of Engineers will conduct soil resistivity measurements in a number of areas to provide the designer data necessary to determine the size and type of cathodic protection for structure protection. The data is provided in the Foundation Report (see Chapter B-1, GEOTECHNICAL). Any additional data or guidance should be requested with the concept submittal. The designer is required to obtain any additional resistivity data he may require to complete his design.

5.11.13.4.2 The designer will conduct current requirement test as required.

5.11.13.4.3 The designer must clearly define areas that will be protected and the area that could be affected by interference and steps to be taken to ensure other structures (pipes, tanks, etc.) are protected from interference.

5.11.13.4.4 Provide sufficient and properly located electrical bonds, electrically insulating devices, and corrosion control test stations to ensure adequate allowance for periodic review and examination of the system.

5.11.13.5 Design of Cathodic Protection.

5.11.13.5.1 A general guide specification shall be used, but it must be tailored to the design application.

5.11.13.5.2 This design shall clearly provide a thorough and comprehensive specification and drawing (including standard drawings available in guide). The expected results shall be proved by field test (during the construction phase) witnessed by the Contracting Officer.

5.11.13.5.3 The design must include applicable drawings, as available, showing existing construction. Verification of the validity of these drawings and/or any other data furnished by the Government shall be the responsibility of the designer's firm.

5.11.13.5.4 The designer shall provide an updated cost estimate of the cathodic protection system. This will include all construction and testing costs related to installation of cathodic protection. The estimate shall be a detailed estimate showing equipment, labor, excavation, etc.

5.11.13.5.5 The design plans and specifications will show the extent of the facilities to be protected, location and type of anodes, location of test points and details for sectionalizing an underground piping system. This design shall be complete enough to purchase equipment and build without design changes to meet criteria of protection.

5.11.13.6 Criteria of Protection. Criteria shall be as specified in guide specifications CEGS 13110 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE); CEGS 13111 CATHODIC PROTECTION SYSTEM (STEEL WATER TANKS); and/or CEGS 13112 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT) as appropriate.

5.11.14 Energy Conservation. Energy conservation shall be considered in the project design. The designer shall carefully consider his selection of light sources and control schemes which are both cost and energy conservative. Electronic ballasts with T-8 fluorescent lamps are recommended for most commercial type applications. Careful consideration shall be given to equipment ratings so that operation is at its most efficient point. The electrical engineer shall closely coordinate with the mechanical engineer to select motors of proper efficiencies and ratings for the equipment to be driven. The choice of lighting levels within criteria shall be carefully made and task lighting shall be considered where possible. Advantage shall be taken of natural illumination where feasible. Use the highest distribution voltage consistent with economics and safety. Contacts with the installation personnel should identify any known rebate programs offered by utility companies respecting energy saving opportunities.

5.11.15 Seismic Protection. All projects will include appropriate provision for protection of electrical equipment against damage from seismic events in accordance with TM 5-809-10 (AFM 88-3, Chapter 13), Seismic Design for Buildings. Normally these requirements can be satisfied by inclusion of guide specifications CEGS13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and/or 16070 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT in the contract specifications. The editing of this specification should be coordinated with the mechanical designer.

5.11.16 Technical Requirements for Nonlinear Loads. Designs for facilities having nonlinear loads shall be in accordance with ETL 1110-3-403, Electrical Power Systems For Non-Linear Loads. Per the requirements of paragraphs 4c and 4g, the use of 75-degree C. (minimum) conductors is required and must be shown as such on the drawings. Branch circuits within the building which serve systems furniture with nonlinear loads shall be 3#12, 1#10 N, 1#12 GND, and 1#12 isolated GND. Otherwise, branch circuits serving nonlinear loads shall have phase conductors with individual neutral conductors. Feeders

serving panelboards with nonlinear loads shall have the neutral conductor ampacity based on at least 1.73 the ampacity of the phase conductors. The simplest way to accomplish this is a double ampacity neutral or parallel neutrals in sizes allowed by the National Electrical Code.

5.11.17 Local Area Networks (LAN).

The design for Local Area Networks shall be included for all Air Force projects as provided for in the RAMP. The basic design will be accomplished by the Air Force and provided to the designer for inclusion in the project. All LAN outlets installed in prewired work stations shall be wired continuous from the outlet to the backboard, multitap, etc., depending on the type of system installed.

5.11.18 Leak Detection For Underground Storage Tanks.

5.11.18.1 Leak detection must be provided for underground storage tanks and piping which will contain petroleum products or other hazardous material. The designer shall provide power to leak detector devices addressed by the mechanical systems designer.

5.11.18.2 Specifications for the leak detection system shall be included in the specification section containing the tank and piping. Refer to guide specification CEGS 13202 FUEL STORAGE SYSTEMS. Locations of the control panels, cables, conduits, alarms, and all other electrical details associated with the leak detections system shall be shown on the electrical drawings.

