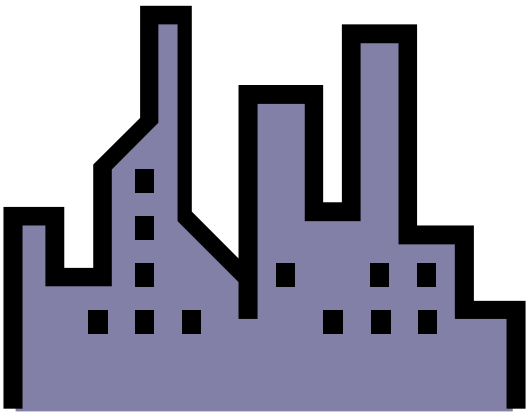
US Army Corps of Engineers
Engineering and Support Center, Huntsville

ENGINEERING GUIDANCE

DESIGN MANUAL



CEHNC 1110-1-1
MARCH 2008

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ENGINEERING GUIDANCE

DESIGN MANUAL

SEVENTH EDITION

MARCH 2008

PREPARED BY

U.S. ARMY ENGINEER AND SUPPORT CENTER, HUNTSVILLE

HUNTSVILLE, ALABAMA

FOREWORD

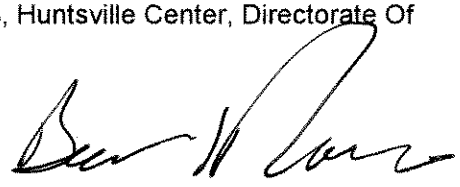
No changes can be made to this document without the agreement of the authorizing signatory and must be approved by the authorizing signatory before implementation.

Date	Issue	Revision	Description	Approved By
Mar 03, 2008	1	N/A	Original Document	/s/

This document provides a consolidated guide for architect-engineers, contractors, and Government personnel when preparing project-related engineering documents, contract drawings and specifications, and various supporting materials. This document will also be used as guidance for all in-house designs prepared by USAESCH. It also provides information on acceptable design standards and processes that the U.S. Army Engineering and Support Center, Huntsville (USAESCH), has determined to be essential for prudent project management. All personnel employed, either directly or indirectly, by the Huntsville Center should familiarize themselves with the guidance contained in this design manual.

The first USAESCH Design Manual was published in July I968. Six editions have been published since 1968. This seventh edition has been updated by the technical branches responsible for USAESCH designs and is considered basic to USAESCH design activities.

Revisions and changes to this manual will be made as necessary and will be noted on the table above. The official copy of this design manual will be available on the HNC website and will be updated as the need arises; any hard copies are unofficial. Specific comments on the contents of this manual are requested from users and should be directed to the U.S. Army Corps of Engineers, Huntsville Center, Directorate Of Engineering, Chief of Design (CEHNC-ED).



BOYCE L. ROSS, P.E.
Director of Engineering
Engineering and Support
Center, Huntsville

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CHAPTER 1

GENERAL INSTRUCTIONS

1-1. PURPOSE AND APPLICABILITY. This design manual identifies and establishes design requirements and provides instructions for the preparation of facility designs, specifications, design analyses, cost estimates, systems engineering plans and associated CADD/BIM/geographic information systems (GIS) standards for projects executed by the U.S. Army Engineering and Support Center, Huntsville, (USAESCH). This manual applies to Architect/Engineers (A-Es), engineering service contractors, other Government agencies and in-house personnel involved with the design of facilities for which USAESCH is responsible. The procedures and instructions in this manual will be referenced in all Architect-Engineer (A-E) and engineering services contracts where applicable. In the event of conflict between this manual and the contract documents, the contract will take precedence. Conflicts will be brought to the immediate attention of the USAESCH Contracting Officer (KO) and Project Manager (PM). In the event of conflict between this document and good design practice the contractor will notify the KO and PM for resolution. Use of this document and adherence to its requirements in no way relieves the Contractor of any of his or her professional, legal, or any other responsibility to deliver a safe, functional, useable design that complies with all relevant codes and standards.

1-2. REFERENCE DOCUMENTS. Execution of design and construction programs is guided by regulations and policy. Designers and design reviewers must be thoroughly knowledgeable with the documents listed below and the discipline-related documents referenced in each chapter. It is the designer's responsibility to obtain a copy of the cited references. Also, it is important that the latest revision of each document be used. Department of the Army (DA) Pamphlet 25-30, Consolidated Index of Army Publications and Forms, provides current information on Army publications. (To view Army regulations, visit http://www.usapa.army.mil/. For other documents listed below visit http://www.hnd.usace.army.mil/techinfo/ or http://www.wbdg.org/ccb/ccb.php.) . Any deviations from these references or those of the subsequent chapters including the use of criteria obtained directly from the Using Agency or other sources must be considered, approved or resolved by USAESCH.

a. Technical Instruction (TI) 800-01, Design Criteria

b. Unified Facility Criteria (UFC) 1-200-01, General Building Requirements

c. Unified Facility Criteria (UFC) 3-400-01, Energy Conservation

d. Unified Facility Criteria (UFC) 4-030-1, Sustainable Development

e. Engineering Construction Bulletin (ECB) 2008-1, Sustainable Design and Development (SDD)

f. Engineering Construction Bulletin (ECB) 2002-13, Design Charrette Guidance for Army Military Construction (MILCON) Programs

g. Army Regulation AR 420-1, Army Facilities Management.

h. AR 415-18, Military Construction, Responsibilities

i. Engineering Publication (EP) 715-1-7, Architect-Engineer Contracting

j. Engineering Regulation (ER) 1110-1-12, Quality Management

k. ER 1110-1-263, Chemical Data Quality Management for Hazardous Toxic, Radioactive Waste Remedial Activities

l. ER 1110-1-8152, Professional Registration

m. ER 1110-345-100, Design Policy for Military Construction

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

o. ER 11-1-321 Value Engineering

p. ERDC/ITL TR-01-6, A/E/C CADD Standard

q. Metric Guide for Federal Construction, 1st Ed.

r. EM 1110-1-1000, Photogrammetric Mapping

s. EM 1110-1-1003, NAVSTAR GPS Positioning Surveying

t. EM 1110-1-1004, Geodetic and Control Surveying

u. EM 1110-1-1005, Control and Topographic Surveying

v. EM 1110-1-2909, Geospatial Data and Systems

w. EM 1110-2-1003, Hydrographic Surveying

x. Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE version 2.5) and SDS Facility Management Standard (SDSFMS) are available at https://tsc.wes.army.mil/products/

y. Energy Policy Act of 2005, EPACT05

1-3. GENERAL GUIDANCE

a. TI 800-01, Design Criteria. This manual contains mandatory provisions applicable to the design and construction of military facilities. The TI design criteria shall be used as a reference publication for all succeeding chapters in this manual. Deviations from the requirements contained in the TI criteria are not permitted unless waivers have been requested and approved in the manner prescribed by Headquarters, U.S. Army Corps of Engineers (HQUSACE).

b. UFC 1-200-01. This UFC shall be used as a reference publication for all succeeding chapters in this manual.

c. Quality Assurance (QA). The USAESCH Quality Assurance Program is a planned and systematic pattern of actions which ensure that all work affecting quality is defined in documentation and that adverse conditions are promptly detected. Quality assurance programs ensure that all work is measurable, inspected, tested, and approved. The QA plan will comply with CEHNC-QM 1.0, or as specified by the scope of work.

d. Ownership and Rights. The final design product and associated deliverables are the property of the Government. As such, the Contractor shall not, within professional engineering guidelines, copyright, or otherwise restrict the Government from using, distributing, duplicating, or disseminating this product.

e. Energy Conservation Analysis and Life Cycle Cost Design Analysis. Each design must incorporate the minimum standards and policies for energy conservation and life cycle cost design analysis as documented in UFC 3-400-01, unless otherwise stated in the scope of work. The cost effectiveness of designs will be based on the life cycle cost over the expected life of equipment, materials, facilities or project, as applicable. Designs will be prepared which have the lowest life cycle cost. However, projects of significant importance to national defense interests may warrant the use of more expensive installations because of requirements for increased availability, maintainability, and reliability. The cost effectiveness of those and other designs will minimize the cost of systems while ensuring that designs conform to the design criteria for the facilities or projects required by the scope of work.

f. Design Charrette. The PM, designer and stakeholders will arrange and conduct a design charrette as outlined in ECB 2002-13.

g. Value Engineering. (See chapter 13) A Value Engineering Study will be performed on each design with an estimated construction or environmental cost of $2M or higher in accordance with ER 11-1-321.

h. Sustainable Design. Each design will incorporate sustainable design and development (SDD) techniques and strategies as outlined in ECB 2008-1 and the corresponding LEED Implementation Guide. Also projects will conform to the requirements of EPACT 05 and UFC 4-030-1.

i. Metric Drawings and Specifications. The use of metric units in designs will be in accordance with ER 1110-345-100 Design Policy for Military Construction. Exceptions to using metric units shall be approved by USAESCH, Chief of Design, ED.

j. Physical Security. Security system design will be in accordance with Security Engineering UFCs (listed in t paragraph j below) and the receiving organization's regulatory requirements. Requirements of AR 190-13 must be met. Facilities storing arms, ammunition and explosives must meet the physical security requirements of AR 190-11. Facilities storing classified materials must meet the requirement of AR 380-5. Facilities for unclassified property (sensitive and non-sensitive including controlled medical substances) shall comply with AR 190-51. Sensitive Compartmented Information Facilities (SCIF) shall comply with Director of Central Intelligence Directive No. 6/9.

k. Anti-Terrorism Force Protection. Design for building and other structures will

be in accordance with applicable references provided in UFC 4-010-01, UFC 4-010-02, UFC 4-020-01FA, UFC 4-020-02FA, UFC 4-020-03FA, UFC 4-020-04FA, UFC 4-021-02NF, UFC 4-022-01 and UFC 4-023-03.

l. Review and Approval. Designs may also be subject to review and approval by commercial power utilities officials or by other Government agencies which control or use the same systems associated with the design.

1-4. DESIGN REVIEW AND SUBMITTAL REQUIREMENTS. USAESCH performs comprehensive technical design reviews to ensure the design complies with current criteria, policies, standards, regulations, and directions of the Using Agency and of USACE. These design reviews do not in any way relieve an A-E designer of its responsibilities including but not limited to professional, legal, quality control requirements, etc. All work shall be cross-checked until all conflicts have been resolved. Work shall be organized so as to ensure proper coordination among various details on drawings, among various sections of the specifications, and between the drawings and specifications. Drawings will meet requirements of and be checked against the A/E/C CADD Standards prior to submittal. Identified below are minimum requirements for each review & submittal; specific design submittal requirements are provided in subsequent chapters.

a. Parametric Design. A parametric design review may be required by the using agency to coordinate the various design elements with the DD Form 1391 as updated to the DD Form 3086. The parametric submittal represents approximately 15% of the total design effort and should reflect the items and quantities shown on the DD 1391 funding document. At a minimum, the review should provide a description of the proposed project under the same project title used on the DD Form 1391 (see AR 420-1 for additional details). Parametric submittal requirements are as follows:

(1) Prepare preliminary sketches of a site plan and area plan showing project features. Examples include proposed buildings, roads, and parking areas.

(2) Prepare pre-design level functional relationship diagram showing functional space arrangements.

(3) Identify the existence of utilities and probable utility connection points.

(4) Provide a complete summary of environmental issues identifying required waivers and permits.

(5) Prepare pre-design level descriptive narrative for geotechnical, civil/site, environmental, architectural, mechanical, electrical, information systems, and other disciplines occurring in the design.

(6) Identify unusual requirements (i.e., special foundations, pilings, physical security, anti-terrorism force protection, asbestos, and lead-based paint abatement, special considerations, Munitions and Explosives of Concern (MEC), etc.) that will significantly influence the cost schedule or risk.

(7) Prepare a report on the basis of design including estimate assumptions and economic analysis considerations. The report will include a conclusion and recommendations section.

(8) Prepare parametric cost estimate for construction.

b. Concept Design. The concept design submittal is an approximately 35% complete design and shall incorporate information from the parametric design. The concept design will provide sufficient detail to demonstrate that it complies with all applicable criteria, codes and standards. Volume 1 of the design analysis, General Description, will essentially be 100% and will provide a complete description of the proposed project and the standards to be used in the final design preparation. The energy conservation and life cycle cost design analysis and the fire protection design analysis will be submitted as part of Volume 1. Volume 2 will contain the outline specifications. The design calculations will be prepared as Volume 3. The cost estimate will be submitted based on the concept plans and specifications under separate cover. Designers are cautioned not to proceed past concept design until directed by the KO.

c. Intermediate Design. The intermediate design is not a traditional Corps of Engineers' requirement and may or may not be included in the contract. The intermediate design may be included per USAESCH direction. The requirements and timing of the intermediate design submittal will be established no later than the pre-design conference, the meetings prior to design, and included in the contract. An intermediate design review takes place mid-way between concept and final design reviews. The intermediate design is used to check progress, schedule, cost, and identify any risks to timely completion of the design.

(1) The intermediate submittals will consist of drawings, redlined Unified Facility Guide Specifications (UFGS), designer prepared project specification drafts, updated design analysis, and a revised cost estimate. The final design will not stop during review of the intermediate submittal. The intermediate design shall be checked to assure all previous comments have been resolved or been incorporated.

(2) Drawings, specifications and design analysis will be updated by all comments and project development. The basis for changes will be documented.

d. Independent Technical Review (ITR). The designer shall have an independent technical review conducted (review by someone technically qualified from each discipline other than the designer/ design engineer(s)) of all drawings, specifications, and other required data prior to the scheduled final review. The intent of the review is to eliminate errors, interferences, and inconsistencies, and will be used to verify that all design criteria; review comments, guide specifications, and any additional information required by this manual are incorporated into the final design. In-house ITR will follow Engineering Quality Procedure, EQP-8-11.

e. Final Design Review Submittals. Design will be complete. At this point, all previous project review and ITR comments/corrections have been incorporated into the drawings, design analyses, specifications, cost estimates, and all other design documents. These submittals will demonstrate technical quality, accuracy, and completeness.

f. Final Back-Checked, Ready-To-Advertise Submittals. A revised final submittal may be required to assure all comments have been satisfactorily resolved and the design is ready to advertise. The final 'ready-to-advertise' construction contract documents (drawings and specifications) shall contain the necessary details to permit

prudent and competitive bids and must be sufficient in technical quality, accuracy, and completeness to afford a clear understanding of the job.

(1) Final Design Analysis. Complete analysis supporting the requirements of the project.

(2) Final Design Drawings, Specifications, and Cost Estimate. Complete, thoroughly checked drawings, specifications, and cost estimate with all comments from the final review incorporated. Any required permit applications, permit approval letters, and/or any requirements that apply to project construction shall be included as an appendix in the specifications.

g. Comments. Reviewers will prepare comments concerning the design in the Design Review and Checking System (DrChecks) located under the ProjNet web portal (https://www.projnet.org). The designer is responsible for evaluating/annotating all comments posted in the DrChecks system regarding their project. The designer is also responsible for clarifying any unresolved backcheck items in the DrChecks system regarding their project.

1-5. FORMAT GUIDELINES. All documents will be legible and clearly expressed. Each submittal required by this manual will be adequately titled and dated, and the name of the submittal stage will be stamped or otherwise marked on the cover sheet. Sheets within a package or pages within a chapter of a document will be consecutively numbered and indexed so that specific items of information can be easily located and referenced. Any deviation from the following instructions shall be approved by the KO prior to implementation. Specification requirements are covered in chapter 2, Project Specifications.

a. Deliverables Submittal Requirements. The designer will furnish reviews and final ready-to-advertise document files on CD-ROMs or DVDs in Adobe Portable Document Format (PDF) and the native source files that created the PDFs. PDF files will be suitable for viewing, without modification, on the Internet. Freeware versions of Adobe Acrobat Reader shall accompany the document files so that the user can either install the programs and documents on a machine, or use the disk in a standalone mode to view the document files. If more than one disk is needed, include the Reader on the first disk of the series. The basic software supplied shall be capable of operating on a typical single Intel Pentium processor PC utilizing the Windows XP operating system with a minimum of 512 megabytes of memory and adequate disk storage for project data.

(1) Submittals Information. Electronic submittals shall have disc case labels that at a minimum have project name, project location, contract #, design agency name, date, level of submittal, and contents.

(2) Drawing Deliverables. PDF files will be bookmarked into design discipline groups (ie, Civil, Structural, Architectural, Mechanical, Electrical, etc.) and bookmarked for each drawing under that discipline. Review sets will include plotted hardcopies for review on bond paper. Firmly bind printed copies of drawings for review on the left side.

1-6. DRAWINGS

a. Drawing Preparation. Drawings will be prepared using the latest, USAESCH accepted version of Bentley's MicroStation CADD software, as described in the contract or by the KO. The format shall follow the A/E/C CADD Standard Manual (ERDC/ITL TR-01-6, http://tsc.wes.army.mil/). The drawings will be identified on the index sheet located at the beginning of the design package. Unnecessary work such as duplicate views, notes and lettering and repetition of details will not be included. USAESCH standard borders and cover sheets will be made available to designers. Details will be reasonably spaced on the drawing sheets and will be arranged in a consecutive sequence. Drawing space on each sheet will be utilized to reduce the sheet count. Selected scales will be reasonable for the detail provided.

b. Building Information Modeling. BIM for Design Build. The use of 3-dimensional (3D) Building Information Model (BIM) technology in the design process may be a requirement of a D-B RFP. When BIM is required for MT projects, all BIM Models and associated Facility Data shall be fully compatible with Bentley BIM file format and the USACE Bentley BIM b8 Workspace. On non-MT projects the Government may decide BIM platform and submittal requirements on a case-by-case basis. Reference MT RFP Wizard requirements for BIM in specification section 01 33 16, Design After Award, and BIM information at: https://cadbim.usace.army.mil/ .

c. Drawing Signatures

(1) Functional User Approval. Prior to proceeding past the concept design stage, the user or a designated representative will approve the design for functional use and provide USAESCH written verification of approval. USAESCH will coordinate and USAESCH Chief of Design, Director of Engineering Directorate (ED), or their designee will initial off on title page that user approval has been obtained and filed in the project folder.

(2) Drawings Signatures. Drawings shall be signed prior to final submission in accordance with ER 1110-1-8152 and this manual. On the individual discipline drawings the drafter of that sheet shall initial "Dwn by:" the person who oversaw the draft of that drawing shall initial "Ckd by:", and the designer of that sheet shall initial "Designed by:". Prior to advertisement, USAESCH will obtain signatures on the cover sheet including the biddability, constructability, operatability and environmental (BCOE) review per the requirements of ER 415-1-11, and the following: Division Chiefs will sign and indicate professional registration at "Reviewed by". Director of Engineering will sign and indicate professional registration at "Recommended by:". Commander will sign and indicate professional registration at "Approved by:"

(a) When USAESCH performs the design in-house, Branch Chiefs will sign and indicate professional registration at "Submitted by:" and the Independent Technical Review (ITR) reviewer(s) shall sign "Reviewed by:".

(b) A-E designers shall sign and stamp or seal design documents. The senior discipline engineer or architect for the firm shall sign and stamp their individual discipline drawings; then they shall sign the "Submitted by:" block on each sheet. Stamps shall be placed in the lower right corner of the drawing sheet within the border.

The A-E engineer(s) or architect(s) who completes the ITR shall sign the “Reviewed by:” on each drawing. The A-E firm owner, or a principal, or an authorized representative of the firm shall sign and affix his or her registration seal in the block provided on the cover sheet.

d. Drawing Groups

(1) For any project that consists of more than 250 drawings, the drawing set will be broken into volumes having not more than 200 sheets per volume. The drawings will be divided at a logical break between disciplines.

(2) For multi-building projects, drawings will, except for site development drawings, be grouped by each building so a single building could be withdrawn by removing a consecutive block of sheets without adversely affecting the construction package. Also the designer will organize standard details into those common to all buildings on shared drawings. These drawings will be prepared to allow reuse, without change, in the event the design package becomes two or more separate construction contracts. Each typical detail will be arranged by design discipline. Standard details not applicable to the project will be deleted. Individual details peculiar to one facility will be shown within its own group of facility drawings.

e. Special Requirements.

(1) Symbols and Abbreviations. Use A/E/C CADD Standards for symbols and abbreviations. Additional symbols and abbreviations may be used when the A/E/C CADD Standards do not contain a needed symbol. Regional symbols and special variations will be avoided.

(2) Legends. For each submittal, legends of symbols and lists of abbreviations will be placed on the drawings. They will include all of the symbols and abbreviations used in the drawing set, but will exclude any symbols and abbreviations not used. Since many symbols are limited to certain design disciplines, there is a definite advantage to using separate legends on the initial sheet of each design discipline or in the standard details package for each discipline. If legends have not been shown by discipline, a legend will be placed on the first drawing. Symbols in legends will be at the same scale as used on the drawings.

(3) Designators. Where appropriate (i.e., programmable logic controllers), use instrumentation and control designators on drawings in accordance with Instrumentation Symbols and Identification, ISA S5.1. Equipment designators will be displayed in a hexagon shape to differentiate from control designators, which are displayed in a circle. Hexagons will be divided horizontally with a solid line and will display the designator symbol in the top half and the sequence numbers in the lower half.

(4) Composite with Key Plans. If the plan of a large building or structure must be placed on two or more sheets in order to maintain proper scale, the total or composite plan will be placed on one sheet at a smaller scale. Appropriate key plans and match lines will appear on segmented drawings. Key plans will be used not only to relate large scale plans to total floor plans, but also to relate individual buildings to complexes of buildings. Key plans will be drawn in a convenient location and will indicate the relative location of the represented plan area by crosshatching.

(5) All drawings will receive a USAESCH file number. File numbers can be obtained from USAESCH, Engineering Directorate, Architecture Branch, ED-CS-A.

(6) Trade names and other proprietary indications will not be used in the contract documents without USAESCH approval. Prepare justification for each occurrence in accordance with instructions in chapter 2, Project Specifications.

f. Revisions

(1) General. Refer to Figures A-1 and A-2 of Appendix A, Standard Operating Procedure for Amendment and Change Order Preparation, to view examples of drawing revisions, their identification, and the posting of changes in the revision area above the title block.

(2) Record Update. The designer shall provide an updated PDF for solicitation and updated CADD source files of all revisions before the project is advertised for bids.

(3) Amendment or Revision Sketches. The practice of issuing amendments or revision sketches or descriptive changes in lieu of revised drawings during the amendment period is discouraged, and will be used only if preapproved by USAESCH. If permitted, descriptive changes and/or sketches must be complete. All descriptive amendments will be posted to the drawings immediately after award of the construction contract, and will reflect no more or no less than provided by the amendment.

g Distribution of Project Materials. All project materials received from designers must be shipped in accordance with contract requirements. Once the PM has verified the completeness and authenticity of the project material, the Service Section of ED-CS-J will distribute the material and maintain review control through design.

h. Engineering Study Drawings. Engineering studies in relation to specific problems do not require full drawings. When possible, study drawings and sketches will be prepared on ANSI D size sheets. When smaller size drawings are required to be included in bound volumes, drawing sizes will be B size (11" x 17") and A size (8 1/2" x 11"). Alter title blocks when necessary to allow spacing for the required signatures.

1-7. DESIGN ANALYSIS

a. General. The design analysis will be submitted in three volumes as follows: Volume 1, General Description, will contain all narrative discussions, history of the project, design assumptions, philosophy, and reference sources (i.e., letters, codes, conference minutes, and pertinent research). The general description may be illustrated by diagrams and sketches that aid in the understanding of design concepts. The design analysis will document significant design choices. That is, it will address alternative systems, arrangements, and hardware that were considered in arriving at the recommended concept and the rationale for selection of the alternatives recommended. The justification of each major selection and design decision must be stated clearly. The analysis will also describe the design provisions made to enhance and to reduce the costs of operation and maintenance of the facility. Volume 2 will contain the specifications; and Volume 3 will contain the design calculations. The Design Analysis will be submitted in accordance with contract requirements. The title page will carry the designation of the submittal being made. Three copies of the final design analysis will

be submitted with the final design. The final design analysis will bear the designation "Final Design Analysis" on the title page. All computations, calculations or design analysis related to code compliance or life safety should have a block at the beginning of that area with “Prepared By:”, “Checked By:”, and the names of those who prepared and checked the information.

b. Appendices. The designer will include, with the final submissions of the design analysis, commercial and technical data on individual items that were used in design details and specifications but not specifically identified. This information will be limited to data useful as identification in the final design review and in the administration of the construction contracts.

1-8. SITE ADAPTION OF DESIGN PACKAGES. The designer will review and update the existing design package as required by the contract to bring it up to the level of a current design. The drawings will be revised to meet current requirements and site adapted to the construction site. The designer will update the specifications to match the revised drawings and to reflect current codes and standards. The design analysis will also be revised to reflect the changed, site specific design requirements. Submission process of a final, site adapted design package will be the same as for a new design.

a. Standard Design Packages. The Corps of Engineers has developed two types of standard design packages: DEFINITIVE design (commonly called a STANDARDIZED DEFINITIVE design) is conceptual (30% design), and the STANDARD design package at 65% to 85% design. These standard design packages must be site adapted via a review and subsequent update of drawings and specifications. The review will assure the packages comply with all local and national codes and standards. USAESCH maintains a digital library of standard designs provided by HQUSACE. They are available online at http://www.hnd.usace.army.mil/stddgn

1-9. COORDINATION OF PLANS AND SPECIFICATIONS

a. Conflicts. Care must be exercised to prevent conflicts between plans and specifications, or between different parts of the specifications and other disciplines.

b. Cross-References. Appropriate cross-references to other sections of the specifications will be included in each section. References to specifications on the drawings and references between drawings will be checked and correct.

c. Government-Furnished Equipment. A list of equipment will be furnished by USAESCH for equipment to be furnished by the government and installed by the contractor.

1-10 GIS PACKAGES

b. Preliminary and Final Design Packages. The electronic submittals shall be compliant with Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE, reference http://www.sdsfie.org/) for GIS.

c. Technical Document, Specification, and Design Guides. All final document files (e.g., reports and associated figures and tables) shall be furnished to USAESCH in

IBM PC-compatible MS Office or higher software and in Adobe Portable Document Format (PDF). Products shall be suitable for viewing, without modification, on the Internet. Freeware versions of Adobe Acrobat Reader and Internet Explorer, as appropriate, shall accompany the document files on CD-ROM so that the user can use the CD to either install the programs and documents on a machine, or use the CD in a standalone mode to view the document files. In submissions with multiple CDs, only one copy of the viewers is required. It shall be included on the first CD of the series. The basic software supported to the field shall be capable of operating on a typical single Intel Pentium processor PC utilizing the Windows XP operating system with a minimum of 512 megabytes of memory and adequate disk storage for project data.

d. CADD Data & Spatial Data. Spatial data created for the project will be provided in neutral, nonproprietary Spatial Data Transfer Standard (SDTS) format at the completion of the project, as well as in either Microstation (Microstation design files), or ESRI-compliant formats (Shapefiles, coverages, or geodatabases) during the project in accordance with contract requirements. The use of one of these proprietary spatial data formats will be defined in the contract. SDSFIE Compliance Checker will be used to check to ensure that the spatial data is formatted correctly to meet the SDSFIE relational database standard. In either case, the data shall be geo-referenced to real world coordinate systems in either U.S. Survey Feet or Meters, and the appropriate Universal Transverse Mercator or State Plane Coordinate System, as required by the project. Unless otherwise stated in the contract, the preferred units and projection or Universal Tranverse Mercator in units of meters. Raster data (orthophotography, remote sensing imagery, etc.) are to be provided in Tagged Image File format (TIF) at the completion of the project, as well as in either TIF format or MrSID-compliant format during the project. The selection of one of these raster data formats will be defined in the contract. Supporting tabular data shall be provided in ANSI SQL language format at the completion of the project, as well as in Microsoft Excel, Microsoft Access, or Oracle database format, dependent upon the storage and performance requirements of the project. The use of one of these proprietary database formats will be defined in the contract. The Final Submittal in electronic format shall contain all required Project (ArcGIS .mxd, or Microstation .dgn) files and Layout files for all plates, figures, and drawings conveyed in the Final Report. The duplication of data types for the Final submittal will facilitate the use of the design within the Corps of Engineers, as well as the propagation of the data to other sources via the World Wide Web. Reference https://cadbim.usace.army.mil/ .

