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CHAPTER III (cont.)

SECTION 3 - PRELIMINARY DESIGN

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SECTION 3 - PRELIMINARY DESIGN

3.0. Preliminary Design Submittal. The Preliminary Design submittal shall consist of the following documents:

- Design Analysis
- Drawings
- Outline or Draft Specifications (See below)
- Cost Estimate
- Completed Environmental Permit Matrix (if required by the scope of work)
- Draft Engineering Considerations and Instructions for Field Personnel Report
- Other Items as Required by the Scope of Work

The designer must include the requirements of Sections 1 and 2 in the Preliminary design documents whether or not concept and/or early preliminary submittals were required. This chapter will define, by discipline, requirements of the Design Analysis and the drawings. Guidance for the preparation of the Outline Specifications is described in the A-E Guide, Vol. 3. Requirements of the Cost Estimate are provided in the A-E Guide, Vol. 2. Refer also to Chapter II, "Presentation of Data", of this Guide for design analysis format, drawing format, and quality requirements. See appropriate Appendices of this volume for Environmental Permit Matrix and Engineering Considerations and Instructions for Field Personnel Report requirements.

3.1. Objective. The Preliminary Design data must be presented in sufficient detail to accomplish the following:

a. Verify that the User's (Customer's) functional and special technical needs have been met, including the minimum requirements stated in this section.

b. Verify to all reviewing agencies that 1.) all previous review comments have been appropriately addressed, 2.) the designer's approach to the solution of the technical aspects of the project is sound and 3.), appropriate controlling criteria (such as AFR's, AFM's, ETL's, Guide Specifications, etc.) are being adhered to. Justification

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for non-compliance with criteria must be provided in the Design Analysis.

c. Provide an outline specification (or draft specifications and marked-up guide specifications if called for in scope of work), and drafts of any A-E prepared specifications due to lack of COE guide specification(s) on subject(s).

d. Provide a current estimate of cost, commensurate with the stage of design. Prepare in the form of a Preliminary Estimate (TYPE B). Base the pricing upon the anticipated midpoint date of construction obtained from the COE Project Manager.

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e. This submittal shall verify that proper structural, mechanical and electrical systems are being utilized and that the architectural treatment selected is appropriate. The documents, in general, shall verify that the project has been sufficiently coordinated among design disciplines and thought out to proceed to completion with no major changes in design.

3.2. Design Analysis - General Requirements. Expand upon and/or modify the narrative and calculations developed in the Concept and/or Early Preliminary submittals, as outlined in Sections 1 and/or 2, to satisfy the Preliminary Submittal requirements.

3.2.1. Future expansion. Where projects are to be designed for future expansion, discuss provisions to be taken to insure the projected construction will proceed in a trouble free fashion. If no provisions have been made for future expansion, so state.

3.3. Drawings - General Requirements. Prepare the preliminary drawings to working drawing level to support the information developed in the design analysis, bearing in mind that the design analysis and the preliminary drawings are complementary and that information clearly and completely contained in one need not be repeated in the other.

3.3.1. The project features should not be combined on a minimum number of drawings, but rather, drawings should be partially filled to allow for additional details required for project (final) drawings. If the size and/or complexity of the project requires additional information be presented to supplement the narrative description, show such information.

3.4. Civil Design.

3.4.1. Design Analysis - Narrative. Expand upon the discussion of civil features that was presented in the concept/early preliminary submittals to include the items described below as applicable to the project.

3.4.1.1. Siting. See Early Preliminary (E.P.) submittal requirements.

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3.4.1.2. Water Supply. Include the following:

a. Provide recommended solution to any previously identified water supply problems.

b. Give basic information such as population, capacity factor, per capita allowances, industrial and irrigation requirements, and fire demands.

c. To the extent required for project purposes, provide information on type, condition, and adequacy of existing units such as wells, pumps, reservoirs, etc., and current water use. If these items have already been described in an existing report, give summary statement and appropriate reference. For new sources, include alternatives such as wells and surface supplies. Provide an explanation of factors affecting choice of location, type, diameter, depth, and important related characteristics.