5.11.19 Year 2000 (Y2K) Compliance.

5.11.19.1 The A-E shall insure that the hardware, firmware, software and information technology systems separately or in combination with each other or other elements specified in the documents developed under this contract shall be year 2000 compliant in accordance with Federal Acquisition Register (FAR) 39.106.

5.11.19.2 The following requirement shall be added to the General Requirements paragraph in Part 1 of any specification that describes equipment subject to the year 2000 compliance requirements. The contractor shall ensure products provided under this contract, to include hardware, software, firmware, and middleware whether acting alone or combined as a system are year 2000 compliant in accordance with Federal Acquisition Register (FAR) 39.

5.11.19.3 See ETL 1110-3-492 for additional information and specification requirements.

5.11.20 Metric Drawings. Exhibit A-5-9 shall be provided on electrical drawings to indicate metric sizes to be used for electrical conduit.

CHAPTER A-5

ELECTRICAL POWER, LIGHTING, GROUNDING,COMMUNICATIONS AND ALARM SYSTEMS EXHIBITS

CONNECTED LOAD				
LOAD		KVA		TOTAL
		1 PHASE	3 PHASE	
LIGHTS				
RECEPTACLES				
POWER	HEATING			
	VENTILATING			
	AIR CONDITIONING			
	OTHER			
TOTAL				

ASSUME HORSEPOWER EQUALS KVA)

CONCEPT LIGHTING SCHEDULE

Room and/or Number	Foot Candles	Fixture		Basis of Design	Notes
		Type	Voltage		

CONCEPT SPECIAL POWER OUTLET SCHEDULE						
ROOM AND/OR NUMBER	PHASE	VOLTAGE	AMPS	FREQUENCY (Hz)	HAZARDOUS CLASSIFICATION	NEMA CONFIGURATION