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CHAPTER 2

PROJECT SPECIFICATIONS

2-1. PURPOSE AND APPLICABILITY. This chapter provides requirements for preparing project specifications. These specifications will be prepared from standard Unified Facilities Guide Specifications (UFGS) unless written permission is given from USAESCH Contracting Officer on A-E designed projects or from ED Director or Chief of Design on in house designed projects. The specifications, when combined with contract drawings, will provide sufficient detail to attract fair and competitive bids or to allow USAESCH to conduct equitable negotiations. Specifications shall be prepared in accordance with approved and established engineering standards as well as established design requirements.

2-2. REFERENCE DOCUMENTS. Specifications will comply with the requirements in the following documents:

a. ER 415-1-10, Contractor Submittal Procedures

b. ER 1110-345-100, Design Policy for Military Construction

c. ER 1110-1-8155, Specifications

d. UFC 1-300-02, Unified Facilities Guide Specifications (UFGS) Format Standard

2-3. GENERAL INSTRUCTIONS

a. Guide Specifications. Go to TECHINFO or UFGS page on the Whole Building Design Guide for information on UFGS and SPECSINTACT. ER 1110-1-8155 mandates the use of UFGS and SpecsIntact. Military Transformation RFP designs allow for the use of other specification systems. Any other design not using SPECSINTACT will require USAESCH approval.

b. Non-UFGS Sections. When a specification section is required that is not covered by the UFGS, preparer shall use a SPECSINTACT template and create the new section in accordance with UFC 1-300-02 (format) and project requirements.

c. Project Information Form. The designer is required to complete the Project Information Form, Appendix B, which reflects key information concerning the contract documents for solicitations.

2-4. CONCEPT (OUTLINE) SPECIFICATIONS. The designer shall add UFGS and template sections to a new SpecsIntact job to create a list of specifications to cover all parts of the job. For the outline specifications the preparer will print the table of contents from a SPECSINTACT developed project. The preparer will pull the UFGS specification sections that are applicable to the project. Sections will come from the current UFGS Master available on the WBDG website. Pull additional sections and change the section name to create placeholders for any non-UFGS sections required for the design. The outline will cover applicable CSI Divisions 1 through 49. The table of contents forms an outline specification to print or made into a PDF file and submitted with the concept design submittal.

2-5. INTERMEDIATE AND FINAL DESIGN SPECIFICATIONS

a. Preparation of Specifications. Division 1 specifications should be coordinated with the associated geographical corps district, area construction office or other Government agency where the project is sited. When a set of specification sections is edited, the specification preparer shall use sections from the most current UFGS master available. For example, if the concept submittal is submitted in March, but the editing of sections does not occur until April, then the preparer will use UFGS sections for the April release. USAESCH's TECHINFO website contains links to SPECSINTACT software, technical publications and standards, and support documents. It is the responsibility of the preparer to ensure that all revisions and notices are incorporated into the current UFGS for the period ending with the acceptance of the final design specifications by USAESCH.

b. Inch-Pound/Metric Specifications. UFGS are available in either inch-pound or metric units. Select inch-pound or metric units depending on the project requirements.

c. Submittal of Specifications. Submit specifications as follows:

(1) At the intermediate level, the draft specifications shall be submitted for review in redlined form using software revision features. Discarded design choices will be visible in spite of markings. Specifications shall be edited to the level of the design completion and will accompany the drawings, and inserts will be inserted into the UFGS pages with accompanying added test indicators. A draft copy of the bidding schedule will be submitted with the intermediate design.

(2) At the final design level, the specifications, Divisions 1 through 49, shall be coordinated with the drawings. Comments from the intermediate review will be incorporated. If an intermediate submittal is not required by the contract, redlined specifications shall be submitted in addition to the manuscript with the final design submittal. A final review will determine that all previous review comments have been either incorporated or justifiably withdrawn; that the specifications have been coordinated with the drawings and the design analysis; and that the individual UFGS have the latest notices and revisions incorporated into them. The redline corrections will be removed from the specifications after all the review comments have been shown to be incorporated. The designer will submit one manuscript copy and two reading copies (loose) of the specifications along with CD containing the SPECSINTACT job and pull data files as well as a PDF file of combined processed sections that contain the typed manuscript information. The contents of the final design specification package shall be as follows:

(a) Cover sheet with title of job, contract number, location, date, and name of designer.

(b) Bidding schedule (CLIN sheet) including descriptive items, units, and quantities (include listing of payment paragraphs in specifications). It will be developed from specifications and coordinated with the cost estimate.

(c) Table of contents for entire project, listing in order the section number and title.

(d) Specification Sections, Division 1 should include, as a minimum:

1 Contractor Quality Control (QC) requirements

2 Submittal Descriptions and Submittal Procedures, including properly filled out ENG Form 4288's and submittal program files.

3 Environmental Protection (as determined by USAESCH and required by contract)

4 Site specific specifications (UFGS and non-UFGS)

5 Other Division 1 specifications as required by USAESCH and contract to complete the project specifications package

(f) Specification Sections, Division 2 through 49 as applicable.

(g) General Project Information completed for the project. Refer to appendix B or the General Project Information form.

(h) Lists of all Government-furnished, contractor-installed property with descriptions and cost.

(i) List of all proprietary items with location in specifications, cost, manufacturer's name, and justification

(j) Work sequence including unusual schedule requirements such as equipment installation during construction, or work split between two contractors working on different jobs at same time.

(k) Construction schedule including duration in calendar days coordinated with list of major milestones.

2-6. AMENDMENTS

a. Amendments as Revisions to Specifications. Should revisions or corrections to the specifications or drawings be required between the date of issuance of the solicitation and the closing of the solicitation, an amendment will be required. Depending on the terms of the design contract, the specification preparer will be required to either prepare the amendment and make the necessary changes to the contract documents or provide technical assistance to USAESCH in the preparation of the amendment.

b. Scheduling of Amendment. The amendment will be prepared and submitted under a strict time schedule directed by USAESCH.

c. Preparation of Draft and Final Specification Amendment. Draft revisions to the specifications will be indicated by responsible designers electronically redlining affected specification sections of the advertised solicitation. The final amendment will be prepared in accordance with the details given in Appendix A.

2-7. PROPRIETARY ITEMS. Where specific equipment or material are required by criteria or design conditions, the item is the product of a single manufacturer, and/or no substitutes will be acceptable, compliance with the requirements of ER 1110-345-100 is required. The designer will make the determination that use of the proprietary or "sole source" item is essential. In each case the following actions will be taken:

a. Justification. The preparer will submit a written request to use the proprietary item with complete detailed justification for Government approval prior to including the product in the design documents. Requests will be based on a fully justified determination that only that particular product will meet the essential requirements.

b. Approval. Approval requests go from USAESCH to Headquarters, Department of the Army (HQDA), DAEN-MPG, the approval authority for proprietary items.

c. Requirements. After proprietary item use is approved, specify the item, and after the make and model number, add the words "No substitutes will be acceptable."

d. "Brand Name or Equal" Specifications. The use of brand name or equal specifications should be avoided, where possible. Where used, brand name or equal specifications must meet the requirements of FAR Sub-Part 10.004(b)(3), DFARS Sub-Part 210.004, and DFARS Sub-Part 252.210-7000, "Brand Name or Equal." Note that brand name or equal specifications should, among other requirements, include a complete common generic identification of the item, a list of all known acceptable name brand products, and all salient physical, functional, or other characteristics used to determine equality and are essential to the needs of the Government.

2-8. GOVERNMENT-FURNISHED EQUIPMENT (GFE) When Government-furnished, contractor-installed materials or equipment are involved, such GFE will be described on a separate list arranged by reference designator and provided along with the submittals outlined in paragraphs INTERMEDIATE AND FINAL DESIGN SPECIFICATIONS. Descriptions will include manufacturer make and model, weight, dimensions, quantity, cost, and other information required by the contractor to insure the value of the GFE.

2-9. REMOVAL OF EQUIPMENT OR MATERIALS (DEMOLITION)

a. Materials Removed from Buildings. Materials to be removed will be identified on the drawings with the disposition and handling listed in the Demolition Specifications by category. The categories of removed materials are defined as:

(1) Reinstalled items are those which, after removal, will be reused, reinserted, remounted, or otherwise built into the new work under the contract. (Such items will not be identified as "Government-furnished.")

(2) Salvaged items are those which, after removal, will be delivered to Government storage.

(3) Debris includes all removed materials that are not noted or specified for reinstallation or salvage.

b. Materials Removed During Site Preparation. Materials to be removed from the site will be so noted on the drawings. The disposition of such removed materials will also be noted on the drawings or stated clearly in the specifications.

2-10. COMMON SPECIFICATION ERRORS

a. Ambiguities in Specifications. Preparers shall avoid using ambiguities in the specifications. The expression "as directed by the Contracting Officer" should not be used if it is feasible to give specific instructions in the specifications. Preparers should contact the project manager to obtain specific information so that indefinite terms can be eliminated. For example, when material is to be stored, the specifications should state "to be stored in Building 210" or "in the Base Salvage Yard," rather than "as directed by the Contracting Officer." When it is impossible to determine ultimate disposition of excess excavated materials, broken concrete, etc., specifications should state that the haul will not exceed a stated number of miles.

b. References

(1) References Made to Blank UFGS. References such as "will conform to UFGS-08 34 59" are not valid references. The UFGS are for use in writing project specifications, not as reference documents. It should be noted that these are guides and are not project or standard specifications.

(2) References to a third party will be avoided. The "Contractor" and the "Contracting Officer" are the only contracting parties in a contract; therefore, only "Contractor" and "Contracting Officer," and in certain instances, "Government" will be used throughout. Reference to work to be done "by others" should be made only when that work is not a part of the subject contract and will actually be done under another contract. Reference to third parties, such as "buyer," "supplier," "owner," "post engineer," "architect-engineer," "subcontractor," and "engineer" will not be used in the specifications.

(3) Section number and cross references to other paragraphs, pages or sections by number designation are improper. Reference to other sections will be made by section number and title in lieu of their respective numbers alone. References to paragraphs within in the section will be made by paragraph title alone.

2-11. BIDDING SCHEDULE. The bidding schedule or CLIN Sheet should be prepared concurrently with preparation of the specifications. It should reflect the cost estimate in delineation of funding sources, i.e., MCA, O&M, R&D, etc. Care should be taken to completely cover each payment item without overlapping other payment items. Payment clauses should be inserted into the appropriate specifications where required. It should be made clear exactly what is and what is not to be paid for under each item. If a pay item description is quoted, the nomenclature should correspond exactly to that given in the bidding schedule. Additive or deductive bid items, as well as optional bid items, if used, should be clearly defined on the drawings and in the specifications so that only a brief description will be necessary on the bidding schedule.

2-12. PAYMENT PARAGRAPH. The preferred method of payment for all work under the contract will be lump sum on the bidding schedule. Payment paragraphs are not necessary for projects with only one lump sum bid item. Unit prices will be used where

large quantities of work such as grading, paving, building outside utilities, or site preparation are involved; where quantities of work, such as excavation, cannot be estimated with sufficient confidence to permit a lump sum offer without a substantial contingency; where estimated quantities of work required may change significantly during construction; or where offerors would have to expend unusual effort to develop adequate estimates. Payment paragraphs are required at the front of each section covering work where payment will be broken out into separate bid items. When unit-price payment is used, a measurement paragraph is required to define the unit and the method of verifying quantities. Prior to final submittal, the bidding schedule or CLIN sheet will be prepared to reflect the cost estimate and will be coordinated with the payment paragraphs to verify that each item is properly covered and that it is perfectly clear how and under which items the various costs are to be included.

2-13. SUBMITTALS. Division 1 through Division 49 submittals will be listed on ENG Form 4288. The Submittal Register (ENG Form 4288) will be the product of the SPECSINTACT software. The Submittal Register will be placed at the end of the Division 1, Section 013300, SUBMITTAL PROCEDURES. Each submittal will be listed as either for "Government Approval" or "For Information Only." New submittal requirements should be limited to those required for quality control during construction and those required for operation, maintenance, repair, and warranty enforcement after construction.

CHAPTER 3

GEOTECHNICAL

3-1. PURPOSE AND APPLICABILITY. This chapter provides guidance on the requirements for subsurface investigations, geotechnical reports, design analyses, and geotechnical data for inclusion in design and contract documents. The design will be accomplished in accordance with the referenced documents listed below and with the criteria furnished in the Statement of Work. Geotechnical investigations need to be completed very early in the project since they provide essential information for major site development and design decisions.

3-2. REFERENCE DOCUMENTS

a. TI 800-01, Design Criteria

b. UFC 3-220-01N, Geotechnical Engineering Procedures for Foundation Design of Buildings and Structures

c. UFC 1-200-01, General Building Requirements

d. UFC 1-300-07A, Technical Requirements: Design Build

e. UFC 3-220-03FA, Soils and Geology Procedures for Foundations Design of Building and Other Structures (except Hydraulic Structures)

f. UFC 3-220-08FA, Engineering Use of Geotextiles

3-3. PARAMETRIC DESIGN. The parametric design submittal (if required) should contain as much information on general geology and physiology of the project site as is available, including existing subsurface data and whether additional investigation is required for the design.

3-4. SUBSURFACE INVESTIGATION AND GEOTECHNICAL REPORT

a. Subsurface Investigation. Planning for and contract preparation for subsurface investigation is generally performed by USAESCH. Implementation of the subsurface investigation may be performed by either USACE or an A-E.

b. Planning. The subsurface investigation should be planned considering the regional geology, existing subsurface information at the site or its vicinity, the site history, and locations of project features. The history of the site should be considered to assess whether subsurface conditions may have changed since existing subsurface information was obtained. A preliminary boring location plan showing proposed locations of borings, test pits, geophysical investigations, etc. should be prepared.

c. Drilling and Sampling. Preliminary boring location plan and drilling instructions containing specific requirements for drilling, sampling, backfilling of boreholes, disposition of samples, etc. should be provided in the work plan for the subsurface investigation. Right-of-entry and drilling permits will be obtained where required. No drilling will be performed prior to obtaining utility clearance.

d. Laboratory Sampling. Laboratory testing will be performed on selected samples as needed to accurately characterize the subsurface conditions at the site and to determine parameters for design analysis. Tests will be appropriate for the type of materials encountered in the borings.

e. Boring Locations and Elevations. Accurate determination of locations of borings at their as-drilled locations will be documented both using coordinates on the drilling logs and showing the locations on the boring location map. Datum and units of location coordinates and elevations will be indicated on the boring logs and boring location map. All changes to proposed boring locations at any stage should be documented. The method of locating borings will be described in the Geotechnical Report.

f. Geotechnical Report. The Geotechnical Report will be prepared by or under the direction of the geotechnical engineer or geologist responsible for the subsurface investigation. The Geotechnical Report will present the results of the subsurface investigation including laboratory testing and will offer recommendations for the design of structure foundations, pavements, and other geotechnical features. Specialty field tests such as pH measurements, resistivity tests, and percolation tests will be included for use in design, if appropriate. The designer will be responsible for selecting the structure foundation type. The Geotechnical Report will contain all the required data to design the foundation, to include items such as construction and permanent dewatering, pile driving, slope stabilization, etc. The geotechnical investigation will adequately characterize the site geology and hydrogeology and will provide the designer all geotechnical data required to complete the project design. The Geotechnical Report including logs of borings and laboratory test data will be included in Volume 3 of the Design Analysis and shall be reviewed by USAESCH. The following items at a minimum will be addressed in the Geotechnical Report:

(1) Foundation Design. The Geotechnical Report will recommend the type of foundation system to be used for each primary structure in the project. The geotechnical designer will participate in preparation of earthwork specifications. See requirements for shallow foundations and deep foundations below and UFC 3-220-03FA for further design requirements. If shallow foundations are recommended, the Geotechnical Report will recommend the allowable bearing pressure, the depth of placement and bearing elevations for the footings, minimum footing widths, and minimum footing embedment depths. Requirements for measures such as soil stabilization, removal and replacement of unsatisfactory materials, surcharge fills, and capillary water barriers will be addressed in the Geotechnical report if these measures are needed. All footings, grade beams, slabs, etc., will be designed utilizing the recommendations and restrictions presented in the Geotechnical Report. The designer shall be responsible for obtaining all geotechnical data required for the design of each type of foundation during the subsurface investigation if tasked to perform the subsurface investigation. If deep foundations are recommended, the Geotechnical Report will provide recommendations for the type of deep foundation system to be used (piling, caissons, etc.), elevation of top of sound rock if applicable, the size and length of the piling or caissons, required tip elevations, and the allowable bearing capacity. The designer will determine the number of piles or caissons, actual spacing, and the pile cap design. The number and location of test piles and load tests to be specified in the construction contract should be recommended in the Geotechnical report.

(2) Dewatering Systems. Groundwater levels at borings, soil classifications, and sieve analysis of aquifer samples will be documented and included in the Geotechnical Report and shall be used to determine routine requirements for temporary dewatering systems. More specialized investigation such as piezometer installation, field pumping tests, and laboratory permeability tests may be used and are advisable if a large dewatering effort will be required. Based on the results of the geotechnical investigation, the designer will determine project dewatering requirements. All the required information necessary for the design of the system (hydrogeologic data, geotechnical analyses of sediments, aquifer properties such as hydraulic conductivity, transmissivity, storage coefficient, etc.) should be collected during the geotechnical investigation and presented in the Geotechnical report. The use of slug tests to determine aquifer characteristics is not acceptable for dewatering designs. Short-term construction dewatering due to poor surface drainage, precipitation, or short duration work at or near the water table is generally considered a contractor responsibility. Using information from the Geotechnical Report, the designer should alert the contractor to any known conditions that shall require dewatering. When temporary construction dewatering is required due to a consistently high water table or the effects of underlying artesian aquifers, the designer will design and present a dewatering plan in sufficient detail that the contractor can bid on and install the dewatering system. Design of long-term or permanent dewatering systems, including selection of well screen slot sizes, screen lengths, discharge pipe sizes, installation methods, etc. is the responsibility of the designer.

(3) Cathodic Protection and Grounding Systems. The geotechnical investigation and report should include all pH tests, salinity tests, resistivity measurements, etc., required to design corrosion control and grounding systems. The raw field data will be provided in the Geotechnical Report without interpretation or recommendations. The designer will design all corrosion control and grounding systems required for the project and will advise the PM or KO immediately if additional field data is required.

(4) Pavements. The Geotechnical Report will recommend for pavement subgrades the allowable design California Bearing Ratio (CBR) and modulus of subgrade reaction parameters with the required compaction effort. Guidance will be offered on the types of base course materials available in the area and design strengths. The designer will prepare all earthwork specifications for pavement subgrades and pavement material specifications. See chapter 4, Civil Engineering, for deviations or exceptions.

(5) General Earthwork and Special Features. The Geotechnical Report will recommend undercutting requirements, fill and backfill placement procedures, types of compaction equipment to be used, and outline earthwork procedures for special features such as retaining walls, embankment construction, earth covering of structures, basements, buried and mounded tanks, utilities, etc. The designer should consult with the geotechnical engineer or geologist responsible for the subsurface investigation, in the design and preparation of specifications for any special features with geotechnical aspects that are not included or adequately described in the Geotechnical Report.

(6) Boring Logs and Location Map. Logs of borings will be provided as an appendix to the Geotechnical Report, design analysis, and contract specifications. Locations of borings, test pits, monitoring wells and piezometers will be shown on boring

location map(s) in the appendix with boring logs in file log's PDF, on civil site plans, or in both the log's PDF file and on civil site plans. Boring location maps will be clearly legible when printed at 8.5 in. x 11-in. size if included in the log's PDF file.

(7) Laboratory Test Data. Laboratory test data will be provided as an appendix to the Geotechnical Report, design analysis, and contract specifications.

(8) Other Considerations. The following items should be discussed, if applicable, in the Geotechnical Report:

(a) Description of structure(s)

1. Written general description
2. Type of construction contemplated.
3. Size and Height
4. Finished Floor elevation; Elevation of existing ground
5. Type of Foundation recommended
6. Approximate load (s)
7. Special Features affecting Foundation Design

aa. Water table, or history of dewatering or seepage problems

ab. Condition or history of nearby buildings

ac. Analyze whether dewatering would cause settlement of adjacent structures

ad. Location of fills or dump areas near site, which may jeopardize foundation

ae. Existing buried Utilities conflict with new foundations

(b) Specific recommendations for foundation design and/or construction based on site features.

1. Topography
2. Surface Water
3. Groundwater
4. Subsurface soil conditions
5. Availability of borrow materials
6. Location & availability of spoil areas
7. Permitting actions required.
8. Site seismology considerations

(c) Results for:

1. Bearing capacity
2. Piles (Type, length, capacity, type of installations)
3. Retaining Walls or basement walls
4. Mat Foundations/Spread Footings
5. Slope Stability
6. Settlement
7. Permanent ground water drainage around or under structures
8. Construction Dewatering
9. Erosion control during and after construction

(d) Design Calculations

1. Include applicable design calculations on settlement, bearing capacity, seepage, uplift, stability analysis, quantities, shrinkage, dewatering, etc.
2. Show formulas, assumptions and reference source

(e) Site Plan

1. Show building road locations
2. Contours

3. Boring, test pit, infiltrometer locations
4. Locations of temporary & permanent surface water diversion measures
5. Location of buried utility line (existing & to be installed)

3-5 CONCEPT DESIGN REQUIREMENTS

a. Concept Design Analysis

(1) Incorporate recommendations stated in the Geotechnical Report into the design.

(2) Provide geotechnical design calculations using parameters outlined in the Report and include a copy of the Report in Volume 3 of the design analysis.

(3) Notify the Geotechnical branch through the PM/KO of any conflicts between the Geotechnical Report and concept design. If the topographic surveys are to be performed by the designer, then an electronic file copy of the survey must be sent to the entity performing the geotechnical investigation, as soon as possible but no later than the date for the submittal of the Concept Design.

(4) Include boring logs and laboratory test data as an appendix.

b. Concept Drawings. The Concept Drawings should include the following.

(1) Locate soil borings, test pits, monitoring wells and piezometers on the civil site plan. If necessary, appropriate symbols will be added to the legend.

(2) A note will be added to the civil site plan: "For logs of borings and test data, see __." and reference the appendix that includes boring logs and test data.

c. Specifications. A basic outline in accordance with chapter 2, Project Specifications will be provided.

3-6. INTERMEDIATE DESIGN REQUIREMENTS. The intermediate design review will occur in accordance with contract requirements between the concept and final reviews. By the intermediate review, all previous comments will be resolved/incorporated into the intermediate design.

a. Intermediate Design Analysis. The designer will:

(1) Update and expand the Concept Design Analysis to support the submittal.

(2) Comply with the accepted comments on the concept design.

(3) Perform any Concept Design tasks that were not completed.

(4) List additional information or criteria needed for final design.

b. Intermediate Drawings. The designer will update the design drawings from 35% and will demonstrate cost effective progress toward achieving the final design. .

c. Specifications. The outline specifications previously submitted for concept phase shall be revised, updated, further developed and resubmitted in accordance with chapter 2, Project Specifications.

3-7. FINAL DESIGN REQUIREMENTS. he designer shall advance the design to completion resolving/incorporating all comments from the previous reviews.

a. Final Design Analysis. The designer will:

(1) Update previously prepared analysis to support final plans and specifications.

(2) Include a copy of the Geotechnical Report in the design analysis.

b. Final Drawings. The designer will:

(1) Add general notes to drawings as required.

(2) Ensure all comments from previous reviews have been incorporated.

c. Final Specifications. The designer will:

(1) Complete the draft specifications to cover all items of earthwork or geotechnical aspects of the project.

(2) Ensure consistency of terminology between plans and specifications for notations on specific items of work.

(3) Perform check to ensure adequate referencing for construction details.

CHAPTER 4

CIVIL ENGINEERING

4-1. PURPOSE AND APPLICABILITY. This chapter provides guidance on the requirements for site planning and layout; roads, railroads, parking areas, drainage; and master planning. The design shall be accomplished in accordance with the referenced documents listed below and with the criteria furnished in the contract.

4-2. REFERENCE DOCUMENTS.

a. AR 210-20, Master Planning for Army Installations

b. TM 5-803-5, Installation Design

c. UFC 1-300-07A, Technical Requirements: Design Build

d. UFC 2-000-02AN, Installations Master Planning

e. UFC 3-210-01A, Area Planning, Site Planning and Design

f. UFC-3-210-02, POV Site Circulation and Parking

g. UFC 3-210-06A, Site Planning and Design

h. UFC 3-230-17FA, Drainage for Areas Other Than Airfields

i. UFC 3-250-01FA,: Pavement Design for Roads, Streets, Walks, and Open Storage Areas

j.. UFC 3-250-18FA, General Provisions and Geometric Design for Roads, Streets, Walks, and Open Storage Areas

k. UFC 4-010-02, DOD Minimum Standoff Distances for Buildings

l. UFC 4-860-01FA, Railroad Design and Rehabilitation

m. UFC 4-860-02N, Trackage

n. UFC 4-860-03FA, Railroad Track Standards

0. Manual on Uniform Traffic Control Devices for Streets and Highways (published by the Department of Transportation)

4-3. SITE PLANNING AND LAYOUT.

a. General. Site development is the phase of land development that utilizes site survey data to develop layout plans to allocate space necessary for facilities, buildings, roads, , parking areas, grading and drainage, utilities and landscaping. To implement site planning and layout, detailed standard civil engineering and land management practices will be applied.

b. Objectives. Typical plot plans for each facility will be engineered to fit the physical characteristics of the site upon which the facility is to be constructed. Grading design will be considered in the early design stage and will take into consideration the following principal objectives:

(1) Disposal of surface water.

(2) Preservation of the natural terrain

(3) Reasonable balance of cut and fill

(4) Avoidance of wavy profiles in streets and walks.

(5) Avoidance of costly erosion-control measures.

(6) Avoidance of snow, dust, and sand drifts.

(7) Avoidance of steps in walks.

(8) Preservation of satisfactory ground levels so that existing trees may be saved.

(9) Development of finished grades high enough where rock will be encountered close to the surface, thereby reducing costs of utility trenching.

c. Government-furnished Data (Unless otherwise provided). Before the designer begins the site development, obtain the following data:

(1) Site survey showing existing topography.

(2) Locations of existing roads, utilities, buildings, and other features.

(3) Geotechnical requirements. See chapter 3, Geotechnical.

(4) Water courses, ponds, etc., and the elevation of high water.

(5) Rock outcrops by outlines.

(6) Data on existing trees and ground cover vegetation.

(7) Horizontal and vertical survey control monuments for locating new construction.

(8) Frost data.

(9) Seismic data.

(10) Weather data.

(11) Photographic data, if applicable.

(12) Location of known and suspected MEC/UXO.

d. Site Development General Criteria

(1) The locations of buildings shown on the typical plot plans will be considered based on functional relationships to each other for operational efficiency and economical operation &maintenance. Consideration will be given to the orientation of the buildings to take advantage of sunlight, prevailing winds, and other site features to the maximum extent possible (exposure of entrances to cold winter winds and snowdrift should be avoided). Air-conditioned and heated buildings should be oriented to expose areas to sun loads to optimize the solar effect. Energy conservation and life cycle cost design features will be reflected in the Energy Conservation and Life Cycle Cost Design Analysis specified in chapter 1. Buildings will be located to conform to UFC 4-010-02.

(2) The layout of streets and railroads within the project areas will be shown on the typical plot plans for convenient, safe access and circulation. The street system provides for local traffic only and discourages through traffic. The design engineer will lay out and design access roads, railroads, parking areas, walks, and service areas for maximum effectiveness.

(3) Vehicle parking will be designed for off-street parking located in proximity to the facilities served. Parking will be designed for easy entrance and exit, and for safe maneuvering of vehicles. The arrangement and layout of parking spaces will be in accordance with UFC 3-210-02.