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d. In describing proposed work, include functional design concepts basic to selection of unit type, construction, economy of operation, controls, etc. Provide statement of preliminary sizes and capacities of major components, any critical elevations or dimensions, and essential related items as estimated from preliminary calculations.

e. For new sources, include data on existing supplies and alternatives for new sources such as wells and surface supplies. Provide data for all proposed water wells and test drilling programs with full explanation of factors affecting choice of location, type, diameter, depth, and important related characteristics.

3.4.1.3. Water Distribution. For service lines, distribution main extensions and new distribution systems, state the selected pipe sizes, state the proposed friction coefficient, approximate controlling elevations, special material requirements and any special features of the design such as pressure reducing or regulating valves as determined from preliminary calculations. Also discuss the requirements for pressure release and vacuum relief valves.

3.4.1.4. Water Treatment. Where water treatment is included in the project, the designer shall provide a copy of the water analysis and describe the elements of the design including the capacities and number of units, monitoring equipment and controls. The alternatives considered and the reason for selecting the design over the alternatives shall be discussed demonstrating how the design will correct the objectionable characteristics of the water.

3.4.1.5. Sewerage. Include the following:

a. Sanitary Sewer System: See Early Preliminary submittal requirements.

b. Lift Stations: Develop required size and capacity for any required lift stations.

c. Sewage treatment: Where waste treatment is included in the project, explain the degree of treatment required to meet the applicable discharge standards. A complete description of the nature of the waste shall be

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included. Describe the elements of the design including the capacities and number of units, monitoring equipment and controls. The alternatives considered and the reason for selecting the design over the alternatives shall be discussed demonstrating how the design will achieve the treatment goals. Pilot plant testing programs which are to be conducted shall be described, and in the case of land treatment, a soil testing program shall be developed and described.

3.4.1.6. Drainage: See Early Preliminary submittal requirements.

3.4.1.7. Grading: Describe the grading plan and the controlling slopes which will be used in the design.

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3.4.1.8. Roads, Streets, Parking Areas, Open Storage Areas, Hardstand Areas, and Sidewalks: Provide specific data relating to the design such as type, volume, and composition of traffic; vertical and horizontal controls, and class and category of road or street. Discuss handicap parking requirements.

3.4.1.9. Fencing: See Early Preliminary submittal requirements. In addition, describe the gates, and all fencing features such as outriggers, barbed wire or tape and controllers.

3.4.1.10. Dust and Erosion Control: See Early Preliminary submittal requirements.

3.4.1.11. Railroads: See Early Preliminary submittal requirements.

3.4.1.12. National Pollution Discharge Elimination System (NPDES) Permit: In projects where waste water is not discharged into an existing collection and disposal system, the NPDES permit will be referenced and appended to the Design Analysis (See Appendix C, Environmental Considerations). Excepted from this requirement are small drainage storage facilities where no separate permit is issued.

3.4.1.13. Environmental Impact: Review the Environmental Impact Analysis (Environmental Impact Assessment or Environmental Impact Statement) to determine whether any design feature changes the conclusions or recommendations of the analysis. Should changes to the analysis be required as a result of the design, a complete description of the required changes shall be included in the Design Analysis. If no changes are required to the analysis, the designer shall include this conclusion in the Design Analysis.

3.4.1.14. Airfield Pavements: The District will furnish the pavement section design consisting of a brief description of foundation explorations, materials investigations, field tests, a statement of values used in pavement design, and basis for selection of pavement sections.

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3.4.2. Design Analysis - Calculations.

3.4.2.1. Water distribution and service lines.

Furnish the flow requirements, line sizes, friction factors, head loss, water velocities, and line pressures for each pipe material option . Provide fire flow test data or other measurements upon which the calculations are based. Show calculations demonstrating the ability of the water distribution and service lines to deliver water at the required pressure and quantity.

3.4.2.2. Water and Sewage Treatment: List all

criteria used for the design of each treatment process and operations. Furnish all calculations showing the design of the processes and operations including the hydraulic and organic loading. Provide a hydraulic profile of the treatment plant.

3.4.2.3. Sewage Collection: Use the most

conservative value based on the population or fixture unit method for computing expected flows. Show peak and average expected or measured flows and any factors used in estimated flows. Provide the flows, sizes, slopes and velocities of each line segment.

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Required velocities will be based on average and peak flows, not pipes flowing full (See AFM 88-11, Vol. 1/TM 5-814-1). In addition, for lift stations show required head, volume of wet well, cycle times at peak and average flows, and pump controls.