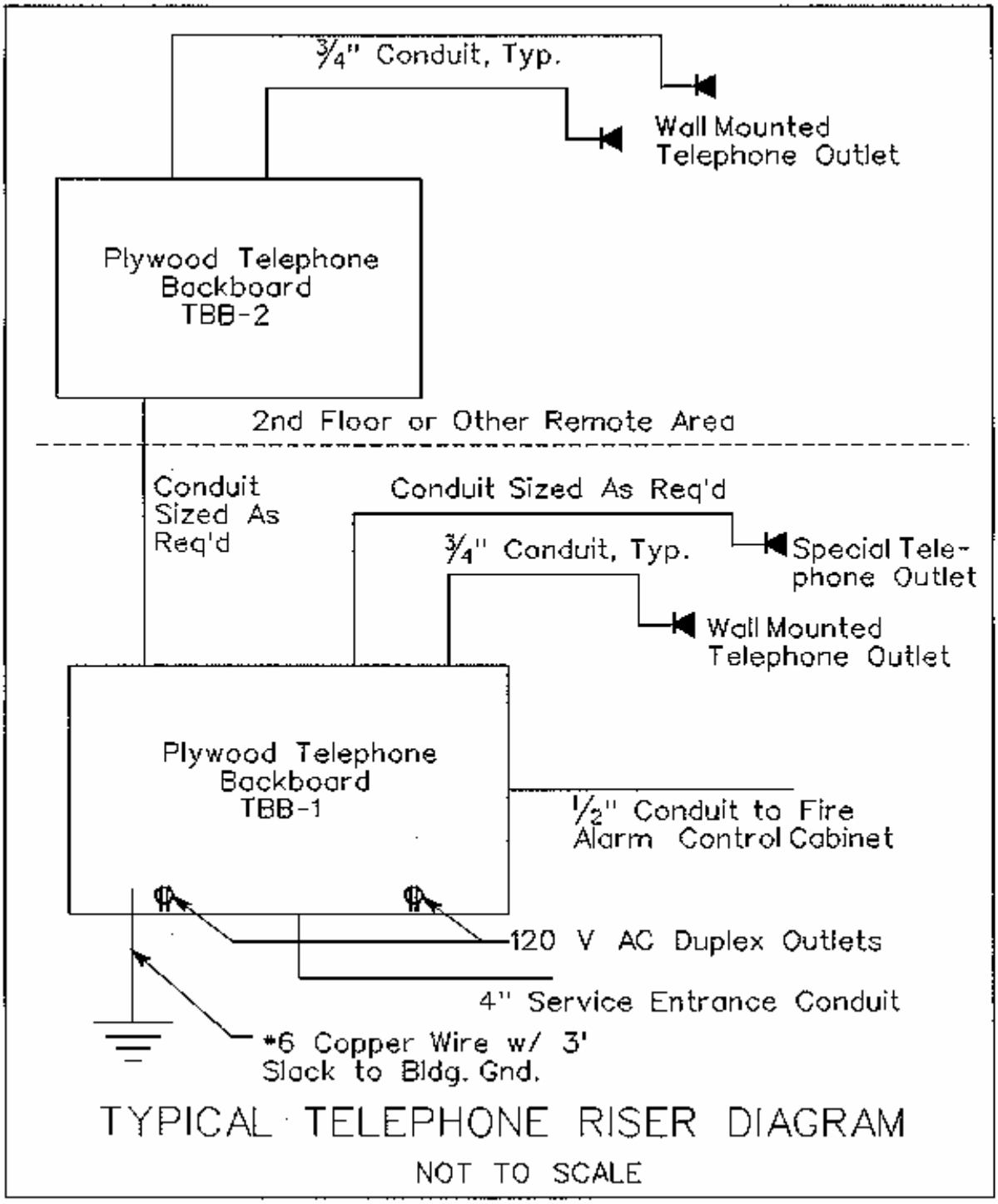
LIGHTING FIXTURE SCHEDULE

Purpose: The purpose of the lighting fixture schedule is to indicate the lighting fixtures required by the designer. All lighting fixtures shall be detailed.

LIGHTING FIXTURE SCHEDULE									
CONTRACT DRAWING FIXTURE MARK	FIXTURE			LAMP			MOUNTING METHOD	SPACING TO MTG. HGT RATIO	REMARKS
	Voltage	Min. Ballast Factor	Watts	Type	No.	Watts			

PANEL _____ TYPE _____ MAIN BUS RATING _____
MAIN BREAKER: NO. OF POLES _____ FRAME _____ TRIP _____ TYPE _____
VOLTAGE _____ MINIMUM BREAKER INTERRUPTING CAPACITY (RMS SYM AMPS) _____

DEVICE		BRANCH CIRCUITS			PHASE LOAD (VOLTS –AMPS)			BRANCH CIRCUITS			DEVICE	
AMPS TRIP	POLES	DESIGNATION	VOLTS-AMPS	NO.	ΦA	ΦB	ΦC	NO.	VOLTS-AMPS	DESIGNATION	POLES	AMPS TRIP
TOTAL								TOTAL CONNECTED LOAD _____ TOTAL DEMAND LOAD _____				


¾" Conduit, Typ.
Wall Mounted Telephone Outlet
Plywood Telephone Backboard TBB-2
2nd Floor or Other Remote Area
Conduit Sized As Req'd
Conduit Sized As Req'd
¾" Conduit, Typ.
Special Telephone Outlet
Wall Mounted Telephone Outlet
Plywood Telephone Backboard TBB-1
½" Conduit to Fire Alarm Control Cabinet
120 V AC Duplex Outlets
4" Service Entrance Conduit
#6 Copper Wire w/ 3' Slack to Bldg. Gnd.
TYPICAL TELEPHONE RISER DIAGRAM
NOT TO SCALE

Design Checklist
for
Telephone Prewiring

1. This checklist covers a proposed approach to deal with this issue and includes some recommended procedures to ensure that the required background information needed to design the "prewiring" portion of the Air Force projects is obtained. The intent is also to ensure that all agencies assigned responsibility for action accomplish that action and do it in a time frame that assists rather than frustrates the design effort.

2. The Base Communications Officer (BCO) is responsible for providing criteria for prewiring a facility. He is to identify all communications (COMM) requirements to the Base Civil Engineer (BCE) for inclusion into the 1391 and the RAMP.

3. The COE Project Manager and the engineer should carefully review the RAMP and during the prenegotiation conference at the base, both should go over that in detail with the BCO and the BCE representatives. At that time, all COMM systems which are candidates for prewiring shall be identified and the data in the RAMP verified and expanded as necessary. Some of the area to be covered and questions to be raised are included below:

A. What type of telephone system will serve this facility?

(1) Will the facility be served directly from an electronic Base Dial Central Office (DCO)? _____Y/N

(2) Will the facility have an Internal Private Automatic Branch Exchange (PABX)? _____Y/N

(3) A 1A2 Key System? (uses 25 pair cables per outlet) _____Y/N

(4) An electronic (Hybrid) key system? (uses two- or three-pair cables per outlet) _____Y/N

(5) BCO must identify the locations of all key telephone equipment and identify the type of telephone (single line or multiline key type) at each outlet location.

(6) BCO must provide the location for each telephone outlet and its type or provide review comments on the AE's proposed location in early design submission.

(7) Verify type of cable to each outlet and advise A-E to show that on the floor plans. Data should include gauge, pair count, and type of wire.

(8) Must determine if an overhead or an underfloor raceway system will be used and the type of raceway system.