(4) Sidewalks will be designed to provide convenient and safe pedestrian access and circulation within the area. Walkway width will be based on pedestrian traffic volume. The minimum width will be four feet; this width may be increased in increments of two feet as required to accommodate the anticipated volume.

(5) The planting of grass (seeding, sodding, and sprigging) and other landscaping will be included as an integral part of the design. The cost of such landscape plantings will be a part of the cost estimate. The planting of trees and shrubs will be included in project construction only when specifically directed by the contract.

4-4. ROADS, RAILROADS, PARKING AREAS, AND DRAINAGE

a. General. Roads and parking area pavement will consist of a subbase course, base course, and a flexible or rigid pavement surface course. Surfacing will normally be hot-mix bituminous concrete surface course though other materials may be used based on availability and cost. Curbs, combination curbs and gutters, or shallow paved gutters, and attendant underground storm drains will be constructed along streets and around off-street parking areas in built-over areas. They will not be constructed along roads and at remote facilities except as required for drainage and erosion control. In some cases subgrade stabilization may be economically warranted for flexible and rigid pavements. For flexible pavement, stabilization of subgrade is to increase the California Bearing Ratio (CBR) value in lieu of increasing thickness of the base to conform to design curves. The stabilization for rigid pavements is not to increase the K value of the soil, but to provide a surface suitable for operation of construction equipment. If uniform stabilization is not specified, severe disturbance and spot stabilization necessary during

construction will result in a non-uniform subgrade detrimental to this type pavement. In areas containing relatively stable material near the surface, stabilization of subgrade should not be necessary. Roadway traffic control signs and markings will be designed in accordance with the "Manual on Uniform Traffic Control Devices for Streets and Highways."

b. Reference Documents. Comprehensive outlines of basic design principles for this work are provided in UFC 3-250-18FA, UFC 3-250-01FA, UFC 4-860-01FA, and UFC 3-230-17FA.

c. Pavement Design. Pavement structural design and subsurface surveys will be furnished by USAESCH or performed by the contractor if directed by the KO. This will include class, category, design index, CBR, modulus of subgrade reactions (K), concrete flexural strength, and the type of thickness of the various component layers adopted for construction.

d. Plans and Profile. In all designs, simplicity and economy are desired. As an example, only those typical sections that are necessary to specify the paving section will be shown. Finished surface grades for the pavement on parking areas and other large paved areas will be shown by contours, usually at an interval of 0.03048 meters (0.1 foot). A contour interval of 0.3048 meters (1.0 foot) is usual for graded areas. Plans and profile will be shown for all roads and railroads, preferably with the profile shown directly under the plan. A sufficient number of typical cross sections will be shown for roads, railroads, and parking areas to clearly indicate the construction to be performed. For roads or railroads of any considerable length, cross sections will be plotted at minimum intervals of 30.48 meters (100 feet) for computing quantities of earthwork. These cross sections and all earthwork calculations will be furnished to USAESCH along with prefinal plans to facilitate checking earthwork quantities.

e. Drainage Pipes. It is the policy of USAESCH, in the preparation of contract plans and specifications, to allow the construction contractor an option of materials for drainage pipes. Size selection should be based on individual design calculations using Manning "N" values specified in UFC 3-230-17FA. These calculations will be shown in the design analysis. Strength requirements for the various sizes of pipe will be indicated on the plans.

f. Drainage Design Analysis. A complete design analysis for drainage features is required as a part of each design submittal. The design analysis will indicate the formulas and assumptions as well as references to any textbook tables used to determine pipe sizes and other important features of the design. A print of the area involved will be furnished with the design analysis showing the individual drainage areas used in the design. These may be outlined in red on a print showing the drainage system if desired.

g. Pavement Design Analysis. A brief design analysis will be prepared, based on USAESCH-furnished designs, for all paving features. In the case of flexible pavement, it will consist of the class, category, index, CBR of the subgrade, the type, and thickness of the various component layers and a typical cross section adopted for construction. In the case of portland cement concrete pavement, the modulus of subgrade reaction, class, category, index, the 28-day flexural strength of the concrete, the total thickness, and a typical cross section adopted for construction will be given.

These items will be coordinated with USAESCH prior to the concept submittal for review.

4-5 DESIGN & DRAWING REQUIREMENTS.

a. Parametric Design Requirements. The designer will develop a conceptual site plan (see 1-4.a.), which encapsulates the project requirements. The plan should be an efficient layout with emphasis given to user requirements. The plan will show building locations, parking areas, roads, limits of paving and hardstands, and pedestrian access points. The plan will be developed so that a preliminary cost estimate can be prepared.

b. Concept Design Requirements

(1) Concept Design Analysis. Provide information concerning the following, as applicable:

(a) General

1. General overview of major site features planned, such as building orientation, drainage patterns, parking provisions, traffic circulation, provisions for the handicapped, security requirements, airfield pavement work, etc. A coordinate grid system will be shown on all plan sheets.

2. Provide a description of any locations of wetlands, as defined by Federal and/or State criteria, historically significant areas, or areas with endangered species of wildlife within the project site area. All areas will be defined by qualified professionals and flagged in the field. The topographic survey will label and present the defined areas. Coordinates must be clearly shown on the design drawings for all environmental areas or wetland boundary.

3. Provide applicable State/local flood requirements.

4. Discuss existing site features including general topography, acreage, boundaries, adjacent site usage, etc.

5. Discuss impacts of new construction on existing facilities.

(b) Removals

1. Preliminary discussion of items requiring removal or relocation.

2. Method and location of the disposition of waste or salvage materials

(c) Layout

1. Provide rationale for locating major site elements.

2. Provide set back or specific clearance requirements for major features of work, such as buildings, parking areas from streets, hardstands, etc.

(d) Storm Drainage

1. Provide a summary of specific Federal, State and/or local stormwater permit requirements for water quality/quantity for the project including fees for permit applications and the name of the agency to which the permit application check will be written. Discuss the impacts on the site design. If no stormwater permits or requirements are required, provide a statement to that effect. Provide documentation from the appropriate regulatory agency and regulators name.

2. Discuss the preliminary stormwater design scheme and discuss impacts on the existing stormdrain systems.

3. Provide selected design values to be used in the storm drainage calculations such as surface runoff coefficient, retardance coefficients, infiltration rate, and rainfall intensity based on a 10- year and the 100-year storm frequency.

4. Provide preliminary sizes of stormdrain pipes.

5. Provide preliminary size and preliminary calculations for required stormwater treatment/storage ponds. Discuss impacts on the project site.

6. Provide preliminary Pre and Post construction discharge values for the 10-year & 100-year storm event.

7. Discuss the proposed stormdrain pipe materials.

(e) Grading

1. Discuss existing site features affecting grading such as buildings, streets, curbs, walks, fences, water courses, ponds, elevation of high ground water, rock outcrop, etc.

2. Provide minimum elevation to provide flood protection (if applicable).

3. Planned finished floor elevation.

4. Cut or fill requirements and rough estimate of quantities.

5. Discuss minimum and maximum slopes to be used in the design for embankments, ditches, pipes, etc.

(f) Utility Plan. This plan will identify and locate water lines, sanitary sewer lines, force mains, industrial waste lines, and other subsurface utility features.

(g) Pavement Structure Design

1. Vehicular Pavements Thickness Design.

aa. Specific design values for which pavement thickness is based including the number, type, and maximum weights of vehicles, category of traffic, class road or street, and resulting design index.

ab. Flexible Pavements - required thickness of base and pavement

based on the design index and established subgrade CBR.

ac. Rigid Pavements - required thickness of non-reinforced concrete pavement based on a 28-day flexural strength concrete of 650 psi and the established modulus of subgrade reaction.

2. Discuss the proposed base course type and select subgrades. Provide intended compaction requirements.

(h) Road and Streets, and Parking Areas

1. Provide listing of traffic volumes and vehicle types.

2. Provide American Association of State Highway and Transportation Officials (AASHTO) design vehicle for which turning movements are to be provided for and corresponding minimum turning radius.

3. Provide project design speed.

4. Provide maximum degree of curvature and control grades.

5. Provide sight and stopping distance requirements.

6. Provide lane and shoulder widths.

7. Provide cross-slopes for lanes and shoulders.

8. Embankment slopes.

9. Requirements for curbs, sidewalks, guardrails, traffic signs and markings, fencing, etc.

10. Rights-of-way and easements

(i) Parking and Open Storage Areas

1. Type vehicles to be accommodated

2. Size of individual parking spaces and number to be provided

3. Number and location of handicapped parking spaces

4. General location of parking or storage areas

5. Location of ingress and egress

6. Pedestrian access

7. Use of 90º, 60 º, or 45 º parking and relation to traffic operation

(j) Miscellaneous Site Features

1. Curbs, and curbs and gutters - types and locations

2. Sidewalks - width, and locations

3. Physical Security Features - justification, type, size and location of fences & gates.

(k) Railroads

1. Type of service for which track shall be provided.

2. Anticipated volume

3. Maximum grade and degree of curvature

4. Features of track construction such as thickness and type of ballast, weight of rail, dimension of ties, size of turnouts, etc.

5. Special requirements for track scales, bumpers, signals, grade crossings, derailers, etc.

(l) National Pollutant Discharge Elimination System (NPDES) Construction Permit. Provide specific requirements for State and Federal NPDES Construction Permit for the project.

(m) Erosion and Sediment Control Plan. Describe intended design of sediment and erosion control for the project.

(n) Outline Specifications. Provide in accordance with chapter 2, Project Specifications.

(o) Additional Information. List additional information or criteria needed for design.

(2) Concept Drawings (35% Submittal). The designer will provide the following:

(a) Location, Vicinity Maps and General Site Plan

1. Indicate project site. Provide preliminary borrow and spoil areas, haul routes, and contractor’s access to the site.

2. Provide State vicinity map.

3. Provide Location map for local access to project site.

4. Provide a general site plan consisting of a complete sheet showing the project area with structures to be built as well as structure relationship to other or major existing structures.

(b) Removal Plan

1. Indicate items to be removed.

2. Pavement structures: Indicate pavement layer thickness for removal depths.

(c) Layout Plan

1. Provide an overall site plan showing total development.

2. Show the proposed geometry of the site plan using a minimum scale of 1:500 (1" = 30'), unless otherwise directed. Include the existing topography without contours that shall remain after construction.

3. Use graphic symbols to distinguish new and existing site work, and provide legend to define graphic symbols.

4. Provide sufficient geometric information to adequately locate all new major site elements.

5. Identify the grid state system used. Include a north arrow.

6. Provide centerline stationing for all roads, streets, parking areas, runways, taxiways, etc.

(d) Grading and Drainage Plan

1. Show the complete drainage concept using either finished contours or slope arrows include preliminary storm drainpipe sizes.

2. Use a minimum scale of 1:500 (1" = 30'), unless otherwise directed.

3. Show and identify all existing buildings and facilities on plan.

4. Show the proposed finished floor elevation and critical spot elevations.

5. Provide control monuments, list horizontal and vertical data for each.

6. Reflect existing utilities with the topography. If necessary for clarity, show removals, relocations, and new work for utilities on separate plans.

7. All contour intervals shall be 1 foot (25cm), unless otherwise directed.

(e) Centerline Profile. Provide preliminary profile for centerlines. Show existing ground line and preliminary new finish grade with percent new grades indicated.

(f) Typical Section for Roadways & Parking Areas

1. Roadways: Provide preliminary typical sections for each different roadway width. Indicate lane widths, shoulder widths, and cross-slopes.

2. Parking Areas: Provide preliminary typical section for various parking areas.

(3) Specifications. Provide in accordance with chapter 2, Project Specifications.

c. Intermediate Design Requirements. The designer will advance from concept into design. All comments from the concept review will be resolved/incorporated into the intermediate design.

(1). Intermediate Design Analysis. Update and expand the Concept Design Analysis to support the submittal and include the following, as applicable:

(a). Storm Drainage Design

1. Storm drainage design-calculations consistent with the requirements of the applicable TMs and based on the design values established in the Concept Design Analysis.

2. A map outlining drainage areas affecting new construction.

3 Complete calculations for sizing retention and/or detention ponds. Calculations verifying compliance with all State regulations. Documentation demonstrating that the design and design calculations have been coordinated with applicable State Regulatory Agencies.

4. Provide watertight joints for drainage pipe under all pavements (aircraft and vehicular) when the pipe is placed in a non-cohesive soil (see UFC 3-230-17FA). Provide soil tight joints at all other locations.

5. Contour intervals should be 1 foot (25cm), unless otherwise directed.

(b). Pavement Design

1. Complete flexible and rigid pavement design calculations consistent with the requirements of the applicable TM's and based on the various design values in the Concept Design Analysis.

2. Complete calculations for pavement options to be allowed.

3. Materials to be used in pavement structure and their thickness.

4. Minimum compaction requirements.

(c) Additional Information. List additional information or criteria needed for final design.

(2) Intermediate Design Drawings. Although it is intended that major items of work be shown separately, different items may be shown on the same sheet provided that the presentation is sufficiently clear to permit legible reproduction at half-scale.

(a) Location and Vicinity Maps. Update from 35% as required.

(b). Removal and/or Relocation Plan

1. Indicate all items of site work that require removal or relocation.

2. Provide dimensioning for removal items such as pavements, curbs, sidewalks, etc.

(c) Layout Plan

1. Complete the geometric layout of all items of new work using coordinates for locating new work or, use offset dimensions from existing structures

2. Include in the plan information on specific items of work.

3. Complete the legend to include all items and symbols shown on the plans. Symbols should be consistent between successive drawings.

4. Show on the plan the construction centerline, right-of-way limits, and all-important topographical features such as fences, buildings, streams, railroads, etc.

5. Locate or make reference to monuments and benchmarks for horizontal and vertical control.

6. Provide complete survey information necessary for establishment of the survey centerline, new structures, building column lines,, etc, including coordinates or computed bearings, radii, curve data, superelevation requirements, point of intersection of centerlines, etc.

7. When superelevation is required, include in the plan a diagrammatic profile of how the superelevation is obtained and also tables of shoulder slopes versus cross slopes for the superelevated section.

8. Note on the plans the size and type of all existing structures and the manner in which they are to be utilized, removed, or otherwise affected by new work.

9. If widening of the pavement is required in curves provide sufficient details to facilitate the construction.

(d) Grading and Drainage Plan

1. Indicate all items of work superimposed on the existing topography.

2. Indicate the proposed contours for new grading and provide spot elevations as required to facilitate field layout. All contour intervals should be 1 foot (25cm), unless otherwise directed.

3. Layout the new storm drainage system using the symbols covered in

the legend.

4. Identify drainage structures with number designations corresponding to those used in the storm drainage schedule to be included in the drawings.

5. Indicate the finished floor elevations of new buildings.

6. Locate or make reference to monuments and benchmarks for horizontal and vertical control.

7. Provide locations of soil boring locations and designations.

(e) Utility Plan. The utility plan will identify and locate water lines, sanitary sewer lines, force mains, industrial waste lines, and other subsurface utility features.

(f) Profile Sheets for Roads, and Parking Areas

1. Provide the centerline profile. Unless otherwise directed, use a vertical scale of 1:50 (1" = 5') or as appropriate to terrain. Indicate and label beginning and ending tie points.

2. Provide elevations at points where changes of grade occur.

3. Indicate the lengths of vertical curves.

4. Indicate the existing ground line at centerline on the profile.

5. Indicate the percentage of slope for all grade lines. Provide special information pertaining to the profile and affecting the design such as curb grades, gutter grades, drainage structure inverts and top elevations, etc.

6. Provide centerline grade elevations at each 50-foot (15M) Station.

7. Show new and existing drainage structures on the profile.

(g) Utility Profiles. Provide profiles for all storm drains and sewer lines. Indicate invert elevations of all drainage structures, manholes, storm drainpipe with size and invert elevations, ground profile, and new or existing structures or utilities crossing the new utilities.

(h) Miscellaneous Details. Plans shall include the following,

1. Minimum paving and compaction requirements.

2. Typical sections through the building site as required for clarity.

3. Legend.

4. Storm drainage pipe and structure schedule.

5. Parking layout.

6. Superelevation and widening details.

(i) Concrete Joint Plans

1. Concrete Joint Layout Plans: Provide a joint layout plan for each concrete apron, hardstands, road, pavement, etc. The joint plan must clearly indicate the required joint type for all joints as well as slabs that require reinforcement. The scale of layout plans shall be 1:200 (1"=20') unless otherwise approved.

2. Concrete Joint Grading Plans: Provide a joint grading plan for all concrete pavements, aprons, hardstands, roads, etc. The grade for each joint intersection shall be provided on the plan at the specific joint. Only joints with grades, which can be linearly interpolated, may be omitted. Sufficient grades must be provided to facilitate calculation of all joints in the plan.

3. Concrete joint details: Provide details of all joint types as applicable to the project. Provide detail of joint sealant.

4. Sidewalk joint layout: Provide details of sidewalk joints for entrances at buildings, handicap ramps, and circular drives, etc, as applicable.

(j) Erosion and Sediment Control Plan

1. For all projects with land disturbance provide a sediment and erosion control plan. The plan will design the necessary "best management practices" required to control sedimentation and erosion throughout the life of the constructed facilities.

2. Provide calculations in the design analysis for sizing sedimentation basins, ditches, ditch liners, etc.

3. Provide details as required for all erosion and sediment control devices.

4. Provide erosion and sediment control phasing notes.

5. Provide a Storm Water Pollution Prevention Plan. Plans must be in accordance with the current EPA requirements and state/local requirements. The plan will be coordinated with the Sediment and Erosion Control Plan.

(k) Planting Plan. The planting plan will locate and identify items of plant material to be used and existing materials to be preserved or removed. A plant list including quantities, sizes, and varieties of plants will be included. The designer will prepare this plan only when directed by USAESCH at the beginning of design.

(3) Specifications. The outline specifications previously submitted for concept phase shall be revised, updated, further developed and resubmitted in accordance with chapter 2, Project Specifications.

d. Final Design Requirements. This is the un-reviewed 100% submittal. The designer will advance the design to completion resolving/incorporating all comments from the previous reviews.

(1) Final Design Analysis. Update previously prepared analysis to support final plans and specifications. Any required permit application packages shall be included as an appendix in the Final Design Analysis.

(a) NPDES Construction Permit Application

1. Provide a completed application for the required signature, for applicable projects requiring State and Federal NPDES Permitting. The PM will provide the name, title, address, etc. of officials signing permit applications.

2. Provide Best Management Plan certification for State projects requiring certification of the Best Management Plans.

(2) Final Drawings

(a) Add general notes to drawings as required.

(b) Insure correct cross-referencing among site drawings for appropriate details, sections, match lines, etc.

(c) Eliminate all conflicts (horizontal and vertical) among site plans and architectural, structural, and utilities plans.

(3) Final Specifications

(a) Complete draft of specifications to cover all items of site work. Any required permit applications, permit approval letters, and/or any requirements that apply to project construction shall be included as an appendix in the specifications.

(b) Insure consistency of terminology between plans and specifications for notations on specific items of work.

(c) Perform check to insure adequate referencing for construction details.

e. RFP (Request For Proposal) Development Requirements. UFC 1-300-07A includes guidance to allow for three different levels of RFP development. These are 'Nominal', 'Partial', and 'Full' project criteria development. This section provides both mandatory and specific criteria requirements that will be used, in conjunction with UFC 1-300-07A in the development of Huntsville Center RFPs.

(1) Mandatory Requirements. The following are requirements and criteria that must be included (as applicable) in the RFP for every project regardless of the level of RFP development:

(a) Storm Drainage System. EPA National Pollution Discharge Elimination System (NPDES) permits for construction activities may be required. The Design-Build contractor should be made aware of this in the RFP. The Design-Build contractor's

design will determine the need for the permit. If the permit is required, the D-B contractor will prepare the documentation for the Storm Water Pollution Prevention Plan (SWPPP) and monitoring plan. This documentation will be submitted to the Contracting Officer's Representative (COR). The COR will submit the documentation for permit application.

(b) See UFC 1-300-07A for additional mandatory requirements.

(2) Specific Requirements. The following are requirements and criteria that must be included (as applicable) in the RFP for every project for the indicated level of RFP development. Where the requirements stated in this document differ from the ones in UFC 1-300-07A, this document will take precedence:

(a) 'Nominal' Project Criteria: Include special site design requirements and a preconcept plot plan (if available).

(b) 'Partial' Project Criteria: Include special site design requirements and a preconcept plot plan (if available).

(c) 'Full' Project Criteria:

1. Preliminary Site Plan (includes grading, stormwater management, utility services, paving, curbing, walks.)

2. Preliminary Landscaping Plan or allowance amount.

3. Pavement Design Analysis.

4. Edited Specifications (includes preliminary specifications on all sitework items including paving sections, earthwork, utilities.)

NOTE: Check individual contract for level of RFP development and for specific design level requirements.

4-6. MASTER PLANS.

a. General. Master plans are drawings and plans that depict actual installation configuration and future expected development. Elements of master plans include basic information maps; analysis of existing facilities/environmental report; building information schedule; future development plans; analytical/environmental assessment report; tabulation of existing and required facilities; and capability plans.

b. Scope. The development of master plans is applicable to the US Army Corps of Engineers and all commands and activities involved in the preparation and maintenance of master plans. Army Regulation 210-20 requires that all Army installations, with permanent construction requirements, have master plans prepared and maintained to facilitate installation and development in a manner that will lead to effective fulfillment of Army missions at minimum cost.

c. Reference Documents. Master planning reference documents are shown in AR 210-20 and UFC 2-000-02AN.

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CHAPTER 5

WATER, WASTEWATER, SOLID AND HAZARDOUS WASTE SYSTEMS, AND ENVIRONMENTAL PROTECTION

5-1. PURPOSE AND APPLICABILITY. This chapter presents the requirements for preparing drawings and design analyses for water supply systems, water and wastewater treatment facilities, water distribution and storage, wastewater collection, irrigation systems, and solid and hazardous waste treatment, storage, and disposal systems. This chapter also presents the requirements for environmental protection and environmental documentation the designer is required to provide during the design and/or construction of USAESCH projects. The designer must ensure all documents on water, sewerage, solid and hazardous wastes, and environmental protections are technically feasible, cost effective, and meet established guidelines. The specific submittal requirements presented in this chapter supplement the requirements of chapter 1, General Instructions. All required documents, including drawings and the design analysis, will be prepared in accordance with chapter 1, General Instructions.

5-2. REFERENCE DOCUMENTS. Directly related reference documents are as follows:

a. AR 200-1, Environmental Protection and Enhancement

b. AR 200-2, Environmental Effects of Army Actions

c. AR 420-47, Solid and Hazardous Waste Management

d. TM 5-634, Solid Waste Management

e. TM 5-813-1, Water Supply: Sources and General Considerations

f. TM 5-813-3, Water Supply: Water Treatment

g. TM 5-813-4, Water Supply: Water Storage

h. TM 5-813-5, Water Supply: Water Distribution

i. TM 5-813-7, Water Supply for Special Projects

j. TM 5-813-8, Water Desalination

k. TM 5-814-1, Sanitary and Industrial Wastewater Collection: Gravity Sewers and Appurtenances

l. TM 5-814-2, Sanitary and Industrial Wastewater Collection: Pumping Stations and Force Mains.

m. TM 5-814-3, Domestic Wastewater Treatment

n. TM 5-814-5, Sanitary Landfill

o. TM 5-814-7, Hazardous Waste Land Disposal/Land Treatment Facilities

p. TM 5-814-8, Evaluation Criteria Guide for Water Pollution Prevention, Control, and Abatement Programs

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

r. National Fire Protection Association Codes

s. Code of Federal Regulations, 40 CFR Parts 260 through 270, Protection of Environment

5-3. TECHNICAL REQUIREMENTS. The following technical requirements will be adhered to, unless required otherwise by the contract. In case of conflicts between references or requirements, contact the PM or KO for guidance. The facility will comply with all applicable Federal, State, and local regulations.

a. Domestic and Industrial Water Supply, Treatment, Storage, and Distribution. These systems will be designed in accordance with TM 5-813-1 through TM 5-813-7.

b. Outside Fire Protection. Outside fire protection systems will be designed in accordance with the applicable sections of TM 5-813-1, TM 5-813-4, TM 5-813-5, TM 5-813-7, UFC 3-600-01, and the NFPA. Fire protection requirements will be reflected in the Fire Protection Design Analysis as specified in chapter 1.

c. Sanitary and Industrial Wastewater Systems. These systems will be designed in accordance with TM 5-814-1, TM 5-814-2, TM 5-814-3, and TM 5-814-8.

d. Irrigation Systems. Irrigation systems will be designed in accordance with industry standards. If treated wastewater effluent is to be used for irrigation, requests for approval will be submitted to USAESCH and the regulatory agencies.

e. Solid and Hazardous Wastes Systems. Such systems will be designed in accordance with TM 5-634, TM 5-814-5, and the 40 CFR series.

f. Potable Water Quality. The quality of potable water will meet the current EPA, state, and local drinking water quality standards.

g. Wastewater Treatment Plant Effluent Quality. Wastewater effluent will meet the EPA, state, and local wastewater discharge permits. Wastewater treatment plant effluent will be reused to the maximum extent possible for irrigation, plant wash-down, etc. Provisions will also be made to reuse industrial and cooling tower blow down water to the maximum extent possible.

h. System Reliability. Only those systems and/or processes having proven reliability, ease of operation, and minimum maintenance requirements will be considered.

i. Safety and Comfort Items. If operators are used to perform facility operations, adequate safety and comfort items will be provided including emergency shower and

eyewash, toilets, and drinking fountains.

j. Storage Space and Handling Facilities. Adequate storage space and handling facilities will be provided for supplies, chemicals and spare parts.

k. Corrosion Protection. Those systems and structures that are buried, submerged, or in contact with ground or substances which may be corrosive, will be protected from corrosion. Noncorrosive materials will be used to the greatest extent possible.

5-4. DESIGN ANALYSIS. A design analysis will be required with each review as described in chapter 1. The design analysis will be checked by an engineer other than the engineer developing the analysis.

5-5. DRAWINGS. Drawings under this discipline will be included with Civil Engineering drawings.

5-6. ENVIRONMENTAL DOCUMENTATION. Environmental documentation preparation is the responsibility of the proponent of the project. The designer may be required to prepare environmental documentation as part of the services required by the project scope of work. Environmental impact generated by the proposed project will be assessed in accordance with the National Environmental Policy Act of 1969 (NEPA) and AR 200-2. All projects will include environmental documentation either in the form of Record of Environmental Consideration (REC), Environmental Assessment (EA), or Environmental Impact Statements (EIS).

5-7. ENVIRONMENTAL CONTROL DURING CONSTRUCTION. Mitigation of potential environmental pollution during construction will in accordance with Federal, State, and local regulations. The design may require the construction contractor to submit an environmental protection plan during construction for approval. The environmental protection plan will comply with applicable Federal, State, and local regulations. Environmental pollution will be defined as the discharge of storm water runoff, chemical, physical, or biological elements or agents that adversely affect human health, unfavorably alter ecological balance, or degrade the environment. The foregoing requires consideration of air, water, land, noise, solid and hazardous wastes, radioactive materials as well as other pollutants.

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CHAPTER 6

ARCHITECTURAL

6-1. PURPOSE AND APPLICABILITY. This chapter outlines the requirements, responsibilities, and objectives for preparing and presenting architectural designs. Excellence in architectural design will be a prime goal for military construction projects. Designers will assure architectural compatibility with the local environment, economy of construction, sustainability, energy conservation, functional requirements, interior and exterior detailing, life cycle cost and siting. The architectural theme is normally established by the installation design guide. In absence of an installation design guide, the designer will establish an overall theme for architectural style (existing or new), colors, materials in keeping with local culture and customs that are appropriate for the geographic area or climate and are widely available.