3.4.2.4. Storm drainage: Show all the calculations used for determining the design flows and pipe sizes (including all pipe material options). List rainfall intensity, return period, concentration times for each drainage area and the infiltration factors used. Provide an analysis of each new culvert and of existing culverts which are used in the design. Verify the adequacy of the storm drainage system for the project area. Show the principal water courses and location, size and invert elevation of existing and proposed new drainage facilities including surface ditches, storm sewers and culverts. Provide drainage area maps for systems that drain into or through the project area.

3.4.2.5. Roads, Streets, Parking, Open Storage, Hardstands and Sidewalks. Show design calculations including selection of design wheel loads, material, and type of construction and class of each type of paving. In cases where the design was performed by the District, it is sufficient to append a copy of the "Foundation Report and Pavement Design" or "Geotechnical Report" (prepared by the District) to cover the items in the report. Include all calculations for curbs, alignment, intersection sight distances, stopping and passing sight distances and superelevation.

3.4.2.6. Utility Trench Design. For projects that involve supply, collection, and/or distribution utility conduits, (rigid or flexible), support with calculations the trench design (bedding, initial backfill, and final backfill) for each one of the pipe options given in the COE Guide Specifications. The trench design is to be based on American Water Works Association Standards, or American Society of Civil Engineers Manuals and Reports on Engineering practice, as applicable. A trench cross section for each one of the pipe options is to be shown on the drawings. A Soil Classification of the native soil, including as a minimum: identification, gradation, group symbol, and Atterberg limits, shall be included in the

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supporting data of the trench design. The deletion of any pipe option, as called for in the COE Guide Specifications, must be supported with complete engineering calculations. The engineering-based justification for the deletion of any pipe option must also be narrated in the Design Analysis. Since controlled compaction is required during construction, hydraulic consolidation of bedding or (initial or final) backfill material is not to be allowed. Pipe thrust block design shall be based upon measured or calculated pressures, the foregoing soils data, and approved design methodology as presented in AFM 88-10, Volume 5, Appendix C/TM 5-813-5, Appendix C. Calculations shall be provided in the Design Analysis.

3.4.3. Drawings.

3.4.3.1. Demolition Plan. Provide thicknesses of slabs to be removed and show sufficient dimensioning to properly locate the materials to be removed. Clearly show the full extent of AC pavement to be removed, show all utility lines needing removal, and the sizes of all trees and other objects requiring removal.

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3.4.3.2. Grading and Paving Plan: Show new grading contours superimposed on existing topography. Indicate via symbols the different types of paving materials used and show new and existing pavements differently, per Standard Detail S-4, sheet 116 of the Standard Details for Utilities, Foundation, Paving and Railroads.

3.5. Landscaping Design:

3.5.1. Design Analysis - Narrative/Calculations. See prior submittal requirements.

3.5.2. Drawings. In addition to that required in prior submittals, provide the following:

- a. Show proposed special design features such as flagpoles, raised planters, benches, trails and special paving treatments.
- b. A plant schedule listing both the botanical and common names of species to be used.
- c. If an irrigation system is required, provide an irrigation plan showing connection to water service, the main and branch lines, valves and, if an automatic system, the controller location(s).

3.6. Architectural Design.

3.6.1. Design Analysis - Narrative/Calculations. Expand discussion of subjects initiated in earlier submittals and include discussion of the following as applicable to the project:

3.6.1.1. Space Planning. Discuss the following as applicable to the project:

- a. Organization of functional spaces to establish workable adjacency relationship.
- b. Building layout to establish convenient circulation flow for materials, equipment, services and people.

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c. Consolidation of spaces into sound compatible zones and protective construction zones, e.g., for fire, storm and fallout.

d. Space layout compatible with modular (structural and environmental) support systems.

e. Interior parking and service areas.

f. Signage; directional, informational and motivational.

3.6.1.2. Physical Security. Discuss required lock and keying, intrusion detection system, audible and visual alarms (coordinate with electrical designer) restricted access areas, interior guard/canine support and any required interface with local authorities.

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3.6.1.3. Tempest/EMP Shielding. Discuss architectural features necessary to insure required shielding attenuation values are not compromised, especially details required for openings and penetrations. Coordinate with electrical designer.