(9) Verify size of the communication equipment rooms based on type and size facility. Verify the AC service requirements for the facility using the same reference.

(10) Verify the number and size of cross connect closets based on type and size facility.

(11) Ask the BCO to provide any unique grounding requirements for the telephone system and to furnish the required impedance of the ground system.

(12) Ask the BCO to identify the point of connection (manhole, aerial drop to underground conduit, etc.) for the telephone service tie cables to connect the facility to the base DCO.

(a) How many pairs are required?

(b) Is duct existing or will ductbanks and manholes have to be built?

(c) What are BCO recommended sizes for each of these?

(d) What type of primary surge protectors are required for the service entrance cables?

B. Is there a Broadband Cable System (BCS)? _____Y/N

(1) Identify locations and type (floor, wall, etc.) of outlets for the system.

(2) Verify system bandwidth and identify any of the systems that may share the cable (CATV, CCTV, data nets, etc.) so any unique interface requirements can be met.

(3) Will the BCS be a dual cable system or a single cable using midband split configuration, etc?

(4) Determine contact in the Air Force EI organization who will provide design assistance to the A-E.

(5) Ask the BCO to verify type of raceway system and its location (overhead or underfloor).

C. Are there any COMM Systems? _____Y/N

(1) Ask the BCO and BCE representative to identify any other systems that are to be prewired.

(2) Cover all COMM systems mentioned in paragraph 18-17 and any other the BCO identifies.

(3) Establish all of the criteria for each COMM system as developed for telephone and BCS system in paragraph 3A and 3B above.

D. Conduit.

(1) Is rigid steel conduit required for all COMM systems? _____Y/N

(2) Will conduits be home run back to the COMM closets or will they be stubbed into the ceiling?

4. Discuss design review responsibility and design implementation procedures and ensure points of contact are identified for each agency for coordination and action. Identify the COMM system needs at the prenegotiation conference, assign persons responsible to obtain data and to accomplish actions, set milestones and then ensure they are met. Milestone notices and many followup actions by the COE Project Manager to ensure all tasks are completed will be necessary to get this new system cranked into both agencies' way of doing business.

USER REQUIREMENTS CHECKLIST

1. GENERAL:

The user requirements checklist is to be utilized as a guide to assist the designer in developing user requirements for an MCA project.

2. PROJECT INFORMATION:

LOCATION:_____MCA PROJECT #:_____
FY-____ LI_____ USACE DISTRICT:_____
PROJECT NAME:_____

a. What is the distance from the project to:
The DCO?_____ft. Nearest interface?_____ft.

b. What is the point of the nearest interface:
Building #?_____ Manhole?_____ Pole #?_____ Cable #?_____

c. What distance will the new circuits be required to be run:
Buried?_____ft. Aerial?_____ft. Underground?_____ft.

d. Can the project be supported by the installed switch for the expansion: New switch? Y/N_____ Ports required? #_____

e. Is there likely to be future growth in the area of the project that will require additional circuits? Y/N_____

f. Are there any secured circuits required? Y/N_____

g. Are there any special use circuits required? Y/N_____
Alarm? Y/N____ EMCS? Y/N____ Fire? Y/N____ Other? Y/N____
(If yes, specify)_____

h. How many telephones are required:
2,500? #_____ 500? #_____ Special feature? #_____

i. Are there sufficient numbers of available circuits to support the project at the interface point:
Fiber? Y/N_____ Copper? Y/N_____

j. How many additional circuits will be required to support the project from the DCO:
Fiber? #_____ Copper? #_____

k. How many outlets are required in the project:
Telephone? #_____ Data? #_____ Television? #_____

l. Is there a requirement for television? Y/N_____
Headend equipment? #_____ Amplifiers? #_____
Distribution cable? #_____ Feeder cable? _____ft.

m. Is there a requirement for a Local Area Network? Y/N_____
How many stations? #_____

n. What type of LAN is required: Ethernet? Y/N_____
AT&T ISN? Y/N_____ Starlan? Y/N_____ Other?_____

o. Is there any house wiring required? Y/N____
_____ft. Type_____

p. Is there a visual information requirement? Y/N____

q. Is there a supporting equipment requirement not covered above?
Y/N____ (If yes, specify)_____

r. Are there any unique requirements not considered? Y/N____
_____

NEMA APPROVED METRIC SIZE
DESIGNATIONS
(ELECTRICAL CONDUIT)

USA TRADE SIZE	METRIC SIZE DESIGNATIONS
1/2"	16 mm
3/4"	21 mm
1"	27 mm
1-1/4"	35 mm
1-1/2"	41 mm
2"	53 mm
2-1/2"	63 mm
3"	78 mm
3-1/2"	91 mm
4"	103 mm
5"	129 mm
6"	155 mm