6-2. REFERENCE DOCUMENTS. The documents listed below are directly referenced in this chapter and should be used. Designers are required to become familiar with the requirements in these documents and ensure compliance where applicable.

a. ER 1110-345-700, Design Analysis, Drawings and Specifications

b. FED-STD-595B, Colors and 29 CFR 1910.144, Safety Color Code for Marking Physical Hazards

c. UFC 3-600-01, Fire Protection Engineering for Facilities

d. UFC 4-010-01, DOD Minimum Antiterrorism Standards for Buildings

e. NFPA 80, Fire Doors and Fire Windows

f. NFPA 80A, Recommended Practice for Protection of Buildings from Exterior Fire Exposures

g. NFPA 101, Life Safety Code

h. UFC 3-190-01FA, Joint Sealing for Buildings

i. IBC, International Building Code

j. TI 800-01, Design Criteria

k. UFC 1-200-01, General Building Requirements

l. Americans with Disabilities Act and Architectural Barriers Act Accessibility guidelines

m. Uniform Federal Accessibility Standards (UFAS)

n. ACSIM Installation Design Standards (IDS)

o. ECB No. 2008-1 Sustainable Design and Development

6-3. ARCHITECTURAL/DESIGN CONSIDERATIONS.

a. Special Considerations. There are areas which require special consideration to ensure design quality and compliance with applicable codes and standards. Energy conservation and life cycle cost design features will be reflected in the Energy Conservation and Life Cycle Cost Design Analysis specified in chapter 1. New and existing inhabited buildings must comply with mandatory DOD minimum antiterrorism standards as set forth in UFC 4-010-01. Essential architectural considerations or emphasis are as follows:

(1) Functional Design. Facility planning will employ economical, functional architectural and engineering design tailored to the requirements of the project, with attention given to the selection of exterior and interior finishes and to the extent and type of equipment and services to be provided.

(2) Sustainable Design. Architecture directs much of the sustainable design requirements. Sustainable features will be provided to the greatest extent possible within the scope of the project including but not limited to: passive and active solar design, daylighting, ventilation, solar screens and shades, thermal performing envelope, building arrangement, building reuse, etc.

(3) Technical Codes and Standards. Compliance with minimum life safety, building codes and technical manuals cited in this document are mandatory. If deviations from criteria or codes are necessary, requests will be put in writing and fully justified with compensating provisions to assure an equivalent level of safety. State and local building codes and building regulatory agencies do not normally have jurisdiction on military installations. State and local building codes and regulatory agencies have jurisdiction over Government-owned or Government-leased facilities that are not on military reservations.

(4) Construction Classification. The designer is responsible for determining that occupancy classifications, minimum fire resistances, fire protection systems, and means of egress conform to the codes and standards cited above.

(5) Barrier Free Design. Except for specifically exempt facilities, all facilities will be designed to meet the accessibility standards as referenced in TI 800-01.

(6) Site Adaptation. When site adapting standard design drawings (or using earlier designs from other locations), the design changes will generally be limited to the selection of alternate exterior or interior materials, when such changes are economically and regionally justified, and to update changes necessary to conform to current criteria.

(7) Alternate Designs and Recommendations. Alternate designs will not be developed unless required by the contract. Designers, however, are encouraged to make recommendations to improve the functional and/or technical criteria.

6-4. CONCEPT DESIGN. The designer will prepare the concept design in accordance with the functional criteria and the contract. This submittal will include as a minimum the following:

a. Design Analysis. The designer will state the purpose, function, and capacities in sufficient detail to fully present the design solutions, materials, features, and the visual appearance of the project. The design analysis will also include a statement of any requirements for signage plans or graphics, and will provide a brief statement on the interior and exterior finish materials used in the project. The designer/ architect will submit complete calculations for gross building areas, the "U" values for each exterior wall assembly and roof assembly, and the counts for toilet fixtures, urinals, and lavatories per appropriate codes and standards.

b. Architectural Drawings. Drawings will be provided in sufficient detail so the Using Agency can visualize precisely how the designer has interpreted the functional and operational requirements. Drawings will include, but not be limited to, the following:

(1) Cover Sheet. The designer will produce a cover sheet and obtain authentication IAW with chapter 1.

(2) Perspective. The designer will provide single-line perspectives when required by the contract. This is normally shown on the cover sheet.

(3) Architectural Floor Plans.

(a) Composite Plans. If the overall floor plan cannot be drawn on one sheet at a 1:100 (1/8-inch per foot) scale, the designer will provide a smaller scale, 1:200 (1/16-inch per foot), floor plan showing exterior walls, interior partitions, circulation elements, and cross referencing for enlarged partial plans. A key plan will be used on each sheet which shows the relationship of the partial plan with the rest of the building.

(b) The floor plan or partial floor plans will be drawn at 1:50 (1/4-inch per foot) for small buildings or 1:100 (1/8-inch per foot) scale with major elements enlarged on another drawing. The plan should include critical and overall dimensions and functional arrangements of areas, including corridors, exits, stairs, support spaces, etc. Spaces will properly relate to access roads, parking lots, service areas, etc.

1 The column grid lines will show the relationship of architectural and structural systems. Columns and grids lines will be shown on all design submittals and will be consistent with the functional requirements.

2 The location and rating of fire walls and partitions will be shown on the architectural floor plan. Openings in and penetrations through firewalls and partitions will be designed in accordance with NFPA standards.

3 Gross Floor Areas. Floor areas will be indicated in tabular form on the architectural floor plan sheet. The breakdown will be composed of the totals for spaces computed at full areas, for spaces computed at one-half area, and for their combined total. The areas will be computed in accordance with the TI 800-01. The floor plan itself will be devoid of floor area indications.

4 Rooms. On the architectural floor plan where an area is divided into rooms, individual room numbers and names will be shown for each room. These names and numbers will be used in preparing the room finish schedule.

(c) Multi-story Buildings. The designer will show a plan for each floor and include the table of Gross Floor Calculations on the sheet with the first floor plan.

(d) Demolition Floor Plans. For renovation projects, demolition floor plans will show clearly the work and non-work requirements on renovation and modification projects. Where work is extensive, show existing-to-remain, demolition and new work.

(e) Fire Protection Code Compliance Plans. The code compliance information will be presented on the drawings in the concept design phase. These drawings will be updated to reflect design evolution changes and submitted with subsequent design review packages, but will not be part of the final construction drawings. The presentation will be in a format that will facilitate code and regulation evaluation against the design submitted. The analysis will be based on the International Building Code and NFPA 101 Life Safety Code. The plans will contain the following:

1. Occupancy classification(s)
2. Construction type classification(s)
3. Allowable floor area(s)
4. Allowable floor area(s) and area separation requirements
5. Allowable building height and number of stories
6. Allowable building height and area increases
7. Building occupancy separation(s)
8. General fire suppression requirements due to occupancy hazards and/or building area increases
9. General fire detection requirements of the occupancy classification
10. Site separation requirements identifying clearances to property lines and other buildings
11. Allowable percentage of exterior openings
12. Fire ratings of exterior openings if required
13. Building occupancy loads per floor or building area
14. Means of egress requirements to include required width and capacity of passage ways, corridors, stairs, ramps and doors; travel distances, common path of travel exit discharge; horizontal exits and areas of refuge; fire resistive requirements for exit and exit access enclosures.
15. Fire resistance of materials identifying fire test numbers of assemblies used.

(f) Building Elevations. Building elevations will show grading, openings, and principal exterior materials. Exterior elevations will be drawn to scale showing all windows, doors, louvers, canopies, platforms, gutters, downspouts, visible structural frame, control and expansion joints, and panels.

(g) Building Sections. Cross sections will be provided to show the uniqueness of the facility in terms of material, finishes, ceiling heights, and construction techniques. Number of building sections will depend on the complexity of the facility.

(h) Wall Sections. Wall sections will be provided for major components and building systems. Wall sections will show materials, thicknesses, methods of attachments, and relations of architectural elements to supporting structures.

6-5. INTERMEDIATE DESIGN.

a. Drawings. The following design information or new sheets will be added to the concept architectural drawings:

(1) Architectural Floor Plan. This plan will be updated to include door and window numbers, door swings, completed space names, space numbers, section cuts, etc., and will reference all section cut lines on plans to the appropriate detail and any appropriate construction notes. Enlarged plan callouts will be added.

(2) Reflected Ceiling. A reflected ceiling plan at the same scale as the floor plan will be added showing ceiling materials/systems to be used throughout the building. The plan will show location of all elements to be placed on the ceiling including, but not be limited to, HVAC diffusers, lights, speakers, and fire protection detectors.

(3) Roof Plan. A roof plan showing slopes, drainage, scuppers, roof-mounted equipment, skylights, and traffic surface walkways will be developed and added to the concept drawings.

(4) Building Sections. Additional cross sections through the entire building showing major building components, building systems, and construction materials.

(5) Wall Sections. Typical wall sections (interior and exterior) will be shown in sufficient number and size to convey the intended construction. Wall sections will show additional dimensions, materials, techniques, and unique connections.

(6) Schedules. Tabular schedules of interior finishes and colors, doors, windows, etc., will be developed. Schedules may be placed on the same sheet as the floor plan when the scale and size of the building permits. All blanks on schedules will be filled in. A dash will be used when an entry is not applicable. Ditto marks will not be used on a schedule. The abbreviations and their definitions will be identified as a note.

(a) Finish Schedule. A finish schedule will be provided for each building. Color selection of exterior and interior finishes, if selected, will be provided. These selections will be incorporated into the finish schedule, or on a separate schedule on the same drawing. The schedule, or its notes, will include exterior colors.

(b) Door Schedules. Every door will be assigned a separate number. This number will be circled and clearly indicated on the drawings. The numbering of doors should be as consecutive as possible, beginning with the principal entrance and progressing clockwise around and through the plan. Hardware (HW) will be indicated on the door schedule by set numbers (HW-1, etc.). The designer will have the option to expand the door number symbol on the plans to include door and hardware set numbers. The description of each hardware set number will be specified. Door schedules will show louver and glazing sizes and types required. Louvers, as differentiated from stamped open lattice grilles, will be used. Fire rating, when applicable, will be indicated on the schedule for the appropriate door. The door schedule will cross reference the head, jam, and sill details which are provided for each door on the detail sheets.

(c) Window Schedules. Window schedules may be placed on the sheet with

the door schedule, or may be placed on a separate sheet. Method of compliance with energy conservation requirements contained in TI 800-01 must be indicated.

(d) Equipment Schedules. Where food preparation and serving equipment are required, a schedule defining the preliminary equipment selection will be included. This may be provided on a "blow-up" plan sheet of the area where food service equipment is to be installed or on a separate sheet immediately following the kitchen food preparation service area and its details. The schedule format for food service equipment should comply with commercial standards or accepted methods of depicting this type of equipment. Each piece of equipment will be assigned an individual number and tracked according to that number. All the salient features of the equipment including power requirements will be included on this sheet.

6-6. FINAL DESIGN.

a. Final Drawings

(1) Required Drawings. Final drawings will show all pertinent plans, elevations, sections, details, schedules, and notes to present a complete and accurate description. Door, window, and space numbers will be properly shown. Location of wall sections and cross sections will be shown on plans and elevations.

(2) Coordination of Drawings. The designer will ensure the architectural drawings have been properly coordinated with structural, mechanical, electrical, and site drawings, as well as with specifications.

(3) Accuracy of Drawings. Dimensions, schedules, sections, and details will be completely reviewed and checked to ensure proper coordination.

b. Hardware Consultant. On large complex facilities, the technical support of a certified hardware consultant is recommended to assist in the selecting and specifying the proper hardware sets.

CHAPTER 7

STRUCTURAL

7-1. PURPOSE AND APPLICABILITY. The purpose of this chapter is to outline requirements, responsibilities, and objectives for the structural design of hardened and ordinary construction. It is applicable for all structural designs for which USAESCH has design responsibility.

7-2. REFERENCE DOCUMENTS. The following Government and Non-Government publications will be used as sources of criteria for structural design. The criteria from the Government sources may be supplemented, but not supplanted, by applicable criteria contained in the Non-Government sources (nationally recognized codes, standards, and specifications).

Government References:

a. ER 1110-345-100, Design Policy for Military Construction

b. ER 1110-345-700, Design Analysis, Drawings, and Specifications

c. TI 800-01, Design Criteria

d. TM 5-818-1, Soils and Geology Procedures for Foundation Design of Buildings and Other Structures (Except Hydraulic Structures)

e. TM 5-1300, Structures to Resist the Effects of Accidental Explosions

f. UFC 1-200-01, General Building Requirements

g. UFC 3-310-01, Load Assumptions for Buildings

h. UFC 3-310-02A, Structural Design Criteria for Buildings

i. UFC 3-310-04, Seismic Design for Buildings

j. UFC 3-310-07A, Cold-Formed Load Bearing Steel Systems and Masonry Veneer/Steel Stud Walls

k. UFC 3-310-05A, Masonry Structural Design for Buildings

l. UFC 3-320-04A, Metal Building Systems

m. UFC 3-320-05A, Structural Design Criteria for Structures Other than Buildings

n. UFC 3-320-06A, Concrete Floor Slabs on Grade Subjected to Heavy Loads

o. UFC 3-340-01, (FOUO): Design and Analysis of Hardened Structures to Conventional Weapons Effects

p. UFC 3-340-02AN -09AN, Design Series: Facilities to Resist Nuclear Weapons Effects

q. UFC 3-340-13, Basic Guidelines for Chemical Warfare Hardening of Facilities

r. UFC 4-010-01, DOD Minimum Antiterrorism Standards for Buildings

s. UFC 4-010-02, (FOUO): DOD Minimum Standoff Distances for Buildings

t. AR 190-11, Physical Security of Arms, Ammunition and Explosives

u. AR 190-13, The Army Physical Security Program

v. AR 380-5, Information Security Program

w. AR 385-64, U.S. Army Explosive Safety Program

x. AR 415-15, Army Military Construction Program Development and Execution

y. DA PAM 385-64, Ammunition and Explosives Safety Standard

z. DoD 6055.9 STD, DOD Ammunition and Explosives Safety Standard

aa. DOE/TIC 11268, Manual for Prediction for Blast and Fragmentation Loading on Structures

bb. FEMA 450-1, NEHRP Prestandard and Commentary for the Seismic Rehabilitation of Buildings

cc. FEMA 450-2, NEHPR Recommended Provisions for Seismic Regulations for New Buildings and Other Structures

Non-Government References:

a. AA-94 Part 1-A, Specifications for Aluminum Structures- Allowable Stress Design

b. AA-94 Part 1-B, Specifications for Aluminum Structures- Load and Resistance Factor Design of Buildings and Similar Type Structures

c. ACI 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures

d. ACI 318, Building Code Requirements for Reinforced Concrete

e. ACI 530, Building Code Requirements for Masonry Structures

f. NDS, National Design Specification for Wood Construction

g. AF&PA/ASCE 16, Standard for Load and Resistance Factor Design (LFRD) for Engineered Wood Construction

h. AISC ASD, Manual of Steel Construction, Allowable Stress Design

i. AISC LRFD, Manual of Steel Construction, Load and Resistance Factor Design

j. ASCE 7, Minimum Design Loads for Buildings and Other Structures

k. AWS D1.1, Structural Welding Code – Steel

l. AWS D1.4, Structural Welding Code - Reinforcing Steel

m. IBC, International Building Code

n. MBMA Low Rise Building Systems Manual

o. SDI Design Manual for Composites Decks, Form Decks, and Roof Decks

p. SJI Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders

7-3. *CONCEPT DESIGN*

a. Design Analysis: Concept design analysis will be developed in accordance with the instructions in chapter 1, General Instructions. The specific content will be essentially as outlined below:

(1) A statement identifying the design as one of the following: (a) an original design, (b) a site adaptation of standard design drawing, (c) a site adaptation of a previous design, or (d) a renovation of an existing structure.

(2) A list of structural design criteria references.

(3) A list of structural design loads and conditions.

(4) A list of structural materials and identification of the proposed use of each material in each building structure.

(5) Description of the structural system for original designs. The vertical and lateral load resisting systems should be clearly described. The reason for selecting a particular framing system should be stated. The selection should be based on a cost comparison of at least three competitive systems. The systems considered and cost comparison results should be stated. Selection of a system which is not the most economical system must be justified. In the event that design, architectural or functional requirements or site conditions dictate the system selection, a statement to this effect should be included and fully justified.

(6) Description of miscellaneous design features. Where applicable to the immediate project, include a description of each of the following design features.

(a) The proposed treatment of any unusual structural features or unique solutions to structural problems.

(b) Measures taken to compensate for expansion/contraction and crack control in masonry walls.

(c) Identification of any major vibrating elements and measures taken to isolate them.

(d) Identification of critical systems or equipment that will be supported by the structural components of the building.

(7) Site Adaptations of Standard or other previous designs. A description of the entire structural system is not required. Instead describe the proposed design changes necessary for adapting the design to the immediate project's site conditions and, when so instructed, address the design changes necessary for conformance with current design criteria.

(8) Renovation of an Existing a Facility. A description of the entire structural system is not required. Instead, describe the proposed design changes necessary for renovating/retrofitting the existing design to the immediate project's site conditions and, when instructed, the design changes necessary for conformance with current design criteria. There are possible scenarios where existing buildings may need to be upgraded to meet the latest seismic and antiterrorism criteria. The designer shall research the latest Unified Facility Criteria to determine if the existing building renovation has 'triggered' the upgrade criteria.

9) Original Design. Provide structural computations to determine preliminary sizing and spacing of primary structural components.

b. Drawings

(1) Original Designs. Drawings will show the following:

(a) Foundation plan and typical sections.

(b) Lateral load resisting system (shear walls, bracing, frames, etc.).

(c) Roof framing plan with sizing of typical members.

(d) Floor framing plan(s), where applicable, with sizing of typical members.

(2) Site Adaptations of Standard or other Previous Designs. List the titles and drawing numbers of the standard or other existing drawings with the basic revisions proposed.

(3) Renovation of an Existing Facility. List the titles and drawing numbers of the existing drawings with the basic revisions proposed.

7-4. INTERMEDIATE DESIGN

a. **Design Analysis.** Contents will include all the items in the concept submittal plus all design progress to point of submission of this submittal. Structural calculations will be developed to the contract required Intermediate Design level of completion. All computer programs used will be fully documented including a description of the method of analysis, the preparation of input, and description and interpretation of the output. The design analysis will include:

(1) Original Designs. All electrical and mechanical equipment requiring seismic qualification will be clearly denoted in table format. This list will be coordinated with the electrical and mechanical designers and included in their respective sections of the design analysis. Design calculations will be furnished for all structural members and systems such as foundations, frames, floors, roofs, stairways, equipment supports, and ancillary structures. All computations will be given a complete numerical and theoretical check. Calculation sheets will carry the names or initials of the designer and the dates of calculations. The structural design must include calculations of lateral load path to resist seismic and wind loads. Preliminary calculations for steel secondary members and critical connections for the primary steel framing members must be included. For reinforced concrete and masonry, calculations to determine wall/slab/roof thicknesses and reinforcing steel sizes and spacing shall be included.

(2) Site Adaptations of Standard or other Previous Designs. It is not necessary to develop complete structural calculations for a site adaptation because the adapted design is presumed to be correct and pre-approved for which it was designed. A comparative analysis for site adaptations to the same completion level as the Intermediate Design is required instead of complete calculations. The Intermediate Design comparative analysis will identify the previous design being copied, list the structural differences (such as changes in design wind pressure and allowable soil bearing pressure), and provide computations for adapting the design to the site conditions. Site adaptations always involve some changes in design conditions, such as length or spacing of beams, exterior wall construction, actual live loads, and foundation conditions. A comparative analysis will identify the standard design being copied, enumerate the structural differences, and provide sufficient computations (Intermediate Design level complete) to justify the differences. For site adaptation of previous design, the designer will verify that the previous design is adequate for the structural loading for the project site location. He will prepare a new foundation design, and submit a new design analysis containing all the pertinent information and calculations from the original design analysis plus all the new information and calculations up to Intermediate Design level of completion.

(3) Renovation of an Existing Facility. The structural designer will examine the architectural, electrical, and mechanical drawings when they are 35 percent complete, and become knowledgeable with the existing structure. The designer will understand the structural capability and limitations of the existing building. The designer will determine if changes represented by the rehabilitation will endanger any part of the existing structure. If the review results in negative findings, the designer will immediately notify the PM or KO. Based upon contract requirements or direction from the PM, the designer may be tasked to design and detail the alterations necessary to make the completed structure safe. The contents of the structural calculations will be similar to paragraph 7.5 a. (1) above.

b. Drawings. Contents shall include all the items in the concept submittal plus all design progress to point of submission of this submittal. The intermediate design (Original Designs, Site Adaptation Design of Standard Drawings and Previous Designs, Renovation of an Existing Facility) drawings will include the following items:

(1) Connection details for primary steel framing members.

(2) Reinforcing steel sizes and spacing for all primary framing members.

7-5 FINAL DESIGN. This submittal will incorporate all accepted comments generated from the previous submittals. Contents will include all the items in the intermediate phase plus all design progress to point of submission of this phase.

a. Design Analysis.

(1) Original Design: Design computations will include an investigation of loading (gravity, wind, seismic, blast, etc.), shear, moment, stress analysis diagram, uplift, stability, and deflection calculations. The computations will be systematic and accurate. Complete design calculations are required. The designer will present the calculations in a clear and legible form, incorporating title page, table of contents, and a tabulation showing all design loads and conditions. Pages will be numbered consecutively and identified in the table of contents. Cross-referencing will be clear. The source of loading conditions, formulas, and references will be identified. Assumptions and conclusions will be explained. All computations will be given a complete numerical and theoretical check and the designer's and reviewer's names and dates of design and review will be recorded on the calculation sheets. For computer software analyses, the designer will include all applicable input and output data in readable, printed form as part of the design calculations. All computer codes will be identified. Computer-generated procedures and calculations will be verified by hand calculations to verify the procedures used and accuracy of the results, unless this verification has been done on a previous project. Every computer calculations does not have to be verified by hand, but sufficient hand calculations will be performed by the designer to demonstrate the accuracy of the computer calculations.

(2) Site Adaptation of Standard Designs and Previous Designs. A comparative analysis as identified in paragraph 7-5a. (2) above must be 100 percent complete. When applicable, the contents of structural calculations per paragraph 7-6a. (1) above will be provided.

(3) Renovation of an Existing Facility: The designer will understand the structural capability and limitations of the existing building. The designer will determine if changes represented by the rehabilitation will endanger any part of the existing structure. If the review results in negative findings, the designer will immediately notify the PM or KO. Based upon contract requirements or direction from the PM, the designer may be tasked to design and detail the alterations necessary to make the completed structure safe. The contents of the structural calculations will be similar to paragraph 7-7 a. (1).

b. Drawings. Contents will include all the items in the intermediate phase plus all design progress to point of submission of the phase. The drawings will be complete and

provide details of all structural elements. The following requirements will be incorporated:

(1) Original: Drawings will be complete and accurate and completely coordinated with the other design disciplines. Drawings should use Architectural drawings as reference file where applicable. The drawings will be complete with all plan views, sections, details, schedules, diagrams, and notes necessary for the bidding and construction of the project. For structural steel framing, the drawings will meet the requirements for design drawings set forth in the AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings. For structural concrete, the drawings will conform to the standards for engineering (design) drawings set forth in the ACI Detailing Manual (ACI 315). Additionally, those items described below which are applicable to the design will be incorporated in the drawings.

(a) Provide a complete set of general notes indicating design loads and material strengths.

(b) Use grade beam, slab, lintel, column, and footing schedules where the size of building warrants.

(c) All critical structural steel connections will be completely detailed and shown on the contract drawings. Critical connections are those connections subjected to moment, axial and shear loads, or combinations thereof. Only simple connections (i.e., connections classified as shear connections and subjected to shear loads only) may be deferred to the construction contractor for detailing.

(d) All roof and floor openings, with details, will be shown on the structural drawings.

(e) Grid Systems, Dimensions, and Floor Elevations.

1. Grid System. Each foundation plan, floor plan, and other structural plan will have an alpha-numeric grid system aligned with the columns, or with load bearing and non-load bearing walls, as applicable. Use the same grid system for all plan views. Grid system will match other design disciplines.

2. Dimensions. Each view shown will have all necessary dimensions. On plan views, the dimensions will define the location of grid lines, offsets, and all structural elements, as well as the overall sizes of buildings and structures.

3. Finish elevation of the first floor will be indicated as 100'-0", and elevations for other floors, foundations, and roofs will be referenced to this basic elevation.

(f) Plan Views.

1. Foundation plan will show the size and location of all foundation elements, such as foundation walls, grade beams, piers, footings, piles, and pile caps, drilled piers, and/or foundation drains, which are included in the design. Elevations for footings, pile caps, and foundation drains will be indicated on the plan.

2. Floor slab plan for building slabs-on-grade and exterior slabs at building entrances will show location and type of joints, slab thicknesses, and reinforcing, elevation of slab surfaces, and any other design features, such as drain trenches or equipment bases which affect the slab design. Also, indicate whether slabs are placed over vapor and capillary water barrier.

3. Framing Plan. A separate framing plan will be provided for each structural floor and roof. Plans will show the size, spacing, and location of all floor/roof framing members, their supporting columns or walls, and all auxiliary members such as bracing, bridging, and sag rods. Also, the size and location of all major openings through floors and roofs will be shown.

4. Elevation views, sections and details as necessary to fully illustrate the complete design.

(2) Site Adaptation of Standard Designs and Previous Designs: Provide 100 percent complete drawings for those applicable items listed in 7-7 b (1) above.

(3) Renovation of an Existing Facility: Provide 100 percent complete drawings for those applicable items listed in 7-6 b (1) above.

7-6. STRUCTURAL SYSTEMS. Structural designs should use material efficiently, provide maximum usable space, minimize the use of special equipment, and utilize conventional methods of construction. Consideration must be given to future uses of the structure, possibilities of alterations, and alternate functions and maintenance costs during the required lifetime of the structure. The selection of the structural system will be in accordance with UFC 3-310-02A.

7-7. COORDINATION. The importance of coordination cannot be overemphasized. Structural drawings will be coordinated with other design disciplines. Special attention should be given to:

a. Specifications. The structural sections of the specifications will be checked against the design drawings. If the specification section refers to the drawings for design and construction data, the drawing will contain the data and vice versa.

b. Bonding and Grounding. Facilities may require bonding and grounding of metal work to eliminate interference with radio or radar operations explosive hazards, or for lightning protection. The structural engineer will coordinate facility criteria with the design so that bonding and grounding of reinforcing bars, structural steel, and other metal work can be easily accomplished and can be shown in detail on the drawings, and will be in agreement with the appropriate electrical section of the specifications. For certain operations, floors will be spark proof or electrically conductive.

7-8. DESIGN CALCULATIONS. Computations will be indexed and arranged in an orderly manner, with basis of design followed by calculations and appropriate sketches shown, so that elements of the structure can be easily identified. The loads acting on the element will be calculated and the required physical properties of the element determined and shown on the sketches. Formulas, tables, curves, etc., used in calculations will be referenced. When computers are used to perform design calculations, in addition to other information required elsewhere in this manual, the

calculations will include:

a. Basis for Design. The design will describe methods, assumptions, theories, and technical formulas employed in design solutions.

b. Computer Applications. Copies of computer data, accompanied by diagrams that identify supports, joints, members, and according to the notations used in the data listings, will form integral parts of the design calculations in lieu of manual computations otherwise required. These listings will be augmented with intermediate results, where applicable, so that sufficient information is available to permit manual checks of final results.

c. Information. The name and description of the computer programs will be provided. Other information will be in sufficient detail so the method of solution and limitations may be identified. Designers are encouraged to use well-documented, widely accepted, structural analysis programs that are continuously maintained and enhanced by an experienced computer service organization.

d. Confidential or Proprietary Information. The use of confidential or proprietary information should be avoided. If proprietary or confidential computer programs are used, it is the responsibility of the designer to provide suitable documentation to confirm accuracy. In order to verify the accuracy of the proprietary or confidential program, sample problems should be solved and the results compared with results from a widely accepted structural analysis program.

e. Data Submission. Output data from critical load cases and all input data will be submitted for review. Loads and load combinations will be per paragraph 7.11 below. At a minimum, the calculations must clearly show the load combinations and the designer will explain how the loads are applied to the structure. Output must clearly identify all structural members shape and size. Output must clearly identify all applicable code criterion have been met. At a minimum, the output must clearly show support reactions, member deflections, stress check ratios (actual/allowable), and the controlling load combination for the various structural members. Data will be double checked for accuracy. Final submission will include a set of checked computations marked final. Designers will provide signature approval that the data are complete and accurate. The practice of sending additional sheets to be incorporated with previously submitted computations is not acceptable.