3.6.1.4. Acoustical Design. Discuss any special acoustical wall or ceiling requirements including effects from interior and exterior sound sources as applicable.

3.6.2. Drawings: Continue to develop the drawings initiated in earlier submittals and in addition, provide the following:

3.6.2.1. Roof plan: Indicate mechanical equipment and vents, roof drains, roof slopes, crickets, etc. Cross reference to where flashings and curbs are detailed for roof penetrations, including those for mechanical and electrical features.

3.6.2.2. Reflected ceiling plan: Provide for all buildings except industrial-type buildings containing minimal office space.

3.6.2.2.1. Fire ratings: Show rating of one hour or more for partitions, ceilings, ceiling-roof or ceiling-floor assemblies. This may be shown on the reflected ceiling plan, when provided; in a "REQUIRED FIRE RATING SCHEDULE", listing each room or area to be separated; or in a single line floor plan which indicates only fire partitions and fire walls.

3.7. Structural Design:

3.7.1. Design Analysis - Narrative. Outline and define the structural methods and materials of design and construction and include all criteria and assumptions and calculations on the following items:

3.7.1.1. Foundation Design: Provide a statement referencing the Geotechnical Report which will be attached as an Appendix to the Design Analysis. The Geotechnical Report will normally be provided by the COE. Describe the type of foundation proposed, estimated depth of bearing, allowable bearing values, compaction requirements, and any

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other measures mentioned in the soils report, or recommend two foundation types as being acceptable. In these cases an economic comparison between the two shall be presented and the more cost effective type selected. See AFM 88-5 CH 2/TM-5-809-2 and C.O.E. Standard Details for Utilities, Foundation, Paving and Railroads, sheets F-1 to F-9. Concrete slabs on grade shall not bear directly on or be tied to footings, pedestals, or walls. At least six inches of earth or gravel cushion shall be provided.

3.7.1.2. Economic Analysis of Structural Systems:

Provide an economic comparison of at least three structural systems for each area of the building that has a distinctly different framing scheme. Availability of local labor and materials shall be considered in selecting the systems. A portion of the structure large enough to be representative of the entire building shall be designed in sufficient detail to provide for labor and materials estimate that will be the basis of the structural system selection. Each of the systems should be presented on a sketch indicating the sizes of all the framing members for each area of the building with a

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different framing scheme. Investigate various column spacings. For a one story structure, the comparison shall be done for the roof structure. For a multistory facility, one cost comparison shall be presented for the floor system and one for the roof system. Attach the comparison to the Design Analysis as an Appendix. Provide a description of all the candidate solutions and indicate that the most economical has been selected.

3.7.1.3. Design Loadings (AFM 88-3, Ch. 1/TM 5-809-1): Describe the lateral force resisting system by defining the location and number of shear walls, materials to be used for a diaphragm, seismic joint locations, foundation ties, factor of safety for overturning, and any other components of the lateral force resisting system. Provide a statement of live loading to be used, to include floor loads, wind, snow, earthquake, etc., together with data to justify when different from established criteria. Seismic design shall be in accordance with AFM 88-3 CH 13/TM 5-809-10, State the Seismic Zone, K, I, C, and Z values.

3.7.1.4. Working Stresses: Indicate selected stress where options are provided. Indicate any deviations from prescribed working stresses, together with reasons therefor. Describe type and class of material selected and indicate source of stress selected.

3.7.1.5. Blast Design: For structures designed for blast and dynamic loads, list all appropriate design parameters such as, amount, type, TNT equivalent, and location of explosive material in each area for the donor system. Locate explosives in a position that will impose the largest loads on the structure. For the receiver system, describe the personnel, equipment, and any other explosive materials which require protection in each area. Also, define the protection categories for each area to prevent the following: (a) Communication of detonation by fragments and high blast pressures; and (b) Mass detonation of explosives as a result of subsequent detonations produced by communication of detonation between two adjoining areas. Define blastwall, blastdoor, and frangible element locations to complete the description of the protective construction design approach.

3.7.2. Design Analysis - Calculations. Provide as

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required by the above paragraphs to support selected design features. Calculations shall be organized and summarized in a Table of Contents. Calculations are to be checked and so noted by signature/initials of the checker.

3.7.3. Drawings.

3.7.3.1. Foundation and Floor Plan: Show type of foundation proposed, depths of footings, relation of walls and floor slab to foundation system, overall dimensions, column spacing, joint pattern in slab-on-grade, tie beams, grade beams, etc.