7-9. BASIC DESIGN REFERENCES. The basic structural design references for buildings are provided in UFC 1-200-01, UFC 3-310-02A., and UFC 3-310-01.

7.10. DESIGN LOADS

a. Conventional Loads. Design load criteria shall be in accordance with the applicable references provided in UFC 1-200-01 and UFC 3-310-02A .

b. Blast Load. See paragraph 7.19, Hardened Structures.

c. Standard Designs. Standard designs for buildings previously designed by other criteria for wind, snow or seismic loads that equal or exceed the design loads required by applicable references provided in UFC 1-200-01 and UFC 3-310-02A need

not be redesigned when appropriately site adapted.

7.11. COMBINED LOADS. Loads will be combined to produce the worst case in accordance with the applicable references provided in UFC 1-200-01 and UFC 3-310-02A.

7-12. FOUNDATION DESIGN. Foundation design will be in accordance with the applicable references provided in UFC 1-200-01 and UFC 3-310-02A. The designer will furnish preliminary plans and schedules of column loads with dead and other long term loads identified for use in developing foundation recommendations. Coordinate with geotechnical requirements, chapter 3.

a. Expansion Soil Areas. Design of buildings founded on expansive soil shall be in accordance with the applicable references provided in UFC 1-200-01 & UFC 3-310-02A.

b. Special Concrete Requirements. See applicable references provided in UFC 1-200-01 and UFC 3-310-02A.

7-13. CONCRETE DESIGN. Concrete design will conform to the applicable references provided in UFC 1-200-01 and UFC 3-310-02A.

7-14. MASONRY DESIGN. All masonry design shall be in accordance with the applicable references provided in UFC 1-200-01 and UFC 3-310-02A.

7-15. STRUCTURAL STEEL. Structural steel design shall be in accordance with the applicable references provided in UFC 1-200-01 and UFC 3-310-02A. The type of steel, the system framing, and the design method employed will produce the required structure at the least cost. Steel sections specified will be standard and readily available. The structural steel erection plan must meet the requirements of OSHA Steel Erection Standard.

a. Welded Structures. The design of welded components shall be in accordance with the applicable references provided in UFC 1-200-01 and UFC 3-310-02A.

b. Weight of Section. In order to expedite delivery, minimum weight section of structural steel shapes will be used wherever practicable.

c. Connections. High-strength steel bolts or welded connections will be used in either shop assembly or field erection of structural steel.

(1) The engineer-of-record is responsible for the design of all structural steel connections performed in-house. All critical structural steel connections are completely detailed and shown on the drawings. Critical connections are those connections subjected to moment, axial and shear loads, or any combination thereof. Transferring this design responsibility to the construction contractor by wording on the drawings or through the specifications is not permitted.

(2) Only simple connections may be deferred to the construction contractor for design. Simple connections are connections classified as shear connections and subjected to shear loads only. Design and detailing of these connections should follow

the AISC Steel Design Manual.

7-16. STEEL JOISTS. Steel joists will be in accordance with the applicable references provided in UFC 1-200-01 and UFC 3-310-02A.

7-17. STRUCTURES OTHER THAN BUILDINGS. The design of structures other than buildings will be in accordance with the applicable references provided in UFC 1-200-01 and UFC 3-310-02A.

7-18. HARDENED STRUCTURES. Hardened structures are defined as structures that must resist the effects of nuclear or conventional weapons effects and intentional or accidental explosions. In addition to the preceding requirements, hardened structures will be subject to the requirements of this section. Design will be IAW the regulations referenced in paragraph 7-3.

a. Loads. AFWL-TR-74-102 and UFC 3-340-02AN to 09AN will be the basis for design loads from nuclear weapons effects. Structures designed to resist the effects of conventional explosions will conform to the requirements specified in TM 5-1300, HNDM 1110-1-2, and DOE/TIC 11268. TM 5-1300 provides loads primarily for design of reinforced concrete structures. DOE/TIC 11268 and UFC 3-340-01 provides additional data and design examples to supplement the other references.

b. Loads and Locations. For conventional explosions, the charge and its location used in the calculation will be consistent with the operation reflected in the final drawings. If a change in charge or location results in a significant variance, immediately notify the PM or KO. Based upon contract requirements or direction from the PM, the designer may be tasked to change the design calculations and the drawings accordingly.

c. Stress and Ductility. The yield stress in structural members and the amount of acceptable deformation of members will be IAW the criteria documents above, unless specified otherwise.

d. Concrete Construction. Concrete structures that are to be hardened will be designed and detailed to provide continuity, ductility, and resistance to loading and rebound. Reinforcement will be lapped adequately to assure continuity. Joints will be detailed to ensure ductile behavior of the entire element and, if practical, to develop the ultimate strength of the weakest connected element. Reinforced concrete barriers and containment structures capable of resisting accidental explosions will be designed and detailed IAW TM 5-1300 and HNDM 1110-1-2.

e. Structural Steel Construction. The use of steel construction is acceptable for major structures where economically feasible. Steel construction will be designed and detailed to achieve continuity and full plastic strength. Bolted connections, when used, will be designed as bearing type, as opposed to friction type.

f. Other Material. The use of steel joists and masonry as structural systems for hardened structures will be allowed only when approved by USAESCH. For blast doors and windows, guidance will be provided by USAESCH.

g. Shock Isolation. Design of shock mountings will consider strength of connections to resist forces caused by accelerations and proper space for relative

displacements of structure and equipment. Shock must be attenuated to a level that is acceptable to isolate equipment.

7-19. SEISMIC DESIGN FOR BUILDINGS AND OTHER STRUCTURES. Seismic design for buildings and other structures shall be in accordance with the applicable references provided in UFC 1-200-01 and UFC 3-310-02A.

7-20. PHYSICAL SECURITY. In addition to other physical security requirements, facilities storing arms, ammunition and explosives must meet the physical security requirements of AR 190-11. Facilities storing classified materials must meet the requirement of AR 380-5.

7-21. ANTI-TERRORISM FORCE PROTECTION. In addition to other ATFP requirements, structural design for building and other structures will be in accordance with applicable references provided in UFC 1-200-01 and UFC 3-310-02A.

CHAPTER 8

MECHANICAL

8-1. PURPOSE AND APPLICABILITY. The purpose of this chapter is to ensure that designs provide a firm basis for obtaining equipment and items which are operable, maintainable, measurable, cost effective, and technically sound. The requirements contained in this chapter apply to all designers in developing and constructing facilities for which USAESCH has design responsibility. Energy conservation and life cycle cost design features will be reflected in the Energy Conservation and Life Cycle Cost Design Analysis specified in chapter 1.

8-2. REFERENCE DOCUMENTS. The most current edition of the publications listed below constitutes an addendum to this chapter. In addition, the requirements of the appropriate Unified Facilities Guide Specifications will be incorporated into designs.

a. TM 5-810-6, Nonindustrial Gas Piping Systems

b. TM 5-840-2, Storage Depots

c. UFC 3-310-03A, Seismic Design for Buildings

d. UFC 3-400-02, Engineering Weather Data

e. UFC 3-410-01FA, Heating, Ventilating, and Air-Conditioning

f. UFC 3-410-02A, Heating, Ventilating, and Air-Conditioning (HVAC) Control Systems

g. UFC 3-410-03FA, Heating, Ventilating, and Air Conditioning of Hardened Installations

h. UFC 3-420-01, Plumbing

i. UFC 3-420-02FA, Compressed Air

j. UFC 3-430-04FA, High Temperature Water Heating Systems

k. UFC 3-430-05FA, Gas Distribution

l. UFC 3-450-01, Noise and Vibration Control

n. UFC 3-450-02, Power Plant Acoustics

m. UFC 3-460-01, Petroleum Fuel Facilities

o. UFC 3-600-01, Fire Protection Engineering for Facilities

p. MIL-STD-101, Color Code for Pipelines and for Compressed Gas Cylinders (Not approved)

q. ASME INTERNATIONAL STANDARDS

(1) ASME B31.1, Power Piping
(2) ASME B31.2, Fuel Gas Piping
(3) ASME B31.3, Process Piping
(4) ASME B31.4 Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids
(5) ASME B31.5, Refrigerant Piping and Heat Transfer Components
(6) ASME B31.8, Gas Transmission and Distribution Piping Systems
(7) ASME B31.9 Building Services Piping

r. American Society of Mechanical Engineers (ASME) Publications. Boiler and Pressure Vessel Code, and Interpretation:

(1) Section I: Power Boilers
(2) Section II: Material Specifications
(3) Section IV: Heating Boilers
(4) Section V: Nondestructive Examination
(5) Section VIII: Pressure Vessels
(6) Section IX: Welding and Brazing Qualifications
(7) Section X: Fiberglass-Reinforced Pressure Vessel

s. AMC-R 385-100, Safety Manual

t. Manufacturers Standardization Society (MSS)

(1) SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture
(2) SP-69, Pipe Hangers and Supports - Selection and Application

u. Instrumentation Society of America ISA S5.1 Instrumentation Symbols and Identification

v EM 1110-1-4008 Engineering & Design – Liquid Process Piping

8-3. FIRE PROTECTION. All designs must comply with UFC 3-600-01. Unless the project scope of work specifies the performance design of the fire protection system, the designer will show all information necessary to construct the fire protection system(s) ("total design"). The information provided will be detailed to the extent that the construction contractor will only provide shop drawings that show compliance with the contract requirements. Where the project SOW specifies the "performance design" of a water sprinkler system, the designer will include the following in the contract documents: water system supply curve plotted on semi-logarithmic paper, occupancy classification, design density, design area, hose stream (where applicable), and duration of the water supply. The performance design will include adequate hydraulic calculations to determine if the facility will require fire pumps or water storage tanks. If calculations demonstrate the need for either item, the designer will include in detail, the necessary items in the design. The designer will ensure that all designs provide the most cost effective fire protection that complies with all applicable requirements and does not increase the risk of property damage or adversely impact life safety considerations.

a. Concept Design

(1) Design Analysis General Description. A description of the system(s) to be used along with a list of standards (including date and reference to applicable sections or paragraphs) upon which the design is based will be submitted. A preliminary version of the Fire Protection Design Analysis in accordance with UFC 3-600-01 will be included.

(2) Design Analysis Calculations. For "total" or "performance design" of water sprinkler systems, the hydraulic calculations specified above for "performance" designs will be submitted at this stage. An equivalent level of information will be submitted at this stage for other extinguishing systems. The calculations required for a "performance design" should be essentially complete at this point. The source for each equation used will be listed, including title, chapter, equation number, etc.

(3) Drawings. For either "performance" or "total" design concept drawings, the information specified above for "performance design" of a water sprinkler system, or the equivalent information for other extinguishing systems will be submitted. Equipment will be drawn to scale.

b. Intermediate Design

(1) Design Analysis General Description. The concept description will be updated to reflect any changes made to the design since the concept submittal. The basis for changes will be documented. Include the final draft of the Fire Protection Design Analysis in accordance with UFC 3-600-01.

(2) Design Analysis Calculations. The concept calculations will be updated to reflect any changes made to the design since the concept submittal. The basis for changes will be documented. Calculations should be complete at t his stage for all extinguishing systems.

(3) Drawings. The layout plan of all equipment and piping will be shown. Section and detail views will be identified. Maintenance access areas will be identified.

c. Final Design

(1) Design Analysis General Description. The intermediate description will be updated to reflect any changes made to the design since the intermediate submittal. The bases for changes will be documented. Include the final version of the Fire Protection Design Analysis in accordance with UFC 3-600-01.

(2) Design Analysis Calculations. The intermediate calculations will be updated to reflect any changes made to the design since the intermediate submittal. The basis for changes will be documented. Catalog cuts from at least three vendors, sufficient in detail to demonstrate compliance with all contract requirements including the contract specifications, will be included for all major items of equipment. For "total design" of water sprinkler systems, completed hydraulic calculations or the equivalent information for other extinguishing systems will be submitted. The calculations will substantiate that the design area indicated is, in fact, the most hydraulically demanding. Computer prepared hydraulic calculations will have a cover sheet that includes design input and provides an explanation of output generated. Output will include a plot of the water

system supply and the sprinkler system demand curves plotted on semi-logarithmic paper. Computer software which uses typical k-factors for branch lines will not be used. All calculations will be accompanied by sketches that identify areas, nodes, piping segments, etc., used in the calculations to facilitate review.

(3) Drawings. The performance requirements of all equipment will be included in an appropriate schedule. A sequence of operation will be included where required to clearly understand the function or operation of any systems or equipment. All equipment will be shown in detail. Where equipment connection details are shown, all valves, gauges, and fittings required by the specifications or otherwise required will be shown. For proper operation and maintenance of the equipment, adequate space will be allotted based on the requirements in the catalog cuts furnished above. Clearances or access required for proper operation and maintenance will be shown on the drawings. Sections, elevations, and details of mechanical rooms and all other congested areas will be provided where required for clarity and coordination. All piping within the mechanical room and all other congested areas will be drawn double-line (to scale). All supports, other than standard piping supports, will be shown on the drawings and clearly detailed. Flow diagrams and/or isometrics and sequences of operation will also be provided as needed for clarity. Fire protection drawings will not contain information pertaining to other disciplines, except where required for reference or coordination.

(a) For "performance design," the intermediate drawings will be updated to reflect any changes made to the design since the concept submittal.

(b) For "total design," the intermediate drawings will be expanded to include the location of all sprinklers, risers, and piping, or the equivalent information for other extinguishing systems. Center-to-center dimensions between sprinklers on branch lines and between branch lines, from end sprinklers to adjacent walls, from walls to branch lines, from sprinkler feed mains and cross mains and branch lines to finished floors and roof or ceiling will be shown. Sections will be included that show typical branch line and cross main pipe routing as well as the elevation above finished floor for typical sprinklers.

8-4. PLUMBING

a. Concept Design

(1) Design Analysis General Description. A description of the system(s) to be used along with a list of standards (including date and reference to applicable sections or paragraphs) upon which the design is based will be submitted.

(2) Design Analysis Calculations. Systems and equipment selection will be based on life cycle cost consideration. The life cycle cost analysis and the energy budget calculations will be included here per instructions in chapter 1. The number and type of plumbing fixtures required will be provided along with calculations to determine the cold and hot water load (flow) requirements. The types and capacity requirements for drainage systems will also be included. Calculations necessary to determine equipment capacities and their corresponding utility requirements will be provided. To facilitate review, all calculations will be accompanied by sketches that identify nodes, piping segments, etc., used in the calculations. The source of each equation used will be listed, including title, chapter, equation number, etc.

(3) Drawings. The drawings will include plumbing fixture layout, floor and area drains, and single-line piping and equipment layout. All equipment will be drawn to scale. Preliminary performance requirements of all equipment will be included in appropriate schedules.

b. Intermediate Design

(1) Design Analysis Calculations. All pipe sizing calculations should be completed and submitted. For all pipes, the calculations will include design flow (in gpm or liters per second and fixture units), pipe size, velocity, friction factors, slopes, lengths and the pressure and flow available at each fixture at designed conditions.

(2) Drawings. The drawings provided at concept submittal will be updated to include the piping plan and piping isometrics for the water and waste/vent systems.

c. Final Design

(1) Design Analysis General Description. All pipe sizing calculations will be completed at this stage. Catalog cuts sufficient in detail to demonstrate compliance with all contract requirements, including the contract specifications from at least three vendors, will be included for all major items of equipment.

(2) Drawings. A plumbing fixture schedule will be provided that lists individual fixtures and the size of all piping connections (cold water, hot water, and waste). The performance requirements of all equipment will be included in an appropriate schedule. A sequence of operation will be included, where required, to clearly understand the function or operation of any systems or equipment. All equipment will be shown in detail. Where equipment connection details are shown, all valves, gauges, and fittings required by the specifications or by other standards will be shown. For proper operation and maintenance of the equipment, adequate space will be allotted based on the requirements in the catalog cuts furnished above. Clearances or access required for proper operation and maintenance will be shown on the drawings. Sections, elevations, and details of mechanical rooms and all other congested areas will be provided as necessary for clarity and coordination. All piping within the mechanical room and all other congested areas will be drawn double-line (to scale), with exterior dimensions that include any required insulation. All supports, other than standard piping supports, will be shown on the drawings and clearly detailed. Isometrics and sequences of operation will also be provided as needed for clarity. Plumbing drawings will not contain information pertaining to other disciplines, except where required for reference or coordination.

8-5. HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

a. Concept Design

(1) Design Analysis. The description of the system(s) will include the indoor and outdoor design conditions will be listed for each area. A preliminary ventilation analysis based on the requirements listed in UFC 3-410-01FA will be provided. The design will meet all ventilation requirements. Conformance to ventilation requirements will also be done in a manner that is life cycle cost effective. Where energy from an existing plant is to be used, verification will be included that capacity, availability, and the reliability of the

plant are adequate to serve the intended loads. As a minimum, block loads that take into account all loads that will influence equipment size will be submitted for each system. All calculations will be accompanied by sketches that identify nodes, piping, or duct-work segments, etc., used in the calculations to facilitate review. The size of major pipe and duct mains will be included. The source for each equation used will be listed, including title, chapter, equation number, etc.

(2) Drawings. A single-line layout will be provided for all equipment, ductwork, and piping. Equipment will be drawn to scale. Preliminary performance requirements of all equipment will be included in appropriate schedules. A preliminary sequence of operation for each system will be included on the drawings.

b. Intermediate Design

(1) Design Analysis. Calculations will be included for the sizing of all equipment and major air and water distribution lines. All pipe sizing calculations will be completed to the Final Design level requirements (see 8-5,d(1) at the Intermediate Design level.

(2) Drawings. The drawings provided at concept submittal will be updated to include the equipment, piping and duct locations. Equipment schedules will include information available based on the calculations.

c. Final Design

(1) Design Analysis. All pipe sizing calculations will be completed at this stage. For all pipes, the calculations will include design flow (over the entire range where applicable), duct size, velocity, slope (if applicable), length and all pertinent details relative to the calculation method used. The entering and leaving design conditions at each piece of equipment (over the entire operating range where applicable) will be listed. The cycle of each heating and/or cooling system will be plotted on a psychometric chart with each point on the chart cross-referenced to the corresponding point in the system. Individual room heat gain/loss calculations will be made. The extrapolation of "typical" room calculations or the proration of block load calculations will not be permitted. A completed ventilation analysis based on the requirements listed in UFC 3-410-01FA will be provided. Catalog cuts from at least three vendors sufficient in detail to demonstrate compliance with all contract requirements, including the contract specifications, will be included for all major items of equipment.

(2) Drawings. The performance requirements of all equipment will be included in appropriate schedules. A sequence of operation will be included where required to clearly understand the function or operation of any systems or equipment. All equipment will be shown in detail. Where equipment connection details are shown, show all valves, gauges, and fittings, required by the specifications or otherwise required. For proper operation and maintenance of the equipment, adequate space will be allotted based on the requirements in the catalog cuts furnished above. Clearances or access required for proper operation and maintenance will be shown on the drawings. Sections, elevations, and details will be provided for mechanical rooms and all other congested areas where required for clarity, coordination, or detail. All piping and ductwork within the mechanical room and all other congested areas will be drawn double-line (to scale) with exterior dimensions that reflect any required insulation. All supports, other than standard ductwork or piping supports, will be shown on the drawings and clearly detailed. A flow

diagram and sequence of operation will be provided for each system. HVAC drawings will not contain any information pertaining to other disciplines, except where required for reference or coordination.

8-6. MATERIAL HANDLING. The designer will document the required capability of equipment to fulfill mission requirements and ensure the equipment has built-in safety features. Material Handling covers items such as elevators, pneumatic-tube systems, monorails, overhead cranes, etc.

a. Concept Design Submittal. The concept submittal will include drawings with sufficient information to indicate the envelope the equipment requires. Electric and other utilities required will be identified.

(1) A design analysis will be furnished by the designer for all major items of equipment. The parameters, calculations, and rationale used for selecting the equipment will be identified, and at least, three manufacturers' names and the model numbers of their equipment will be provided to verify that competition is available. Catalog cuts from at least one manufacturer will be provided to demonstrate compliance with project requirements.

b. Intermediate Design Submittal. This submittal will have the equipment outline clearly defined on the plans with locating dimensions given from walls or columns. Section and detail views will be included if sufficient information is available.

c. Final Design Submittal. The final submittal will be a complete package including plan, section, elevation, and detail drawings to clearly indicate the equipment location and all interface connections. Equipment and system specifications will provide the necessary details for a contractor to purchase and install equipment to meet the functional and space requirements of the design. The materials of construction will consider the function and the environment and must be the best economic choice for the application. The level of detail of specifications for each submittal is covered in the chapter 2, Project Specifications.

8-7. PROCESS PIPING. Requirements and specifications are provided in this section to ensure that process and/or special purpose piping systems/equipment conform to fit, form and function, and project design requirements. The system must be operable, maintainable, and contain adequate controls and safety features.

a. Concept Design Submittal Requirements. Process flow drawings (PFD) and piping and instrumentation diagrams (P&ID) will be provided. Piping plan drawings will depict the routing of major lines.

b. Intermediate Design Submittal Requirements. At the intermediate submittal PFD's and P&ID's will be complete. PFD's will have the flow rates for all process lines identified for the design conditions. P&ID's will have all lines sized and numbered; instrumentation identified including tag numbers. Piping plan drawings will be provided that show the routing of all lines along with pipe identification numbers. Elevation and detail drawings will be started but are not expected to be complete at this time. When equipment is furnished by other than the construction contractor, the interface will be clearly identified. Any areas on hold awaiting information will be identified.

c. Final Design Submittal Requirements. Flow rates, pressure drops, pipe wall thickness, and pipe sizes will be calculated. Test pressures will be taken into account when selecting pipe wall thickness and anchors. Corrosion allowance will be calculated on the basis of standard corrosion factors for the material used, the product handled, and 15 years material life (unless revised by the contract scope of work).

d. Design Considerations

(1) Alignment. The horizontal and vertical alignment of the piping will be carefully planned to use the inherent flexibility of the pipe to absorb expansion. Consideration will be given to road crossings and other obstructions in the route of the piping.

(2) Expansion. The design of flexibility of the system, will consider the maximum and minimum temperatures to which the line will be exposed. This will include not only environmental temperature, but temperatures of cleaning processes such as steam or vapor cleaning. Ample provision will be made for such temperature ranges, and this will be covered by the design analysis. Where expansion of piping will be absorbed by using the inherent flexibility of the piping or by providing expansion loops and bends, the pipe expansion stresses will be calculated by a standard method used in industry. Where computer analysis is used, the analysis will include a user's manual and a sample problem.

(3) Supports. Supports for above ground piping will be designed with full allowances for the movement and forces developed by the piping either during operation, testing, cleaning, or shock loading, whichever is the most severe condition. Supports will be of ample strength to withstand the forces developed by the piping. Supports will be designed to allow free movement of the piping during expansion and to adequately guide the line without binding it. Support design will incorporate stock or production parts, provided they conform to the requirements of design loads and are commonly used. Accurate stress and weight balance calculations will be made to determine forces and movements at each support point, anchor, and equipment connection. Vibration and shock loads will be examined in detail and accommodated. All calculations will be included in the design analysis.

(4) Anchors. Pipe anchors will be designed to withstand the maximum forces developed by the pipe system during the most severe condition of either regular operation, testing, shock loading, or cleaning. Anchors will be proportioned to not less than twice the section modulus of the pipe. Design calculations for anchors will be a part of the design analysis. These calculations should show forces, assumptions, soil bearing values, etc. When it is necessary to use a bellows type expansion device, anchors and supports will be designed to take the full pressure thrust at the highest pressure to which the line will be subjected, either in normal operation or during the pressure testing.

(5) Drainage and Sectionalizing. System operation conditions will be taken into consideration when designing the drainage points and sectionalizing. If a system is to be cleaned in place, the line will be capable of being divided into short sections for ease of cleaning without cutting the piping. Drains will be located at low points, and if they are to be used for cleaning or flushing, they will be large enough to ensure adequate flow. Horizontal pipe runs will be pitched for gravity drain in the desired direction.

(6) Seismic Design. Seismic design of piping, equipment, supports, and anchors will conform to UFC 3-310-04. (Also see chapter 7, Structural.)

(7) Noise Control. Design work will be in accordance with UFC 3-450-01 and UFC 3-450-02.

e. Cleaning. The details of the cleaning processes and the number and location of cleanings will be specified. The specification will call out the degree of inspection and will require the use of approved cleaning facilities. The contractor will be required to provide detailed cleaning procedures before piping is cleaned. Pipe or components cleaned in a shop off the job will be sealed against contamination through use of a substantial sealing method.

f. Components. Components such as valves, strainers, gauges, and other devices will be specified in detail with pressure or temperature rating, size, capacity, pressure, and temperature ranges; test pressures, tolerances, and materials will be called out. Components will be cleaned to the specified cleanliness level at the manufacturer's plant; they will be sealed and packaged so as to arrive on the job site in the specified clean condition.

g. Inspection. Methods and degree of cleanliness and welding inspection will be specified. Generally, welding inspections will consist of visual and radiographic or other nondestructive inspection. The method of testing and the standards used will be documented.

h. Testing. Detailed requirements will be specified for pressure testing, leak testing, and operational testing. Test requirements for components such as leak testing and proof testing will be called out in detail. Operational tests will also be indicated. Records of tests will be made and a reproducible copy turned over to the contracting officer. Performance and other tests of valves, strainers, etc., will require certification with copies furnished the contracting officer.

i. Piping Connections. The method of making piping connections will be specified. Welding and inspection of welding will be in accordance with the ASME Boiler and Pressure Vessel Code, ANSI Piping Code, and the American Welding Society Standards. A requirement for welding procedure, welding operator, and welder qualification and identification will be specified. No unqualified procedure or welder will be used. Detailed requirements for welding will be specified.

j. Protective Coatings. Protective coatings for both aboveground and underground piping will be specified with appropriate test procedures.

k. Materials. The options on materials for the piping systems will be furnished as part of the design criteria.

l. Piping Identification. Requirements for piping identification will be specified.

m. Drawings

(1) Piping System Drawings. Piping drawings will include plans and elevations

of the piping runs with the location of expansion devices, anchors, and changes in direction indicated and located on both the plans and elevations. Sufficient detail will also be provided to ensure interface definition between piping systems and contractor and Government-furnished equipment. Details will be furnished for supports, anchors, pipe sleeve closures, valve pits, guides, and other such features. A process and instrumentation diagram showing the system control components and instrumentation will be provided for each process piping system. Instrumentation symbols used will be in accordance with Instrumentation and Symbols Standard (ISA-S5.1).

(2) Piping Details. Piping details will be shown in isometric wherever practical.

(3) Computer-Developed Drawings. Computer-developed pipe detail drawings will be used when possible.

(4) Miscellaneous. Pipelines, valves, controllers, and instrumentation will be numbered on the drawings. A pipeline and valve listing will be provided.

n. Special Conditions

(1) Hazardous Facilities. Hazardous facilities require special design considerations which include selecting equipment items and materials that prevent damage and hazards to personnel and facilities. Hazards may be created by corrosive acids, explosions, fire, lethal gases, or other causes. AMC-R 385-100 will be used for designing facilities where hazardous (but non-nuclear) munitions materials will be manufactured, processed, stored, handled, or transported within a facility. The safety requirements of the American Petroleum Institute may be imposed for facilities associated with petroleum products or with the conversion of one energy form into another.

(2) Hazardous and Toxic Waste. Hazardous and toxic wastes piped underground must have double containment and meet the requirements of Resource Conservation and Recovery Act (RCRA).

CHAPTER 9

ELECTRICAL POWER SUPPLY, DISTRIBUTION, AND UTILIZATION SYSTEMS

9-1. PURPOSE AND APPLICABILITY. Electrical design for projects includes all tasks required to produce construction plans and specifications for the project as described in the project criteria documents or as stated in the contract. The purpose of this chapter is to provide guidance for preparing accurate and complete electrical designs that are cost effective, energy efficient, and inherently reliable and safe. The guidance and requirements contained herein are applicable to all USAESCH design projects.

9-2. REFERENCE DOCUMENTS. The documents listed below are directly related to electrical power supply, distribution, and utilization systems designs. The latest copy of the documents listed will be used. Designers are required to become familiar with the requirements in these documents and ensure compliance where applicable.

a. AMC-R 385-100, Safety Manual

b. UFC 3-550-03FA, Electrical Power Supply and Distribution

c. UFC 3-520-01, Interior Electrical Systems

d. TM 5-811-3, Lightning and Static Electricity Protection

e. UFC 3-570-02A, Cathodic Protection

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

g. National Electrical Safety Code, (IEEE C2)

h. Institute of Electrical and Electronic Engineers (IEEE) Publications

i. National Electrical Manufacturers Association (NEMA) Standards

j. National Fire Protection Association (NFPA) Codes and Standards

k. National Electrical Code (NFPA 70)

l. Occupational and Safety Health Act Standards, Title 29, Code of Federal Regulations, Parts 1910 and 1926

9-3. GENERAL DESIGN INFORMATION AND GUIDANCE

a. Safety Requirements. Designs will conform to personnel safety requirements in the documents listed above and will incorporate provisions for safe installation, operation, and maintenance of equipment. Electrical designs will be fully coordinated with the project designs of other engineering disciplines and architects to ensure that adequate clearance and access space is provided.

b. Special Materials and Applications. Designs will address and include provisions for specialized applications including specialized materials or equipment mountings.

c. Short-Circuit and Protective Device Coordination Studies. The designer will define the scope of the system protection and the coordination required for the electrical system. The studies will demonstrate that the equipment ratings and coordination of protective devices provide a safe system in accordance with NFPA 70 and IEEE C2. The studies will include the following: (1) a complete single-line diagram of the power system showing all devices which contribute fault current and those which must be coordinated; (2) a short-circuit study including the maximum and minimum values of short-circuit currents at major buses extended down to system buses where currents are equal to 10,000 amperes symmetrical; (3) utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristics and settings, and existing power system data including time-settings; (4) fully coordinated composite time-current characteristic curves including recommended ratings and settings of all protective devices in tabulated form; and (5) associated calculations to demonstrate that the power system protection will be selectively coordinated by the use of devices or equipment selected. Situations where system coordination is not achievable due to device limitations will be noted. The studies will be performed by a registered professional engineer with demonstrated experience in power system coordination within the last three years. See UFC 3-520-01 for additional guidance.

d. Hardened Facilities. Hardened facility designs will incorporate special design considerations for shielding, filters, shock, and vibration.

(1) Hardened designs will conform to the provisions of UFC 3-520-01.

(2) Specialized equipment and material requirements will be specified and shown. Complete mounting details will be provided.

(3) Calculations will be included in the design analyses to demonstrate that the specified equipment and materials will withstand the design basis forces.

e. Hazardous Facilities. Hazardous facilities require special design considerations for selection of electrical equipment and materials to prevent undue hazards to personnel and facilities which would be created by the presence of corrosive materials, explosives, fire, lethal gases, or as detailed in NFPA 70. AMC-R 385-100 will be used for designing facilities classified as hazardous where non-nuclear munitions materials are manufactured, processed, stored, handled, or transported within a facility. The safety requirements of the National Fire Protection Association (NFPA) may be imposed as design requirements for facilities associated with petroleum products, or for the conversion of one energy form into another. Design criteria, guidance, and directives associated with the electrical design of hazardous facilities will be listed in the project criteria documents.

f. Facilities Subject to Seismic Effects. Designs will conform to applicable requirements of chapter 7, Structural, and UFC 3-310-04.

9-4. ELECTRICAL DRAWINGS. Standard Corps of Engineers detailed drawings will be furnished (if available) to the designer and will be used to depict construction or

installation requirements. The designer will develop other drawings required to show the complete design and construction requirements.

9-5. ***CONCEPT DESIGN.*** The concept submittal will consist of design analysis, drawings, outline specifications, and engineering studies.

a. Design Analysis

(1) General Description. A summary of economic factors influencing the choice of lighting, electrical supply systems, and electrical supply and utilization equipment used in the project will be provided along with an indication of how initial and life cycle costs were considered.

(2) Interior Electrical Work

(a) This analysis will include an estimate of the loads, main bus and feeder wire sizes, main switch, service entrance and transformer sizes, including proposed photometric bases. However, individual circuit load tabulations and interior voltage drop calculations are not required for the preliminary analysis.

(b) Lighting Calculations. When required by the contract scope of work, a life cycle cost analysis will be completed to support the choice of all illumination sources; otherwise, the designer will 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 costs, energy costs, maintenance and replacement costs.

(3) Exterior Electrical Work. Voltage levels for primary and secondary distribution systems will be established and an estimate will be made concerning transformer sizes.

(4) Existing load data where connections are made to existing systems will be documented. The designer will determine the availability of sufficient capacity to carry the additional loads.

(5) Cathodic Protection. Systems and equipment requiring protection will be identified.

b. Drawings. Drawings will include, but not be limited to, the following:

(1) Building Floor and Ceiling Plans. Plans will include layouts for lighting, conduits, feeders, branch circuits, grounding, and electrical receptacles. For renovation and modification projects, plans will depict the work and nonwork requirements. Where work is extensive, separate sheets should be used to show existing-to-remain, demolition, and new work.

(2) Exterior Electrical Supply and Lighting. Electrical drawings will include plan and elevation drawings. Electrical supply and lighting layouts will show new and existing utilities. Plans will show locations of electrical supply equipment, building service equipment, and exterior supply circuits affected by new construction or renovation. The plans will be coordinated with other utility plans concerning scale, landmark references

for proximity, and interference management. The plans will be separate from water, sewage, and other utility plans.

(3) Single-line Diagrams. Concept single-line diagrams will depict proposed power sources and distribution schemes (interior and exterior as applicable). The diagrams will include existing and proposed protective device types in sufficient detail to communicate the system protection philosophy.

(4) Drawings will contain nameplate data for components of existing systems which are affected by the new design or which affect the new equipment or systems.

c. Engineering Studies (as identified in the scope of work). Details for special studies required to define design and construction requirements will be submitted. The submittal will define the objective of each study, outline the study procedure, and provide technical references for development of criteria.

9-6. INTERMEDIATE DESIGN

a. Design Analysis. Design calculations and supporting information will be submitted to support the design as follows:

(1) Voltage drop calculations will be submitted for services, feeders, and in worst-cases for branch circuits supplied by panelboards and switchboards. The source of the data (tables, curves, and short-cut methods obtained from accepted sources such as IEEE Standards 141 and 242) must be referenced.

(2) Transformer sizing calculations will include demand loads, diversities between the demands, and loading cycles (when known).

(3) Existing load data tabulation from the previous submittal will include the method of determining the availability of sufficient capacity to carry the additional loads.

(4) Panel and Switchboard Calculations.

(a) A summary of connected loads, demand factors, and demand loads by circuit number for each panel and switchboard will be provided. This includes spare circuits.

(b) 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 will be provided.

(c) Calculations for motor feeders and motor protective devices will be submitted.

(d) Ambient temperature or conductor grouping factors considered in the selection of equipment and/or conductor sizes will be indicated.

(e) Cathodic Protection. Data and calculations will be submitted for surface areas of protected surfaces; 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 design criteria references will be included.

(f) Overhead electrical power line design analyses will include calculations for guy strengths, sag, and stringing tensions. Tabulations will be included on the drawings.

(g) Underground electrical power supply design analyses will include calculations of supply cable ampacities; grounding conductor ampacities; duct sizes; cable pulling; manhole and duct structural requirements; and structural requirements for support of pad-mounted equipment.

b. Specifications. For each luminaire on the lighting fixture schedule for which there is no corresponding sheet in Interior/Exterior Lighting Graphics (see 8-2, Reference Documents), the designer will provide a detail on the drawings and provide a description in the specifications which is similar to the descriptions contained in Interior/Exterior Lighting Graphics

c. Drawings. Design drawings will include, but not be limited to:

(1) Building Floor and Ceiling Plans. Provide layouts for lighting, conduits, feeders, branch circuits, grounding, and electrical receptacles. The configuration and location of major elements of distribution and utilization equipment will be depicted.

(2) Exterior Electrical Supply and Lighting. Elevation views of assemblies will be scaled and will identify each item of equipment arranged on the front of cabinets, compartments, cubicles, panels, and units. Electrical supply and lighting layouts, depicting exact locations with defining details will be included.

(3) Single-line diagrams. Single-line diagrams will depict power sources and distribution schemes (interior and exterior as applicable). The diagrams will show the distribution and utilization equipment and existing and proposed protective device types.

(4) Three-line diagrams required for annunciation, instrumentation, control, and coordinated protection of power system equipment and materials.

(5) Drawings or design analysis data will identify and describe existing and proposed conductors, devices, equipment, and materials by data shown on the manufacturers' nameplate data and on single-line and three-line diagrams.

(6) Elementary or schematic control diagrams.

(7) Power riser diagrams.

(8) Schedules for power panels and panelboards.

(9) Grounding and lightning protection plans and details.

d. Engineering Studies. Reports which document the research performed, descriptions and discussions of the technical issues, and a summary which defines and supports the proposed design will be included in the intermediate submittal. Submittals

will include a copy of previous submittals for each study and will include updated descriptions of the study procedure and technical references.

9-7. FINAL DESIGN

a. Design Analysis. All design assumptions, formulas, and equations used in the design analysis will be submitted. Short-circuit and protective devices coordination studies will be submitted as detailed in paragraph 9.3, d.

b. Final Drawings. Final drawings will show all pertinent plans, elevations, sections, details, schedules, and notes to present a complete description of the construction required. All elements to be constructed will be properly annotated and located with proper dimensions.

(1) Final exterior electrical drawings will include:

(a) Details which clearly depict the installation requirements of overhead and underground supply and utilization equipment.

(b) Clearances required by IEEE C2.

(c) Plans and details which clearly distinguish new from existing construction and define their interfaces.

(d) Equipment schedules for all equipment included in the design will be complete. Abbreviations and their definitions will be identified as a note or on a general notes sheet.

(2) Interior electrical drawings will include:

(a) A lighting fixture schedule.

(b) Complete electrical wiring details.

(c) Riser diagram indicating connections and wiring to main switch, distribution, power and lighting panels.

(d) Details for mounting fixtures and equipment.

(e) Horsepower ratings of all motors.

(f) Panelboard and switch schedule, together with connected loads.

(g) Designation of all rooms and areas as shown on architectural and other drawings.

(h) Internal and external equipment wiring diagrams, including interconnections between related items of equipment.

(i) Cable and conduit schedules (when the same information cannot be adequately shown on other drawings or plans).

(j) Electrical equipment plan, elevation, side views, sectional views, and details (interior and exterior).

(k) Interface drawings between existing electrical systems/equipment and new electrical systems/equipment (when the same information cannot be adequately shown on other drawings or plans).

(l) Nameplate data for components of existing systems which are affected by the new design or which affect the new equipment or systems (when the same information cannot be adequately shown on other drawings or plans).

(m) Equipment Schedules. Completely developed schedules for all equipment included in the design will be submitted. Abbreviations and their definitions will be identified as a note or on a general notes sheet.

c. Engineering Studies. Final reports which document the research performed, descriptions/discussions of the technical issues, and a summary which defines and supports the proposed design will be submitted. Submittals will include a copy of previous submittals for each study and updated descriptions of the study procedures and technical references.

9-8. EXTERIOR FACILITIES, UTILITIES, AND SYSTEMS. Exterior electrical designs will conform to the requirements of UFC 3-550-03FA, UFC 3-570-01, UFC 3-570-02A, IEEE C2, and NFPA 70.

a. General Design Requirements. Designs will show and fully describe the exact point or points of interface between new systems and existing electrical systems. Existing conductors, devices, equipment, or materials required for protection against lightning and switching surges, electrical faults, and sustained overload conditions will be shown. Direct current (d.c.) power supply will be used for 'close and trip' of power circuit breakers and any motor-charging circuits unless otherwise approved. Drawings will include plans and elevations that clearly define construction interface points.

b. Aerial Line Designs. Designs for subtransmission and distribution lines will conform to the requirements of UFC 3-550-03FA. Design drawings will contain a schedule that fully identifies and describes wood poles or other line support structures. The schedule will properly correlate with a dimensioned drawing that shows the routing of aerial lines and the details required for proper installation of the lines. The location of all line equipment, such as line-surge arresters, switching devices, and other line protection features, will be shown in the schedule and on the layout drawings for the lines. Design analyses will include all support strength calculations, guy calculations, span-length calculations, loading calculations, and moments.

c. Subtransmission Systems. Subtransmission systems are defined as those systems rated in excess of the voltage of the distribution system used to distribute power throughout the base, camp, fort, site, station, or installation.

(1) The voltage of subtransmission systems will normally be in excess of 24 kilovolts (kV) but not more than 115 kV.

(2) Extension of commercial subtransmission lines and modifications to existing supply stations will require coordination and approval of the power company and agencies which use the same primary electrical power source. Evidence of coordination and approval will be submitted and approved by USAESCH prior to the completion of designs required by the contract scope of work.

d. Distribution Systems. Distribution systems are defined as those systems used to distribute electrical power within the boundaries of an installation through distribution cables, feeders, or lines to the distribution class of transformers.

(1) The phase-to-phase voltage rating of distribution systems range from 4.16 kV to 24 kV. Designs for new distribution systems will be 3-phase, 4-wire type except as discussed in UFC 3-550-03FA. Normally, two-winding distribution transformers are used to reduce the distribution system voltage to a service voltage of 600 volts or less, except when utilization equipment is rated in excess of 600 volts.

(2) The preferred distribution transformer connection configuration for secondary voltage applications of 600 volts and below is ungrounded-delta-connected primary with grounded-wye-connected secondary. The preferred distribution transformer connection configuration for secondary voltage applications above 600 volts is grounded-wye-connected primary with ungrounded-delta-connected secondary.

e. Service Systems. Service systems will be classified as "low-voltage" when rated at or less than 600 volts, and as "medium-voltage" when services are rated above 600 volts. The exact classification will depend on the voltage rating of utilization equipment and the calculated maximum current demands for loads to be served through service-entrance conductors and associated equipment.

(1) The number of service connections should be limited to the minimum number possible.

(2) Ground-fault current interrupting (GFCI) devices will be provided for low-voltage services when required by the National Electrical Code, or when recommended by the designer to limit potential damage from arcing line-to-ground faults on services to hazardous facilities, or to facilities of sufficient importance to warrant the additional cost of GFCI protection.

(3) Designs for service systems will include additional protection against lightning and switching surges when either medium- or low-voltage services will supply facilities classified as hazardous, or when facilities will contain computers or essential and sensitive electronic equipment.

(4) Enclosed meter sockets will be provided for each building having a connected load of 250 kVA or more to permit check metering.

(5) Medium-Voltage Services. Medium-voltage service entrance conductors and equipment will be designed only when the calculated maximum load demands for a facility exceed 500 kVA, or when the voltage rating of utilization equipment or interior substations or transformers exceeds 600 volts. These services will be 3-phase, 3-wire except when single-phase loads warrant the use of a 3-phase, 4-wire service.

(6) Low-Voltage Services. Low-voltage services will be designed to suit the voltage and load demands of the facilities to be supplied. Aerial designs are preferred unless underground installation is dictated by other design guidance or directed by documents referenced above.

(a) Underground installation will be required for hazardous facilities and when required for security purposes.

(b) Underground installations will be required when the calculated maximum current demands exceed 350 amperes regardless of the service voltage rating. Services should be single-phase, 240-volt, and 3-wire type for facilities with load demands of 50 kVA or less.

(c) Three-phase, 4-wire services should generally be used for load demands exceeding 50 kVA.

f. Exterior Facilities. Designs for exterior facilities will conform to guidance for interior designs. However, special consideration will be given to exceptions with regard to the type and application of conductors, devices, equipment, and materials to be installed in an outdoor environment. Exterior facilities classified as hazardous may require special design considerations, as discussed under paragraph 8-4.

g. Exterior Lighting. Exterior lighting fixtures will be suitable for the specific application. Designers will select the most energy-efficient fixture consistent with the application. Fixtures should be the type or types in Interior/Exterior Lighting Graphics (see 8-2, Reference Documents). When standard fixtures are not suitable, similar details and specifications (in the form as those shown on the Interior/Exterior Lighting Graphics) will be prepared by the designer. Designs will conform to UFC 3-530-01AN.

9-9. INTERIOR FACILITIES, POWER SUPPLY, AND UTILIZATION SYSTEMS.
Interior or enclosed facilities are generally supplied with all power requirements from one or more service-entrance conductors and equipment. However, in some instances, designers will need to specify requirements for installing batteries, converters, generators, inverters, substations, etc., and automatic transfer and by-pass/isolation switches to switch between power sources, or to develop or transform power required to suit the requirements for the facility. Direct current power supplies will also be used for annunciation, fire alarm, and other types of systems when operations of such essential or critical systems must be independent of the availability of a conventional alternating-current (a.c.) power source. Applicable guide specifications and applicable provisions of UFC's will be used to prepare designs in those instances.

a. Interior Substations, Transformers, and Ducts. Medium-voltage transformers or substations will be selected only when calculated maximum demands exceed a rating of 750 kVA.

(1) Designs for facilities exceeding 50,000 square feet, and/or with demands approximating 2,000 kVA will consider the use of interior substations with low-voltage feeder and plug-in bus ducts to eliminate the need for installation of numerous motor control centers or separate motor controllers, power panels or panelboards, and associated cabling, cable trays, raceways, etc., or to reduce excessive losses.

(2) Plug-in bus ducts, when justified, will be specified to have manually operable circuit breakers to protect circuits which serve lighting and power loads rated at or below 600 volts. Ducts will have a neutral conductor of adequate capacity when single-phase loads are served by the plug-in bus duct.

(3) Feeder ducts will have the same number of conductors as the plug-in bus duct or ducts supplied by the feeder duct. The ampacity of feeder-duct conductors will be the same as the plug-in bus duct conductors when the feeder-duct supplies a single plug-in bus duct. Otherwise, feeder-duct conductors will have the ampacity determined by the number of plug-in bus ducts served by the feeder ducts, calculated maximum demands of plug-in bus ducts, and the diversity factor assigned to the feeder duct.

(4) Protective devices will be specified to be installed for each plug-in bus duct served by the feeder duct when two (2) or more plug-in bus ducts are supplied by the same feeder duct.

b. Low-Voltage Service Entrances. Low-voltage service-entrance equipment will be sized in accordance with the guidance contained in UFC 3-520-01 paragraph 2-2. Service conductors will be selected according to the same ampacity requirements, with protective devices selected to operate at approximately 125% of the maximum current demand calculated.

(1) Service-entrance equipment includes panels equipped with up to six (6) circuit protective devices, in addition to any panel protective device or lugs used to terminate incoming service conductors.

(2) Equipment will be specifically listed for use as service-entrance equipment. Drawings will show the location and mountings.

(3) Lightning-surge arresters and surge-protective capacitors will be installed at the same location as the service-entrance equipment when those protective devices are required by the NEC or other referenced documents.

c. Low-Voltage Power Switchgear. Low-voltage power switchgear will be specified and installed only when required by feeder load demands of 400 amperes or larger, when switchgear is more economical than other design alternatives. Switchgear will normally be equipped with a main circuit breaker properly rated to protect the switchgear. The main or external circuit breaker and the switchgear will be specified to have an ampere interrupting capacity (AIC) rating equal to approximately 125% of the maximum fault current calculated to be available at the switchgear. Current-limiting fuses should be included in the design to protect the switchgear only when the available fault current exceeds 65,000 amperes asymmetrical.

(1) The switchgear will be equipped with a full-capacity neutral when it serves single-phase equipment in addition to three-phase equipment or loads, and will be equipped with a copper ground bus throughout the length of the switchgear.

(2) The ampacity of phase buses will be in accordance with the guidance contained in UFC 3-520-01 paragraph 2-2.

(3) Designs will exclude the use of molded-case circuit breakers for either the

main or feeder breakers and will require that breakers be Underwriters Laboratories, Inc. (UL) listed for the specific application.

d. Motor Control Centers. Motor control centers will be included in designs when there are several motors and there is a need for motors to be controlled from a central location, as opposed to individual motor controllers or starters installed at or near the motor location. General guidance for the design of low-voltage power switchgear will be followed relative to the protection of motor control centers, AIC rating, and the type, number ampacity or sizes of phase, ground, and neutral buses or conductors.

(1) Starters will be specified to have circuit breakers except when the in-rush current of large motors requires the use of fused disconnect switches to prevent circuit breaker tripping when motors start.

(2) Control schematics, or elementary diagrams, will be prepared by the designer and included in the design showing all control and protective devices within and external to starters and motor control centers, and associated wiring required for the proper protection and operation of motors or motor power or control circuits. Diagrams will show the location of each device or item of equipment external to the motor control center by the use of an appropriate symbol and by descriptions on the drawings.

(3) Specifications will require that terminals of devices or equipment be wired to compartment terminal block points when it is necessary for connection to other compartment terminal block points. Specifications will also require that wiring be terminated on master terminal blocks in the motor control center for external connections to remote items of equipment or devices.

e. Motor Selection and Motor Efficiencies. Electric motor horsepower rating will be limited to no more than 125% of the maximum load being served unless a NEMA standard size does not fall within the range, in which case, the next larger NEMA standard motor should be used. Minimum motor efficiencies shall be in accordance with the guidance contained in UFC 3-520-01 paragraph 7.1.

f. Switchboards. Switchboards will be included in designs for the following applications: (1) where a centrally located switchboard would prevent the need for several separate panelboards; (2) when the length of feeders originating at the switchboards would not require large conductors to prevent excessive voltage drop at terminals of equipment; and (3) for control rooms when control, instrument, or relaying equipment should be located in that central location.

g. Panelboards. Care will be exercised in selecting panelboards and in the quantity and location of panelboards to minimize costs while ensuring installation of reliable items of equipment which require a minimum of spare parts and maintenance.

h. Interior Lighting Systems. The design of interior facility lighting is to conform to UFC 3-530-01AN. Lighting fixtures should be the types shown in Interior/Exterior Lighting Graphics (see 8-2, Reference Documents) with designs incorporating the optimum methods for energy conservation. An analysis of the different lighting designs will be furnished with design drawings and specifications to justify accuracy and completeness of the designs. The analysis must demonstrate the suitability of the designs to provide quality illumination required to accomplish the work or functional

tasks in specific rooms or areas. The analyses will include all information concerning: the project identification, including the name of the area, building, and room number; the average illumination to be maintained, in foot- candles; lamp data and factors associated with the selection of coefficients of utilization and light loss factors; and calculations made to determine the quantity of fixtures.

i. Special Facilities, Equipment or Systems. Design requirements may vary considerably among a variety of facilities associated with the care and training of military personnel, such as firing ranges, hospitals, housing, testing, and training facilities. Designers will coordinate design efforts with USAESCH for special facilities, equipment, or systems if design documents referenced do not provide adequate design guidance or requirements.

9-10. COMMON REQUIREMENTS FOR ELECTRICAL POWER DESIGNS. The following are design requirements for interior & exterior facilities, equipment & systems.

a. Power Factor Correction. Power factor correction (PFC) will be considered in instances when existing installations have a system power factor of less than 0.90, and when the power factor can be improved to a cost-effective value greater than 0.90.

(1) Installation of switched PFC capacitors in substations, or in long distribution lines, will be considered for large existing bases or installations. However, the design of such PFC methods will be undertaken only when that method is cost effective.

(2) Designs of new facilities at existing installations, or designs for new bases, camps, forts, etc., will incorporate more effective methods to conserve energy, reduce peak load demands, and reduce conductor sizes and corresponding costs.

(3) In general, motors rated at and above 5 horsepower will be provided with PFC capacitors when motors are known to have a power factor less than 0.90. Automatic PFC devices should not be considered for inclusion in designs. PFC capacitors will be shown to be connected to motor terminals except when motors will be supplied as a part of a general equipment assembly. In those instances, capacitors will be shown connected to the load terminals of separate starters, or to the load terminals of starters to be installed in a motor control center.

(4) Designs of capacitor circuits will conform to the applicable requirements of the NEC. The reduction of current attributed to the design of PFC will be considered in determining the ampacity of conductors.

b. Ampacity of Aerial Conductors. Ampacity of aerial conductors, except for related service-entrance conductors, must be able to serve the maximum calculated demand requirements in addition to future demands which can be reasonably anticipated for load growth. In general, the ampacity of aerial conductors should not exceed the current calculated by summing the demand of all connected items of equipment.

c. Ampacity of Service-Entrance Conductors. Ampacity of service entrance conductors, rated at or less than 600 volts, should approximate 150% of the maximum current calculated after reasonable demand and diversity factors are used to estimate the maximum current demands.

d. Ampacity of Feeders. Ampacity of feeders should approximate 150% of the maximum current demands calculated in accordance with the guidance contained in UFC 3-520-01 paragraph 2-2. This will allow for reasonably expected future increases in current demands. The ampacity of insulated feeders and branch-circuit will be selected based on the following guidance related to conductor sizing and temperature rating of conductor insulation.

(1) The ampacities of feeder and branch circuit conductors will be calculated and selected to meet the minimum requirements of the NEC. Ampacities will conform with the UL Electrical Construction Materials Directory, when circuit protective devices are specified to be UL-listed. This will require that insulated conductors have insulation rated 60 degrees C for circuits rated at 100 amperes or less, and rated at or above 75 degrees C when circuits are rated in excess of 100 amperes.

(2) Ampacities will be altered when insulation with ratings of 90 degrees C or above are specified. Insulation with high temperature ratings will be specified to suit the recommendations of equipment manufacturers, or when insulated conductors are installed in a location subject to high ambient temperatures.

e. Ampacity of Branch-Circuit Conductors. Ampacity and temperature rating of branch-circuit conductors will be determined during design based on the above guidance for feeder conductors, and should approximate 125% of the maximum demand calculated for branch circuit wiring. Ampacities will be based on the use of copper conductors. Use of aluminum or copper-clad conductors will not be permitted for branch circuits. Ampacities will be increased when required to limit voltage drop to an acceptable value.

f. Voltage Drop. Voltage drop analysis requirements are provided in UFC 3-520-01 paragraph 2-6. Design analyses for the various systems will include complete and accurate calculations to justify the selection of the types, sizes, and consequent ampacities and voltage reductions associated with the design.

g. Wiring Methods. Wiring methods will be shown or specified to conform to the guidance in applicable UFC's, requirements of the guide specification for Electrical Work, Interior, and will otherwise conform to the minimum requirements of the NEC.

h. Ground-Fault Protection. Ground-fault protection will be incorporated into designs for the safety of personnel, as required by the NEC, and in instances when, following completion of the facility, personnel would be working in an outdoor environment while using electrical items of equipment, or handling energized flexible cables which serve as an extension for electrical power service.

i. Power Receptacles, Cover Plates, and Wiring of Receptacles. Power receptacles that supply power to electrical appliances, portable equipment or tools, and extension cords or cables, will have a grounding pole. Receptacles will have the grounding pole incorporated into the body of each receptacle, along with other poles required to supply power to connected items of equipment.

(1) Receptacles will be standard NEMA type unless others are required for specialized applications. General purpose receptacles and cover plates will be the same

color. Receptacles and cover plates will be ivory color except when a different color is required to match paneling or paint selected.

(2) Outdoor receptacle covers will have spring-loaded or screw-on caps.

(3) Poles or terminals of receptacles used to supply electrical power to connected items of equipment will be wired to suit the current and voltage ratings of loads served by the receptacles.

(4) Metallic raceways will not be used as a ground-current path for branch circuits which supply receptacles. Separate grounding conductors will be provided.

(5) The neutrals of power supplies will not be used as grounding conductors unless permitted by the NEC.

j. Ground Systems. Grounding systems will be designed to limit the resistance-to-ground value to 25 ohms or less depending on the type of installation, equipment, or special circumstances.

(1) Grounding designs for main electric supply stations, major substations, and line-surge-arrester installations will provide a maximum resistance-to-ground of 5 ohms.