3.7.3.2. Floor Framing Plan. See Early Preliminary submittal requirements.

3.7.3.3. Roof Framing Plan. See Early Preliminary submittal requirements.

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3.8. Mechanical Design.

3.8.1. Design Analysis - Narrative. Expand discussion of subjects initiated in earlier submittals and include discussion of the following as applicable to your project:

a. Control System for HVAC. Design of Control System for HVAC shall be implemented in accordance with AFR 88-15 and ETL 83-1.

b. Petroleum, Oils and Lubricants (POL) storage and distribution systems: Describe the unloading facilities, the type of system, such as LPG vapor or central air mix, state the basis for storage capacity, rate of pumping and number of dispensing outlets, equipment power requirements, and a description of the tank.

c. Fire Protection. Coordinate with the architectural and electrical designers to ensure all aspects of the fire protection requirements are addressed.

d. Carbon-Dioxide, Aqueous Film Forming Foam (AFFF), Dry-Chemical, Halon, and other special extinguishing systems: Include information justifying the arrangement, size, and coverage of each system.

e. Meters. State type, number and location of utility meters required in accordance with the appropriate Air Force ETL.

3.8.2. Design Analysis - Calculations. Develop previous calculations as necessary to justify the systems selected on the basis of economic and environmental impact. Include air conditioning load calculations, preferably the building peak loads. Detailed room calculations are not required. When the scope of work requires a computer simulation of the building, compare a minimum of three (3) heating and air conditioning systems per AFR 88-15. Variation of the "U" factor from the stated criteria shall also be integrated into the study.

3.8.3. Drawings.

3.8.3.1. Continue development of the floor plans, sections, and details begun in prior submittals.

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3.8.3.2. Prepare a 1/4" or 1/2" scale partial floor plan of all congested areas (such as bathroom areas and mechanical rooms) for clarity and to insure that sufficient room is available for the plumbing, heating and air conditioning equipment.

3.8.3.3. Prepare isometric drawings of all waste and vent piping.

3.8.3.4. Prepare preliminary system schematics and equipment details.

3.9. Electrical Design.

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3.9.1. Design Analysis - Narrative.

3.9.1.1. Transformer Design: State and justify type of transformer insulation selected. Provide electrical characteristics for the transformer (phase, primary and secondary voltage, number of wires, primary and secondary connection of "delta-wye"). Show characteristics of any subsequent transformation on the load side of the service entrance and a statement of why the particular voltage was selected. Describe alternative systems or equipment considered and reasons for selecting a given system.

3.9.1.2. Economic Analysis. Provide an economic comparison of three (3) alternatives to justify selection of major pieces of electrical equipment. The study will only consider alternatives which meet the design criteria and perform the functions intended. Provide the first cost for each alternative considered and list advantages/disadvantages of each. Attach the economic comparison as an Appendix to the electrical calculations in the Design Analysis. The following items shall be studied:

- a. Transformer types.
- b. Main switch boards.

3.9.1.3. Lighting Fixture Economic Analysis. Provide a present worth, economic/energy study for the various types of lighting fixtures considered. The study will show the annual costs of power and maintenance for each fixture type over its service life. These costs will then be brought back to the present and combined with the first cost to determine the most economical fixture type. Assume an annual interest rate of 7%. Advantages and disadvantages of each will also be noted.

3.9.1.4. Electrical Load Analysis. Show a tabulated estimate of total connected KW load and demand factors, diversity and resulting total demand KW load. Break down the loads to show lighting load, convenience receptacle load, air conditioning loads, heating loads, pump loads, power roof ventilator loads, power receptacle loads for special equipment, and special loads, (such as air compressors, generators, etc.). State the total estimated power factor, the resulting KVA load and size of

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transformers and subsequent transformers (such as dry-type transformers within building), and emergency generator sets as applicable.

3.9.1.5. Energy Conservation. Discuss energy conservation measures, such as task lighting and selection of the most efficient type of light fixture. Indicate type of emergency lighting system to be provided.

3.9.1.6. Hazardous Area Design. Provide a description of the physical limits and components of each hazardous area and the class, division, and group of equipment and wiring.