(2) Grounding systems for hazardous facilities and for facilities containing computers or other surge-sensitive electronic equipment will be designed to achieve a maximum resistance-to-ground of 5 ohms or less.

(3) Design analyses will contain calculations required to demonstrate compliance with the resistance-to-ground requirements.

(4) Designs will show the use of bare copper conductors and copper or copper-clad ground rods, or other grounding electrodes approved by USAESCH to provide the minimum resistance-to-ground required by the specific application.

(5) Designs will consider grounding systems when facilities are constructed or modified in a location subject to lightning storms, and when those facilities are classified as hazardous or designed to house sensitive electronic equipment. This will generally require that all equipment within a facility be grounded to the same facility grounding system, and that separate facility grounding systems be electrically connected to obtain an equipotential ground system for the project or installation.

9-11. COST EFFECTIVENESS OF DESIGNS. A life cycle cost study will be prepared and included in the design analysis with options capable of fulfilling power requirements with equal reliability but at different annual costs. Designs will permit the use of single subtransmission lines, radial feeders, single-ended substations, etc., to minimize the cost of installation of facilities or projects. Note, projects of significant importance to national defense interests may warrant the use of more expensive installations because of requirements for increased availability, maintainability, and reliability of electrical power systems. The cost effectiveness of those and other designs will minimize the cost of installing electrical power supply, distribution, and utilization systems while ensuring that designs conform to the design criteria for the facilities or projects required by the scope of work.

CHAPTER 10

ELECTRONIC SECURITY SYSTEMS AND UTILITY MONITORING AND CONTROL SYSTEMS

10-1. PURPOSE AND APPLICABILITY. Provided in this chapter are design requirements for electronic security systems (ESS), which include intrusion detection systems (IDS), electronic entry control systems (EECS), and closed-circuit television (CCTV) systems, and utility monitoring and control systems (UMCS), which include utility control systems (UCS) and energy monitoring and control systems (EMCS). The purpose of this chapter is to ensure that designs provide a firm basis for obtaining equipment and systems, which are operable, maintainable, measurable, cost effective, and state-of-the-art. The requirements contained in this chapter are applicable to all designers who develop designs for electronic security systems for military facilities and designs for utility monitoring and control and utility control systems for which USAESCH has design responsibility.

10-2. REFERENCE DOCUMENTS. Army regulations and Department of Defense regulations specify minimum requirements, but site specific and local command requirements may require more stringent measures. In addition, Corps of Engineers projects will adhere to:

a. UFC 3-401-01FA, Utility Monitoring and Control Systems.

b. UFC 3-410-02A, Heating, Ventilating and Air Conditioning (HVAC) Control Systems

c. UFC 3-520-01, Interior Electrical Systems

d. UFC 4-020-01FA, Security Engineering; Project Development

e. UFC 4-020-02FA, Security Engineering: Concept Design

f. UFC 4-020-03FA, Security Engineering: Final Design

g. UFC 4-020-04FA, Security Engineering: Electronic Security Systems

h. UFC 4-022-01, Security Engineering: Entry Control Facilities/Access Control Points

10-3. ELECTRONIC SECURITY SYSTEMS. Electronic security systems are used to provide early warning of attempted intrusions, control access to restricted areas, and provide alarm assessment through CCTV. An electronic security system consists of hardware and software components operated by the facility security personnel. The system is configured to provide one or more layers of protection around the asset UFC 4-020-01FA, UFC 4-020-02FA, UFC 4-020-03FA, UFC 4-020-04FA, and UFC 4-022-01 will be used to design electronic security systems. All features of the Electronic Security System will be coordinated and integrated with the requirements for Physical Security features for the project. Design packages will include specifications using as a basis the appropriate Unified Facility Guide Specifications and drawings, all of which provide

design configuration and functional description of hardware. The designer's responsibility is to specify the types of hardware and software necessary to meet the project requirements and determine how the systems will be implemented.

10-4. ELECTRONIC SECURITY SITE SURVEY. Prior to starting any design for Electronic Security Systems, an Electronic Security Site Survey must be performed. This survey must be performed with the Physical Security Site Survey. These surveys must be coordinated with the site specific Design Based Threat and the current Site Vulnerability Assessment for the purposed location for the project. If there is not a current Vulnerability Assessment for the site or the Vulnerability Assessment is not applicable for the new project, a Vulnerability Assessment must be performed to identify all Physical Security and Electronic Security features required for the project to counter potential threats for the project.

10-5. ELECTRONIC SECURITY SYSTEMS DESIGN REVIEW SUBMITTAL

a. Concept Design Submittals. This submittal will include the Electronic Security System Site Survey Report Validation and the construction cost estimate.

(1) Drawing Requirements. The title sheet, site drawing, abbreviation and symbol list, the ESS block diagram including the data transmission medium, the security equipment general arrangement and equipment layout, details associated with the installation design, CCTV assessment block diagram, and the entry control system block diagram will be complete at the time of the concept design review. The security equipment power and lighting and the installation design should be approximately one-third complete.

(2) Design Analysis. Submit three volume design analysis in accordance with chapter 1.

(3) Preliminary Construction Cost Estimate. As a minimum, this will include cost estimates of the following:

(a) Electronic security system components and materials.

(b) Installation of electronic security system components and materials.

(c) Required modifications to and repair of existing electronic security system components.

(d) Security center hardware, software, and data base installation.

(e) Construction and site work to support electronic security system installation.

(f) Training.

(g) Operation and maintenance manuals.

(h) Maintenance and service for the first year (including spare parts).

b. Intermediate Design Review Submittals.

(1) Drawing Requirements. In addition to the concept review submittal, two-thirds of the detailed ESS design will be complete.

(2) Specifications. A marked-up IDS/CCTV/EECS and other Unified Facility Guide Specifications (UFGSs), with annotations to justify any additions, deletions, and modifications, plus draft specifications for all sections not covered by Unified Guide Specifications will be completed.

(3) Design Analysis. Submit three volume design analysis in accordance with chapter 1.

c. Final Submittal

(1) All drawings and documents will be complete. The design agency will have incorporated all required comments from previous design reviews into the documents, and the design agency will have visited the project site to verify that all project drawings and specifications are complete and accurate.

(2) Original source files of drawings, the construction cost estimate and specifications, and the design analyses incorporating the approved final review comments including those from the constructibility review will be submitted to the managing agency.

10-6. UTILITY MONITORING AND CONTROL SYSTEMS. Utility monitoring and control systems, which includes Building Automation Systems, and utility control systems are composed of computer hardware and associated peripherals, software, communication networks, instrumentation, and control equipment. Control of utility systems and heating, ventilating, and air-conditioning equipment are achieved using applications programs. These programs use data base parameters, operator assignable limits, and environment and equipment sensors as input and output control signals to existing systems. These programs are designed to minimize utility consumption. Communication networks use data transmission media of existing LANs, dedicated fiber-optic cables and equipment, and radio frequency equipment for communication between individual building control and monitoring equipment and a centralized control and monitoring center. Design of these systems should conform to UFC 3-401-01FA and UFC 3-410-02A. Design packages will include basic appropriate UFGSs and drawings. The design package provides design configuration and functional description of hardware and software. Energy conservation and life cycle cost design features will be reflected in the Energy Conservation and Life Cycle Cost Design Analysis specified in chapter 1.

10-7. UMCS DESIGN SUBMITTALS

a. Concept Design Submittals. Concept design submittal requirements will include the following data:

(1) Field survey data.

(2) DD Form 1391 validation report, including cost estimate.

(3) Drawings required and level of completion:

(a) The title sheet, site drawing, abbreviations and symbol list, UMCS block diagram including data transmission medium and central station general equipment layout will be complete.

(b) The central station power, lighting, and fire protection drawings will be completed to the level specified in the contract (normally 35%).

(c) Two representative buildings will be completed in accordance with UFC 3-401-01FA, including sequences of operations and data base information related to set points and alarm limits.

b. Intermediate Design Review Submittals. Intermediate design review submittals for UMCS will have all concept review comments incorporated into the project drawings and other documents before the intermediate design is submitted. Other requirements are as follows:

(1) Drawing Requirements. The level of design completion submitted will be in accordance with the contract, normally 65%, for all structures in accordance with UFC 3-401-01FA, including the sequence of operation, and data base information related to set points and alarm limits, communications network layout, and cable routing.

(2) Specification Requirements. The marked up UMCS and all non-UMCS Unified Facility Guide Specifications (UFGS) are required with this submittal.

c. Final Submittal. Drawings submitted for the final review will incorporate all notes and comments from all previous reviews. After the final review conference, drawings containing review corrections will be delivered to the project manager. The final cost estimate will be corrected as necessary.

10-8. DESIGN AND INSTALLATION. The design of the facilities and the performance of the installation work will be in accordance with the guide specifications, drawings, military hand- books, and other industry standards as designated by the scope of work. Design and installation of facilities used for processing classified information will be IAW applicable Department of Defense documents. The design of the facilities will be in sufficient detail to allow repetitive construction of future facilities from one set of drawings and will limit the amount of layout engineering required by the construction contractor.

10-9. REQUIREMENTS FOR PLANS. Plans will contain the following:

a. Floor Plans. The floor plans will show all principal architectural features of the building that will affect the design.

(1) Room designation and number.

(2) Dimensional height, location, number, and size of raceways.

(3) Dimensional height, location, size, and designation of cabinets, outlet boxes, etc. Plans should clearly indicate type of mounting required (flush and surface, wall or floor).

(4) Conduit and communication cable routing and numbers.

(5) Dimensional size, location, space requirements, and designation for all control consoles, equipment local cabinets, power supplies, etc.

(6) Grounding requirements.

b. Schedules. Conduit and cable schedules will be used to show conduits and cables installed. The schedule will contain the number, type, size, origination point, destination point, and termination requirements for each conduit cable.

c. Connections. Connection details will be shown for each cabinet or console in which cables are terminated. The connection details will show locations of terminal blocks in cabinet, type of terminal blocks, termination of conductors, type of terminals used to terminate the cables, and any grounding required. The termination of shields, if used, will also be shown.

d. Construction. Construction details and complete dimensions will be shown for each cabinet. The details will show the outline of the cabinets, thickness of the metal, mounting of internal equipment such as channel support, location of all openings in the cabinet, mounting and securing of doors, and other pertinent features.

e. Sections and Elevations. Details, sections, and elevations will be shown where required for clarifications.

f. Equipment by Others. The drawings will indicate equipment furnished and/or installed by others.

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CHAPTER 11

INSTRUMENTATION, CONTROL, COMMUNICATIONS, AND FIRE DETECTION AND ALARM SYSTEMS

11-1 PURPOSE AND APPLICABILITY. The purpose of this chapter is to ensure that designs for instrumentation, process controls, communications, and fire detection and alarm systems are provided which are operable, maintainable, measurable, cost effective, and technically sound. This chapter also provides a uniform method for monitor and control of facility equipment to limit the degradation of the quality of the equipment and systems by use or time. It is of prime importance that drawings, specifications, and technical directions are compatible with design requirements (and each other), and that graphic symbols, shapes, and equipment identification used in the drawings are the same among all designers. This is especially critical if the graphic symbols used to represent devices (flow lines, signals, remote/local functions, etc., between different disciplines) which, if misinterpreted, lead to conditions dangerous to personnel or equipment. The requirements contained in this chapter apply to all designers for use in developing, monitoring, and controlling functions for large and complex facilities and data handling systems for which USAESCH has design responsibility. It is suitable for use with all engineering disciplines whenever instrumentation, control, and communication functions are needed.

11-2. REFERENCE DOCUMENTS

a. AMC-R 385-100, Safety Manual

b. ISA-5.1, Instrumentation Symbols and Identification

c. MIL-C-17G(3), Cables, Radio Frequency, Flexible and Semi-Rigid (Not approved)

d. Electronic Industries Association (EIA) Publications

e. Insulated Cable Engineers Association (ICEA)

f. Institute of Electrical and Electronic Engineers (IEEE) Standards

g. National Fire Protection Association (NFPA) Publications

h. Rural Utilities Service (RUS) Publications

i. UFC 3-600-1, Fire Protection Engineering for Facilities

j. UFC 4-510-01, Design: Medical Military Facilities

k. Underwriters Laboratories (UL) Publications

11-3. COMMUNICATIONS. Communications design will include telecommunications, paging, video, and intercom systems to the extent required by the project criteria. All telecommunications designs must comply with the Technical Guide for Installation Information Infrastructure Architecture (I3A), USAISEC. Medical facilities must also comply with UFC 4-510-01 Medical Military Facilities.

a. Concept Design

(1) Design Analysis. The concept design analysis will be submitted in three volumes in accordance with chapter 1 requirements.

(2) Drawings. The drawings will include instrument locations and a single-line riser diagram. Preliminary cable requirements will be included.

b. Intermediate Design

(1) Design Analysis. The intermediate design analysis will be at prepared in accordance with chapter 1.

(2) Drawings. The drawings provided at concept submittal will be updated to include the communications room layout, outlet and equipment details.

c. Final Design

(1) Design Analysis. The three volumes comprising the final design analysis will be prepared in accordance with chapter 1.

(2) Drawings. The drawings will be finalized showing all outlet/device, cable and equipment locations, details, quantities/capacities, installation notes and riser and wiring diagrams.

11-4. CLOSED-CIRCUIT TELEVISION.

a. Concept Design

(1) Design Analysis. The concept design analysis will be submitted in three volumes in accordance with chapter 1 requirements.

(2) Drawings. The drawings will include device locations and a representative riser diagram.

b. Intermediate Design

(1) Design Analysis. The intermediate design analysis will be prepared in accordance with chapter 1.

(2) Drawings. The drawings provided at concept submittal will be updated to include equipment and device details.

c. Final Design

(1) Design Analysis. The three volumes comprising the final design analysis will be prepared in accordance with chapter 1.

(2) Drawings. The drawings will be finalized, showing all device, cable and equipment locations, details, quantities/capacities, system interconnections, installation notes and riser and wiring diagrams.

11-5 INSTRUMENTATION AND PROCESS CONTROL EQUIPMENT. Since safety is a paramount design consideration, designers will specify controlled devices with a device setting which minimizes the overall system impact when control system failure occurs. Controlled devices critical to system operation will be provided with a control mode, such that a failure in a control system will automatically transfer to the manual or fail-safe mode as required for safe system operation. Alarms are defined as those audible and visual signals for alerting operating personnel of the need to take corrective process action or to be advised of an operating condition which is deviating from preset limits.

a. Concept Design

(1) Design Analysis. The concept design analysis will be submitted in three volumes in accordance with chapter 1 requirements.

(2) Drawings. The drawings will include device locations.

b. Intermediate Design

(1) Design Analysis. The intermediate design analysis will be prepared in accordance with chapter 1 of this DM and contract requirements.

(2) Drawings. The drawings provided at concept submittal will be updated to include equipment and device details.

c. Final Design

(1) Design Analysis. The three volumes comprising the final design analysis will be prepared in accordance with chapter 1.

(2) Drawings. The drawings will be finalized, showing all device, cable and equipment locations, details, quantities/capacities, system interconnections, installation notes and riser and wiring diagrams.

11-6. FIRE ALARM AND DETECTION SYSTEMS. Designs will conform to the applicable portions of UFC 3-600-01 and to the specific contractual requirements of the project.

a. Concept Design

(1) Design Analysis. The concept design analysis will be submitted in three volumes in accordance with chapter 1.

(2) Drawings. The drawings will include device locations and a representative riser diagram.

b. Intermediate Design

(1) Design Analysis. The intermediate design analysis will be at prepared in accordance with chapter 1. Calculations will be included for the sizing of batteries.

(2) Drawings. The drawings provided at concept submittal will be updated to include equipment and device details.

c. Final Design

(1) Design Analysis. The three volumes comprising the final design analysis will be prepared in accordance with chapter 1. Final calculations will be included for the sizing of batteries.

(2) Drawings. The drawings will be finalized, showing all device, cable and equipment locations, details, quantities/capacities, system interconnections, installation notes and riser and wiring diagrams.

CHAPTER 12

SYSTEMS ENGINEERING

12-1. PURPOSE AND APPLICABILITY. Systems Engineering (SE) is a process that integrates the technical effort within a managed project to transform an operational need, or user's requirement, into a description of systems performance parameters and systems configuration. This chapter provides guidance on activities which integrate the technical and managerial processes required to optimize the performance of a facility in its stated purpose or mission. When implemented early in the design process, systems engineering ensures that the total system is efficient, cost effective, operable, reliable, and maintainable. In addition to a fully integrated engineering effort and an established definition of system or equipment operating parameters, the customer also gains these benefits: (1) the design is conducted on a total system basis which incorporates other requirements; (2) all interfaces are compatible, i.e., system-to-system, system-to- facility, facility-to-facility, supporting equipment-to-facilities; (3) a means is provided for evaluating changes which affect the overall system performance, effectiveness, schedule and cost; (4) a framework of coherent system requirements exists that will be used as performance, design, and test criteria, further, these criteria serve as source data for specifications, tests, contract work statements, and facility documentation; (5) the technical performance is measured for timely assessment of high risk areas/problems; and (6) a means of documenting technical decisions made during the course of the program is available to managers.

When specified in the contract, SE must be implemented according to the requirements defined in this chapter.

12-2. REFERENCE DOCUMENTS. The documents referenced below apply on a case-by-case basis as required by the contract SOW.

a. AMCR 385-100, Safety Manual

b. AR 5-4, Army Productivity Improvement Program

c. AR 11-18, The Cost and Economic Analysis and Program

d. AR 385-16, System Safety Engineering and Management

e. AR 385-61, The Army Chemical Agent Safety Program

f. AR 415-16, Army Facilities Component System

g. ER 11-1-321, Army Programs Value Engineering

h. ER 25-345-1, Systems Operations and Maintenance Documentation

i. Code of Federal Regulations, Title 10 (Energy), Part 436, Subpart A (10 CFR 436A), Methodology and Procedures for Life Cycle Cost Analysis

j. DA Pamphlet 415-3, Economic Analysis: Descriptions and Methods

k. DA Pamphlet 385-16, System Safety Engineering and Management Guide

l. DOD 4120.24-M, Defense Standardization Program (DSP): Policies, and Procedures

m. DOD 5000.4M, Cost Analysis Guidance and Procedures

n. ANSI/ISA-5.1, Instrumentation Symbols and Identification, Instrumentation Society of America (ISA)

o. MIL-STD-881, Work Breakdown Structure

p. MIL-STD-882 D, Standard Practice for System Safety

q. MIL-STD-1472F, Human Engineering

r. EIA/IS 632 and ISO 15288, Systems Engineering

s. MIL-HDBK-759C, Human Engineering Design Guidelines

12-3. SYSTEMS ENGINEERING MANAGEMENT PLAN (SEMP). The Systems Engineering Management Plan (SEMP) covers all systems engineering program elements and development of an SE data base to support project design, construction, test and evaluation, start-up, and acceptance through operation and maintenance. The SEMP is developed during the planning and programming phase of a program or project. An SEMP identifies each specific systems engineering task with a separate task schedule. SEMP's also identify an SE organization within the overall project organization, staffed to the extent necessary to accomplish the system engineering tasks identified in the SEMP. The SE organization will include personnel who are experienced in the management and implementation of a SEMP and whose prime responsibilities are the performance of systems engineering tasks. The plan will also include resumes of key personnel. The SEMP is implemented during criteria development and supports all phases of design.

12-4. SYSTEMS ENGINEERING ELEMENTS. The SE process can be divided into four areas to explain its functions: (1) Analysis, (2) Product Assurance, (3) Integrated Logistic Support, and (4) Configuration Management. The designer may be required to incorporate many of these elements and specific sub elements into the design process and the construction phase prior to the time the facility is released for beneficial occupancy. Each of these elements will be examined in the following paragraphs to determine how they affect system performance.

12-5. SYSTEMS ANALYSIS. Systems analysis includes analysis of the design of complex and high performance facilities, electromechanical systems, associated real property, and documentation during criteria development, construction, initial site activation, operation, and lay-away phases. Systems analysis entails the use of elementary design review techniques; advances in state of the art in all sciences, engineering, and associated fields; and approved engineering practices and standards to ensure functional efficiency and completeness of facilities. The analysis produces engineering data that identifies and specifies the configuration and use of all system elements and their effectiveness in achieving the performance parameters. The

analysis verifies that all facility systems perform in accordance with the customer's functional requirements.

a. Design Charrette. The design charrette brings together the facility user, stakeholders, and design professionals to develop the facility functional requirements and criteria in a focused collaborative effort. The charrette is often the last time that the entire project team including customer and installation representatives is assembled at one time, so it is important that the team members agree that the work products generated by the charrette accurately represent the project in scope, design, costs and customer expectations.

b. Hazards Analysis. Hazards analysis will be performed on the facility and process equipment in accordance with the Systems Safety Engineering requirements described in chapter 14 and referenced publications.

c. Programmatic Life Cycle Cost Analysis. A programmatic life cycle cost analysis (LCCA) is defined as a study of the costs and benefits associated with owning and operating military facilities or components throughout the functional life (concept through retirement) of the facility. The objective of the analysis is to select the most economical alternative, in terms of initial cost and operations and maintenance costs, from two or more candidate alternatives that satisfy a particular design requirement. In this approach, design decisions are based on total LCC rather than first (investment) cost alone which leads to more effective cost allocation.

(1) Requirements, Standards, and Guidelines. A programmatic LCCA will be performed if required by the contract. Basic standards and guidelines for the conduct of LCC studies are contained in AR 11-18 for general design applications and in reference h, 10 CFR 436A for special applications, (e.g., solar energy, wastewater treatment, etc.). Supplemental standards and guidelines that extend the above directives for Corps of Engineers use are contained in DOD 5000.4M.

(2) LCC Methodology. Although DOD policy requires routine application of LCC during design, the scope of LCC will vary from project to project to ensure the study effort is cost effective. Duplication of studies and those situations where the potential savings resulting from the study are less than the cost of the study will be avoided. An interdisciplinary approach will be used to ensure that alternates chosen, whether system, subsystem, or component, will be compatible on a total system basis. The use of this LCC technique will require effort in the design phase beyond that required by the Energy Conservation and Life Cycle Cost Design Analysis specified in chapter 1. The technique will be used to evaluate the cost advantages of alternates that have the greatest potential to improve quality and/or functional efficiency of a system at equal LCC, to lessen the LCC at no loss in quality or functional efficiency, or to improve quality and functional efficiency and also reduce LCC. The LCC analysis will be initiated as early as possible in the project lifecycle and will be scheduled and accomplished at a date sufficient to allow the study to guide the design. Alternatives that have a significant impact on the overall cost and that do not conflict with the design directive will be considered. These should include products and methods that may not be cited in current criteria. Component alternatives must be compatible with the system being designed.

(3) CEHNC-ED-SY will furnish the guidance on items selected for study, data

required, and how the data will be presented.

(4) Cost Data. Initial construction costs for each alternate will be developed in the conventional manner. Maintenance, operating, and custodial costs for the various alternates which must be considered will be obtained from the best available sources, i.e., facilities engineers, manufacturers, utility companies, and maintenance firms. When the required data has been assembled, USAESCH will make the calculations necessary to determine the LCC of each alternate.

d. Requirements Analysis. The designers using SE program plans provided by USAESCH will develop a system requirements analysis. This analysis will be conducted in order to establish project-specific SE plans, goals, and methods necessary to manage critical engineering design aspects.

e. Systems Operations and Maintenance Analysis. A systems operations and maintenance analysis (0&MA) may be performed to identify project requirements for site operations and maintenance. The analysis will serve as a basis for documentation planning (0&M manuals), logistics support, personnel requirements, and training functions.

f. Concept Design Review Submittals. All analyses will be initiated either before design begins or by the time of the concept review conference. The Project Development Brochure, a requirements analysis, and the systems O&M analysis will be completed prior to the start of the design. The LCCA and an outline hazards analysis will be submitted with the project design analysis at the concept review conference.

g. Intermediate Design Review Submittals. The intermediate design submittals will be at prepared in accordance with chapter 1.

h. Final Design Review Submittals. The hazards analysis and all other analyses reviewed during the concept or intermediate review conference will be updated, reflecting any review comments. The final life cycle cost analysis will be included in the design analyses submittal.

12-6. PRODUCT ASSURANCE. This element includes technical management and program execution activities that affect equipment availability, performance, and system effectiveness. This process identifies the measures that reduce the risks and unknowns associated with critical areas of the program and selects the corrective measures that can be implemented.

a. Reliability/Availability/Maintainability (RAM). This analysis will be performed by designers using quantitative goals established in the criteria. The designer will translate these goals for reliability and maintainability into qualitative design requirements to preserve the integrity of the system, to meet production goals, and to achieve safety requirements. This analysis should be part of an interactive process of continually assessing and improving the design. Its objectives should be translated into quantifiable and verifiable contractual terms and allocated through the design hierarchy. RAM analysis will be applied only to critical/high cost systems, or to systems considered especially significant to personnel and equipment safety.

b. Human Factors Engineering (HFE). Designers will consider HFE

requirements during the design phase to ensure that the man-machine operational philosophy and interface requirements are established for all program phases. The HFE program will comply with MIL-STD-1472.

(a) Designs and Specifications. To be safe as well as usable, facilities, equipment, and operations must be adapted to the limitations of the people who use them.

c. Standardization. Standardization is a design-related process that ensures that common equipment, modules, and components are incorporated into the design to achieve the greatest possible economic and operational benefits. The interchange-ability provided through standardization is used during a complex project to reduce stocks of repair parts, reduce logistics requirements, reduce provisioning costs, simplify operations and maintenance instructions, and improve system reliability and maintainability. Standardization will include only those equipment items that are high cost, critical, and that require long lead-time when replacements are ordered. Standardization will use item-type control methods for equipment identification and categorizing. A Government review during the concept and final design phases will determine the degree of implementation of the standardization program. The program will comply with the requirements of DOD 4120.24.

d. Systems Safety Analysis. An analysis to ensure the optimum degree of safety is included in project design will be performed in accordance with the requirements described in chapter 14.

e. Construction Safety

(1) Administration of the safety program on each construction project rests with the constructing USACE district and its parent division. The designer will ensure that adequate safety and occupational health provisions in accordance with OSHA, EM 385-1-1, and chapter 14 of this manual, are included in the contract specifications and cover all hazardous situations expected to arise during construction.

(2) Safety Surveys/Audits. Surveys will be made periodically by the Design Agency, USACE constructing district, and installation safety and engineering personnel to assess contractor safety provisions during construction for compliance with the contractual requirements.

(3) Prefinal Inspections. Districts will include provisions for evaluating safety in all prefinal inspections of completed facilities and systems.

f. Commissioning. The commissioning process is a quality process for achieving, validating, and documenting that a facility and its systems have been planned, designed, constructed, installed, tested, and, as a result, is capable of operating and being maintained in conformity with the design intent.

g. Concept Design Review Submittals. The designer will submit a final RAM analysis, a listing of the standardized equipment and components, and an outline format of the systems safety analysis.

h. Intermediate Design Review Submittals. The systems safety analysis will be completed and submitted. A draft of the QA plan will be provided.

i. Final Design Review Submittals. Submittals will include:

(1) Final list of standardized equipment and components complete and sufficient enough to initiate the procurement of the listed items.

(2) Quality assurance plan.

(3) Hazard tracking log, indicating residual risks and all existing hazards.

12-7. INTEGRATED LOGISTICS SUPPORT (ILS). The ILS process provides an avenue through which management and analysis actions are combined to ensure effective and economical support of all systems and equipment at all levels of maintenance during the programmed life cycle. In addition, ILS is also a planning function used by the technical management elements and tangible support elements to provide the ILS concept objectives. For projects that USAESCH has design/support responsibilities, the designer will develop and define the logistics and maintenance concepts; the maintenance levels for performing scheduled and corrective maintenance; and the procedures for identifying, selecting, procuring, storing, and handling of parts, maintenance equipment, and support materials.

a. ILS Objectives

(1) Early Consideration. Early consideration of support requirements in design and development of new projects is required.

(2) Improved Support. Improved maintenance support and reduced skill requirements.