3.9.1.7. GFCI Equipment. Discuss provisions for GFCI equipment such as generators, including testing requirements.

3.9.1.8. Telephone/Communications System. Discuss provisions for a telephone system relative to use of existing or new telephone cable. Verify if local telephone company must be involved. Define type of communication

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system, size of communication equipment rooms, cross-connect closets, number of telephone and LAN outlets, number of pairs of conductor per telephone outlet, and number of pins per telephone and LAN outlet.

3.9.1.9. Other Systems. Discuss the following: Lightning protection, motor control centers, standby electric power, special purpose receptacles and outlets, grounding, D.C. or high frequency. Lightning protection system shall be designed IAW AFM 88-9, Chapter 3 and NFPA 78.

3.9.1.10. Airfield Lighting. For airfield lighting projects, state whether cable is to be direct burial or in duct. Discuss provisions for standby power, and comment on type of lighting system (such as high intensity or medium intensity, runway, approach or taxiway lighting), lighting equipment, and any conditions peculiar to the installation.

3.9.1.11. Exterior Lighting. For exterior lighting systems provide a statement of requirements for fence lighting, area lighting, building security lighting, parking/street lighting, etc. Include proposed type of luminaire, wattage of lamps, type of lamp beam spread and describe how mounted on poles, buildings, etc. Provide photometric data for area/floodlights and other special luminaires.

3.9.1.12. Cathodic Protection. For cathodic protection systems, provide a description of the location, type, and extent of the system to be installed. State basis for the design proposed.

3.9.1.13. Generating plants: In addition to discussion of the design approach, provide the following for generating plants: estimated connected load, maximum demand load, number and size of units (including KW and PF ratings), engine governor and voltage regulating requirements, voltage and basis for selection, and justification for use of special equipment such as load sensing governors.

3.9.1.14. TEMPEST/EMP Shielding: Indicate which rooms (if not the entire facility) are to receive TEMPEST/EMP shielding.

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3.9.2. Design Analysis - Calculations.

3.9.2.1. Provide calculations for: short-circuits (all buses and panels), voltage drops for feeders and the worst-case branch circuit, lighting (to within +10% of the design lighting intensity levels), and cathodic protection system(s). Indicate the transformer impedance used to determine A.I.C. ratings of transformers.

3.9.3. Drawings.

3.9.3.1. Floor Plan(s). Provide plans showing the location of inside/outside distribution systems, hazardous areas and TEMPEST/EMP shielded areas.

3.9.3.2. Riser Diagram(s). Provide riser diagrams for Intrusion Detection System (if applicable), telephone prewiring system and fire alarm system to show all components and overlap, if any, with Division 15 Automatic Suppression System.

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"There's never enough time to do it right,
but there's always enough time to do it
over."

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CHAPTER 3
SUBMITTAL REQUIREMENTS

<u>Chapter</u>	<u>Paragraph # and Subject</u>	<u>Page</u>
	3.9.3.3. <u>Means of Egress Sketch</u> . Coordinate with architectural designer in the preparation of the "Location of Exit Signs" (Means of Egress) sketch.	
	3.9.3.4. <u>Elevations</u> . Coordinate with architectural designer in the preparation of facility elevations to insure electrical equipment is properly shown, as applicable.	
	3.9.3.5. <u>Equipment Mounting Details</u> . Provide mounting details for RFI filters, panelboards in computer rooms and powerline filters in TEMPEST/EMP room or area.	
	3.9.3.6. <u>Mounting Heights</u> . Indicate mounting heights of appropriate devices on the symbol list. Symbols and abbreviations shall conform to ANSI/IEEE Standards.	
	3.9.3.7. <u>Lighting Fixtures</u> . Provide detail drawings of lighting fixtures with descriptions if C.O.E. Standard drawing 40-06-04 of lighting fixtures are not utilized.	
	3.9.3.8. <u>Seismic Anchors</u> . Show (or note) seismic anchoring for free-standing electrical equipment including lighting fixtures for facilities located in Seismic Zones 3 & 4.	
	3.9.3.9. <u>Receptacle Grounding System</u> . Insert Figure 16-4, TYPICAL RECEPTACLE GROUNDING SYSTEM IAW AFR 88-15, paragraph 16-8.b.	
	3.9.3.10. <u>Miscellaneous Details</u> . Provide construction details of transformer slab, handhole and manholes.	

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