(3) Balance of Support Elements. Optimum balance among support elements. (This can be achieved by possible tradeoffs.)

(4) In-Stock Support. Provisions for in-stock support elements.

(5) Life Cycle Cost. Minimum life cycle cost for support.

b. ILS Subelements.

(1) Supply and Maintenance Concept. When directed by the contract, the designer will develop a maintenance concept for performing scheduled and corrective maintenance.

(2) Provisioning. Designers will make provisions in the equipment specifications for obtaining the Recommended Repair Parts List and necessary technical logistics data in order to support facility system effectiveness. From this information, provisioning recommendations will be made. Designers will define the selection and allocation of repair parts and other support items to the various categories of maintenance based on maintenance allocation and the computation of quantitative requirements for repair parts.

(3) Equipment Identification. All equipment specified and installed for each project will be identified by a noun designator and a consecutive numbering method, generally referred to as a tag number. For example, the tag number is made of a designator equipment code for items in the system and an assigned sequential item number. For systems with instrumentation and control, the Instrumentation Society of America listing will be the standard for establishing the equipment identifiers.

(4) Master Equipment List (MEL). The MEL is a listing of all end-items of equipment within each project that are significant to operations, maintenance, and provisioning. When required by the contract, the MEL will be computerized. See ER 25-345-1 for specific guidance on MEL preparation. To provide a uniform listing, the designer will use the systems/equipment identification procedure in generation breakdown order as the basis for MEL structuring.

(5) Operation and Maintenance Documentation (O&M). The designer, when directed by the contract, will prepare design O&M documentation in accordance with ER 25-345-1. When required, the designer will also perform an 0&M analysis to determine requirements for 0&M documentation for electromechanical or other operational systems. The designer will also identify 0&M logistics data to be provided by vendors and will include these data in the technical and special provisions of the procured equipment and construction specifications. Design O&M documentation will be updated and finalized by the designer or construction contractor or others in accordance with ER 25-345-1 for use during the facility operational phase. All vendor's O&M and logistics data, and O&M documentation will be prepared and presented using the document preparation standards in accordance with the GPO Style Manual and AR 25-30, and submitted for review and approval as indicated in paragraph 12-7c.

(6) Training Program Plan. When directed as a program requirement, designer will develop training requirements in accordance with ER 25-345-1.

(7) Scheduling. Two schedules are required. A Level I schedule is an overview schedule which displays systems engineering requirements as they relate to program phases. The Level II schedule depicts the milestones for each SE element. The designer will submit these schedules as required by the contract. When required to do so, each contractor will prepare in actual calendar time his own detailed schedules (bar charts/CPM/NAS charts) with respect to all SE activities for his area(s) of involvement.

c. Concept Design Review Submittals. The designer will submit a draft:

(1) Design master equipment list

(2) Technical concept narratives

(3) Training and skills analysis

(4) O&M documentation specification

(5) Training requirements specification

d. Intermediate Design Review Submittals. The concept submittals will be

updated to reflect any progress/changes.

e. Final Design Review Submittals. Comments from the O&M concept design review and any other review(s) will be incorporated and the documents updated in the final design review submittals. The final design review submittals will be submitted according to the schedule established by the contract and will incorporate any review comments made during prior review conferences.

12-8. CONFIGURATION MANAGEMENT (CM). This SE element applies the technical and administrative direction and surveillance during the project to properly identify and control changes to the project's baselines (i.e., criteria B/L, Design B/L and Construction B/L) design. It also provides the administrative process to record and report changes to the configurations of systems, equipment, and facilities. These changes are monitored by a Configuration Control Board. The design criteria will be provided by the Design Agency, which will establish responsibilities, requirements, and procedures for implementing CM throughout the project's designated phases (i.e., Design, Construction, Systemizations Operations Closure).

Projects designated for CM will require a CM plan. The CM plan will be developed by the designer. The CM plan will be tailored to the project. Ideally, the CM plan should be submitted before the designated phase for CM design starts.

12-9. ADVANCED TECHNOLOGY. Advanced technology is the research engineering organization which provides guidance to ensure that complex engineering problems requiring research and investigative efforts to resolve technical issues, or to enhance cost effectiveness, are adequately defined, and that special study tasks are formulated and executed to attain identified objectives.

a. Special Studies. The planning and execution of advanced technology special studies to solve design and construction problems will be performed by the designer as directed in the contract.

b. Test and Analysis. For certain complex critical projects, the contractor must demonstrate critical functional performance as part of the construction. These requirements will be identified up-front to the designer and an integrated test and analysis program will be included in the contract documentation developed by the designer. Close guidance will be provided as necessary on a case-by-case basis.

c. New Techniques and Material. Guidance is provided to ensure that unprecedented designs are accomplished through utilization of the latest proven techniques and/or appropriate new materials.

d. Special Conditions. Other conditions that may impact facility design/ operating equipment are as follows:

(1) Nuclear Weapons Effects. Facilities required to resist the effects of nuclear weapons will be designed in accordance with applicable technical manuals and military specifications. USAESCH will coordinate with the user to develop requirements and with the designer to incorporate the requirements into the design.

(2) Electromagnetic Pulse (EMP) Protection. Design guidance for the protection

of facilities required to survive EMP exposure will be provided.

(3) TEMPEST Protection. Design guidance for facilities which require TEMPEST protection will be provided based upon user requirements and the results of the TEMPEST Risk Analysis.

(4) Hazardous Facilities. Hazardous facilities require special design considerations which include selecting equipment items and materials that prevent damage and undue hazards to personnel and facilities. A combination of design operation/maintenance techniques is typically required to insure safe and efficient operation. Applicable TM's, ER's, and specifications will be determined on a case-by-case basis and provided to the designer at the start of the design. Impacts of operational/maintenance issues will be considered during the design process.

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CHAPTER 13

VALUE ENGINEERING

13-1. PURPOSE AND APPLICABILITY. Value Engineering (VE) is an organized effort to analyze a system and its functions so as to achieve the required functions at the lowest total cost. Value engineering will be used to lower a project's first cost and/or its life cycle costs while maintaining or improving its quality, performance, reliability, maintainability, sustainability, safety, and value. The use of multi-disciplined teams and the application of functional analysis and creative techniques as specified in the Value Methodology Standard accepted by SAVE International clearly separate a value engineering effort from other technical reviews. Public Law 104-106 requires that all Executive Agencies establish value engineering policies and procedures. It is the Corps of Engineers' policy that value engineering will be actively applied in civil works and military funded activities and in the performance of work for others. OMB Circular No. A-131 states that VE must be applied to all projects of $1 million or more. Construction and environmental type work have a $2 million threshold for application of VE. USAESCH is committed to having an active and productive VE program.

13-2. REFERENCE DOCUMENTS

a. National Defense Authorization Act, FY96, PL 104-106

b. OMB Circular No. A-131, Value Engineering

c. FAR Part 52.248-2, Value Engineering – Architect-Engineer

d. ER 11-1-321 Value Engineering

e. PMBP Ref 8023G Value Engineering

f. CEHNC-QP-71-03 Value Management/Value Engineering

g. CEHNC-EQP-7-06 Value Management/Value Engineering

h. CEHNC-WI-71-03 Performing a Value Engineering Study

13-3. GENERAL INSTRUCTIONS.

a. Value Engineering Proposals (VEP). FAR 52.248-2 addresses the performance of value engineering services and the submission of value engineering proposals (VEP) by an A-E contractor. Should the Contracting Officer choose to include this clause in the A-E contract, it would require a VE evaluation and study at specified stages of design and the submission of a VE study report that includes developed VEPs. The contractor will be paid for the VE effort, but will not share in any cost savings.

b. A-E Performed VE Studies.

(1) The A-E may be tasked to perform an independent VE study on the design. The VE study must be facilitated by a Certified Value Specialist (CVS) and follow the

Value Methodology Standard accepted by SAVE International. The VE team members are independent of the A-E design team. The CVS and VE team members must be submitted to the contracting Officer for approval. The government may choose to participate in A-E VE studies. Specific details of the VE study task will be included in the A-E contract.

(2) Methods of VE study could include a multi-day workshop facilitated by a Certified Value Specialists (CVS), a VE Design Charrette, individual Value Engineering Proposals (VEPs) developed on focused areas of the design, or other methods deemed appropriate by the VEO and LE.

c. A-E Support to In-House VE Studies. USAESCH may choose to perform the required VE study (in-house or via another contract vehicle) in lieu of tasking the design A-E for this effort. The A-E may be tasked to support this in-house effort in various ways, such as providing team members or the CVS facilitator. This can occur at any stage of design completion although the recommended time is in the early stages of design (planning through 35% design). VE can be combined with a design charrette as long as the appropriate amount of time is available, the value methodology standard is followed and a CVS facilitates the effort. In some cases it may be appropriate to apply value engineering at more than one stage of design (this is required for civil works projects over $10M) or to separate the VE effort into focused areas.

(1) The design A-E may be tasked to perform a VE evaluation to recommend high-cost, low-value items or systems that have potential for VE study. These recommendations should be furnished to the contracting officer with a copy to the value engineering officer.

(2) The A/E will be paid for any tasked effort associated with the VE study but will not share in any VEP savings. The KO may direct the A-E to implement any or all design changes resulting from the VE study. Redesign work resulting from a VE study will be considered a change to the scope of work.

d. In-House Design Efforts. Value Engineering will be applied to all in-house designs meeting the minimum VE application thresholds. An independent in-house VE study team or a contracted VE study team may be used. The study will be facilitated by a Value Specialist and result in a VE report. CEHNC-QP-71-03 VE/VM and CEHNC-WI-71-15 Performing a Value Engineering Study will control the VE in-house process. Specific deviations or modifications to these processes will be detailed in the program's/project's PQCP/DQCP.

13-4. RESPONSIBILITIES.

a. VE Officer. The VE Officer (or his/her selected representative), will act as VE advisor on the PDT and as professional subject matter advisor to the PM and District and Engineering Center Commander. VE Officers will perform the duties outlined in Section 10-(b) of ER 11-1-321.

b. Project Manager. The government Project Manager (PM), in coordination with the Technical Manager (TM) and the Value Engineering Officer (VEO), is responsible for developing a Value Management Plan (VMP) (PMBP Ref 8023G) for each design project. The VMP will be included in each project's PMP. The A-E contract must include

the appropriate FAR VE clauses and VE efforts specified in the project's VMP. The Project Manager (PM) will secure funding for the VE efforts and include all VE efforts in the project's master schedule.

c. Technical manager or Lead Engineer. The TM or LE is responsible for coordinating the VE application approach with the PM and the PDT and ensuring that the PQCP/DQCP addresses the selected approach for implementation.

d. Contracting Officer or Contract Specialist. The contracting personnel are responsible for addressing the contractual VE requirements in the acquisition plan and including the appropriate FAR clauses in the contract.

e. Architect-Engineer. The A-E will perform all VE tasks as specified in the A-E contract. For A-E contracts the services will include VE evaluation and study of design documents immediately following completion of the 35 percent design stage or at such stages as the KO may direct. Each separately priced line item for VE services will define specifically the scope of work to be accomplished and may include VE studies of items other than design documents. The Contractor will be paid as the contract specifies for this effort, but will not share in cost savings that may result from acceptance and use of VE Proposals (VEPs) by the Government.

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CHAPTER 14

SYSTEMS SAFETY ENGINEERING

14-1. PURPOSE AND APPLICABILITY. The requirements of this chapter are to apply engineering and management principles, criteria, and techniques to optimize all aspects of safety within the constraints of operational effectiveness, time, and cost throughout all phases of the system life cycle. Involvement by the Safety Office, USAESCH, is to be included in the early planning stages of projects per PMBP Reference Document REF8016G. The Safety Office, USAESCH will provide guidance and information regarding the application and intent of this chapter and its reference documents.

14-2. REFERENCE DOCUMENTS

a. AR 385-10, Army Safety Program

b. EM 385-1-1, Safety and Health Requirements Manual, Corps of Engineers

c. DA Pamphlet 40-501, Hearing Conservation Program

d. DOD 6055.9-STD, DOD Ammunition and Explosives Safety Standards

e. HNDM 1110-1-14, Demilitarization Facilities for Chemical Agents and Munitions Design Criteria Handbook (Revision A)

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

g. MIL-STD-882, System Safety Program Requirements (latest version)

h. UFC 3-600-01, Fire Protection Engineering for Facilities

i. Occupational Safety and Health Act Standards, Title 29, Code of Federal Regulations, Parts 1910 and 1926

j. IBC International Building Code

k. TM 5-1300, Structures to Resist the Effects of Accidental Explosions

l. REF8016G, Safety and Occupational Health Plan

14-3. EXPLOSIVES SAFETY. DOD 6055.9-STD is the standard for ammunition and explosives safety. Provisions in this standard will be incorporated in the design of all facilities which manufacture, store, demilitarize, or otherwise handle ammunition or explosives. TM 5-1300 and DA PAM 385-64 will be used in locating and designing barricades, blast walls, and other blast-resistant structures.

a. Site Safety Plans. Any project that is associated with or deals with explosives must have a Site Safety Plan (SSP) approved by the US Army Technical Center for Explosives Safety, ATTN: SMAAC-EST, 1C Tree Road, McAlester, OK 74501-9053.

During design no deviations affecting the integrity of the approved Site Safety Plan.are permissible.

14-4. FACILITY SYSTEMS SAFETY . A Facility System Safety effort will be performed on concepts and designs for projects. The level of systems safety effort on an individual facility will be commensurate with the degree of risk involved. MIL-STD-882D and AR 385-10 are the standards for the requirements.

a. Environmental Requirements. Designers must evaluate and provide designs adequate for controlling environmental work factors and stresses which may cause sickness, impaired health, or other deleterious health responses. In buildings, designers will strive to avoid those factors above.

b. Chemical Requirements. Designers, in selecting generic or trade name chemicals called for in the specifications, must investigate the flammability, toxicity, and allergenic hazards associated with them. Nonhazardous chemicals will be chosen whenever possible. Where chemicals of a hazardous nature are employed, the specifications paragraph will specify the hazards, the precautions, and special equipment to be employed. A completed copy of the Material Safety Data Sheet will be furnished to USAESCH, Attn: CEHNC-SO. The designer will adhere to HNDM 1110-1-14 in prescribing chemical guidelines.

CHAPTER 15

COST ESTIMATES

15-1. PURPOSE AND APPLICABILITY. This chapter provides requirements for preparing construction cost estimates. The cost estimates will be prepared in accordance with this chapter and the references shown in this chapter. The cost estimates will provide sufficient detail to meet the need of the project at its particular stage. The more advanced the stage, the more detailed the cost estimate must be to allow effective evaluation of the project. The end result of the cost estimates is to provide sufficient information to the decision makers to determine the ultimate cost of the project and to ensure that bids are fair and competitive.

15-2. METHODS OF ESTIMATING. All projects for which design is initiated are supported by programmed cost estimates. The designer will make all necessary investigations, evaluations, calculations, and adjustments to insure that estimates fit the specific project scope and conditions and are current, accurate, and complete. Further detailed instructions and specific information will be provided separately as necessary. All latest revisions and updates of M-CACES, M-CACES Second Generation (MII) or latest version of M-CACES software will be provided by the Cost Engineering Branch and will be accompanied by its user's manual. No exceptions to using M-CACES will be allowed without written permission of the Chief, Cost Engineering Branch, USAESCH.

15-3. REFERENCE DOCUMENTS

a. ER 1110-1-1300, Cost Engineering Policy and General Requirements

b. ER 1110-3-1300, Military Programs Cost Engineering

c. AR 415-15, Army Military Construction Program Development and Execution

d. UFC 3-700-02A, Construction Cost Estimates

e. EP 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule

f. M-CACES User's Manual (Distributed with software)

15-4. ESTIMATOR QUALIFICATIONS. Cost estimates will be prepared by and reviewed under the supervision of personnel who are competent in cost estimating. Estimators must possess a working knowledge of the work to be performed and be capable of making professional determinations based on experience. If the design staff does not possess all these qualifications, the designer will obtain assistance from a qualified firm whose specialty is cost estimating. In making this determination, the designer will consider the complexity of the project and the number and qualifications of his full-time estimators. In consideration and selection of a consulting firm for cost estimating, the designer will consider, in addition to the foregoing, the firm's specialties, its ability to coordinate the estimates with the designer, and its previous experience in preparing cost estimates for the Government. Estimates prepared by a consultant must be reviewed by the designer before submittal to ensure coordination and compliance with contract requirements.

15-5. SUBMITTAL REQUIREMENTS. The designer will prepare a professional quality cost estimate at each of the various stages of project design. Estimates must accurately reflect the contract requirements and features of work shown on the design documents actually submitted. The degree of detail must be commensurate with that represented by the submitted plans, specifications, design analyses, etc. In cases where the design is not sufficiently complete to enable accurate definition of any portion of the work, appropriate allowances, based on good estimating experience and judgment, must be made to cover work not yet defined.

a. Cost Control. Funds for a project are usually programmed based on the estimated cost at the concept design stage. Based on the programmed amount, which frequently cannot be increased, a construction Cost Limitation (CCL) is determined. The designer is responsible for making every reasonable effort to design a project that can be built within the construction cost limit. Throughout the entire design period, close coordination between the designer and cost engineer must be exercised to insure accurate cost control.

b. Format. Project information will be input so that the final design estimate will be in compliance with the work breakdown structure (WBS) as referenced in ER 1110-3-1300. Bid schedule requirements will also be provided. Within bid items, MII or latest version of M-CACES facility procedures will be used as practicable to group tasks by trade, e.g., masonry, plumbing, fire protection, sprinkler systems, telephone system, and interior electrical work. The latest version of M-CACES Systems, after project and crew data is input, will compute costs and produce the estimate. No summaries are to be suppressed without prior Government approval in each instance.

c. Deliverables. The following items are to be included in estimate submittals, which are to be reviewed by the Cost Engineering Branch, USAESCH.

(1) Three copies of the estimate submittal shall be provided in hard copy format in a three ring binder. The estimate shall also be provided in electronic format on CD-ROMs or DVD. The media will contain an electronic copy of the PROJECT LIBRARY and standard report files. The quantity survey calculations and documentation shall be furnished as a part of the estimate submittal.

(2) Estimates prepared using MII or latest version of M-CACES shall be provided in standard report format using (8-1/2 x 11), landscape, in a three ring binder. The cost estimate that is submitted to the Government shall be accompanied by a letter of transmittal, which includes the following statement: “To the best of my knowledge the confidential nature of this estimate has been maintained”. This statement should be signed, dated and maintained until the official markings have been removed.

d. Bid Schedule. For concept submittals, estimated contract costs will conform to a bid schedule similar to that expected to be developed later with a minimum of at least one bid item for work within any building and at least one to cover exterior work. For later-than-concept submittals, estimates will conform to an acceptable bid schedule proposed by the designer (or specified in the contract). Generally, each different building must be covered under a separate item. Within a building, selected features or work items may be required to be covered under separate bid items for cost accounting or other reasons. Exterior work may be required to be broken into separate bid items

where quantities of work are significant and highly variable or where useful historical cost data can be derived from analysis of bids received. The estimate will present a total amount for each bid item to include direct labor, material and construction equipment costs, indirect costs and profit. The final bid schedule will be as directed or approved by the Government. If the estimated cost of the total project, including cost growth allowances, exceed the construction cost limit, the bid schedule may need to include items under a base bid and additive alternates. Where additional bid item breakdown beyond that proposed by the designer is considered necessary, it will be provided by the designer. Guidance regarding bid item breakdown may be obtained by contacting, the PM/KO in coordination with the Cost Engineering Branch. Estimates for modifications under an existing contract must conform to the contract pay item schedule**.**

e. Contractor Type. The estimate will be structured according to the type contractor considered most likely to bid as prime. For example, if the job is so heavy in mechanical work that most bidders would likely be mechanical contractors, the estimate should reflect a mechanical prime contractor.

f. Cost Breakdown. Costs must be broken down into priceable elements. All cost and quantities in the estimate must be supported. Unsupported lump sum pricing is not acceptable at any stage of design beyond concept. The level of breakdown must be commensurate with detail available from the design documents.

g. Parametric Estimate. Parametric estimates are based on a parametric design and are prepared for a project typically at the 15% design level. They should reflect the items listed on the DD Form 1391 updated to the DD Form 3086 level.

h. Concept Estimates. The estimate should be as detailed as the level of design will permit. The use of lump sum pricing is discouraged. If there is no detail available at the concept stage, the source of the lump sum cost should be documented. Lump sum unit pricing which includes all direct labor, material and equipment costs, and any subcontractor markups, will be permitted through the concept submittal, as appropriate.

i. Estimates Later Than Concept. Estimates prepared later than concept stage will be recorded on MII or latest version of M-CACES in task-by-task detail to accurately reflect the contract requirements shown in the submitted documents. At the final submittal is the contract requirements are sufficiently defined to permit reasonable, accurate and complete determination of all project costs. The ready-to-advertise estimate is an update of the final submittal.

j. Resubmittal and/or Support. If after review, any submitted estimate is found to be noncompliant with the contract requirements, the designer will promptly revise and resubmit the estimate based on review comments as provided by the cost engineering branch. If cost, quantity, etc., of any item in the estimate appears questionable, the designer will provide sufficient explanation and/or supporting data.

15-6. TECHNICAL REQUIREMENTS. Estimates must accurately reflect costs for the project scope and conditions, local labor situation, prices of material, labor costs, and construction equipment anticipated or forecasted to prevail in the project vicinity at the time of construction. The estimate should consider delivery dates for materials and equipment to be installed. Very close coordination and clear communication among the designers and cost engineers is required to assure reliable, accurate estimates. . The

checklist as contained in Appendix D of UFC 3-700-02A shall be utilized in the development of all construction cost estimates.

a. Quantity Survey. Accuracy and completeness of the quantity survey is essential as it directly and critically affects the accuracy of the estimate. The takeoff will be comprehensively and accurately prepared to cover all work for the project. It will be based on all facts that can be gathered from the available engineering and design data. Assumptions concerning details which are beyond the level available at the current stage of design are often necessary to insure that total cost of the overall project work is covered. In such cases, statements and explanations of necessary assumptions will be included so that, when design details become available, quantities can be reconciled. Quantity surveys must be planned to fit the pricing for the work involved, conform to the bid schedule, and be consistent with the payment provisions of the specifications. Surveys must be documented in such a manner that computations can be followed later and verified by others. Tabulation and computation sheets will be dated and will contain appropriate references to plans, specifications, or design analyses.

Relevant sketches will be included. Quantity survey documentation must be furnished as a part of the estimate.

b. Material Pricing. When an item of material is relatively minor or not yet fully defined, as at concept stage, it will be satisfactory to base pricing on data contained in estimating handbooks (including the M-CACES Unit Price Book). In these cases, appropriate adjustments must be made to account for project conditions. At later stages or for significant items, material costs will be based on quotations obtained from manufacturers and suppliers, price lists appropriately discounted, and previous recent quotations. Specific current price quotations (at least two, if practicable) should be obtained for major items of permanent equipment and for significant, unusual or nonstandard material items. Where quantities or unit costs will have only moderate impact, recent reliable quotations from other projects on comparable items are considered acceptable. Freight costs to the project site must be covered. Sales and other applicable taxes must be included in the estimate by applying, in a separate calculation, appropriate percentage markups of material cost. Each submittal for which quotations are appropriate will include a list showing principal items of material, equipment and supplies (such as concrete, structural steel, siding, pumps, chillers, uninterrupted power system, etc.), and indicate the manufacturer/supplier, location, person contacted, telephone number, date, pricing, and all other pertinent information collected or prepared for the estimate. A record of the pricing data must be maintained and submitted as backup data with the estimate.

c. Labor. Labor costs in the estimate must be based on rates that include basic wages, overtime and holiday premium payments, and contractor's contributions for fringe benefits such as health and welfare, holiday and vacation pay, pension fund, apprentice training, etc. Estimated rates should be those which the contractor will be expected to pay when the work is actually performed and must consider prevailing rates actually being paid in the project area. The rates will be no less than those in the Davis-Bacon or Walsh-Healey Act. Information on wages may be available from various sources, such as Corps field offices, other contractors in the project area, etc.

(1) Units Costs

(a) General. Labor unit costs should be based on estimated productivity and cost of wages, fringe benefits, etc., for the labor involved. Productivity estimates are based on experienced rates, tempered by estimators' judgment, and must consider project conditions, labor availability, market conditions, and the like. Useful information can be obtained from vendors, subcontractors, and other pertinent sources.

(b) MII and latest version of M-CACES. For MII or latest version of M-CACES estimates, labor unit cost is a function of the crew unit cost and the value for crew daily output included for each task. The productivity rates in the M-CACES database must be adjusted for project conditions as appropriate. Crews and productivities must be developed by the estimator and should reflect actual work experience. When using a nonstandard M-CACES crew, a DA Form 5419-R should be included in the estimate.

(c) Social Benefits Cost. The contractor's cost for Social Security taxes (FICA), Federal and State Unemployment Insurance, Workmen's Compensation and Employer's Liability Insurance, and any other social benefits must be included in the estimate as a percentage of the labor costs.

d. Construction Equipment. For MII or latest version of M-CACES estimates, costs for construction equipment and tool costs are included in the crew costs in the database. These costs are thereby included by the system for each task, as appropriate. The estimator must determine the appropriate equipment to be used for each crew based upon experience. Crews shown in the M-CACES Unit Price Book should not be used without verification by the estimator of crew size, equipment use, and productivity. EP 1110-1-8 is the basis for M-CACES equipment unit costs and will be used as well for estimating equipment costs for concept estimates. Sometimes large numbers of highly specialized, unusual or unique items of equipment may be required. When it is considered likely that the contractor will rent certain equipment, rental rates should be determined for those items and appropriate adjustments included in the estimate.

e. Subcontract Work. Estimates will be prepared for subcontract work using the same methodology and degree of detail for direct costs as outlined for work by the prime contractor. The subcontract estimate will include costs for direct labor, materials, equipment, and second-tier subcontracts, as well as subcontractor mobilization and other indirect costs and profit. A subcontractor's overhead usually bears a fairly stable relationship to the subcontractor's portion of the work and can be estimated on a percentage basis. Overhead rates typically range from 10% to 15% and profit rates from 5% to 10%, depending on complexity, risk, etc. Judgment must be exercised in selecting appropriate rates. For second-tier subcontract work, overhead and profit markups must be covered for second-tier as well as first- tier. A detailed derivation of subcontractor's overhead costs will be required where his work has unique requirements or where the cost impact of the subcontracted work is significant. When reliable subcontractor quotations are obtained, they may be used to verify the reasonableness of the estimate for the subcontract work.

f. Mobilization and Demobilization Costs. These costs must be estimated by detailed analysis considering equipment requirements, distance to move to project site, transportation methods, effort required to prepare, service, load, unload, etc., and the detail included in the submittal. For most projects, mobilization and demoblization for

the prime contractor may be included in the estimate of indirect costs. Subcontractor mobilization and demobilization costs should be included in the estimated subcontract total. Where costs apply primarily to certain work items, e.g., for specialized equipment, they should be appropriately distributed to applicable items.

g. Indirect Costs

(1) General. For concept estimates where direct cost items may be estimated by experienced unit prices, use of empirical markups for prime contractor is acceptable. For later-than-concept estimates, all field indirect costs for the project must be estimated in detail and then distributed logically to the various items in the bid schedule. Home office expense will normally be prorated to all bid schedule items.

(2) Field Indirect Costs. These include such costs as those for field supervisory, administrative, and technical personnel, offices, shops, yards, utilities, communications, office and engineering supplies and equipment, etc., expected to be incurred at the project site but not chargeable to a specific work item.

(3) Home Office Expense. These costs will typically be included in estimates by applying an estimated percentage to the expected total field (direct plus indirect) cost amount. A contractor's home office expense rate is not fixed, but varies from period to period. It is considered a function of his total general and administrative expense for a specific period divided by his total field costs for that same period.

h. Profit. The estimate will include appropriate allowances for profit. For the prime contractor and for subcontractors whose work is a significant portion of the project, rates for profit allowance will be determined by the Weighted Guideline method. For less significant subcontract work, experienced percentage rates may be used. Profit may be calculated within MII or latest version of M-CACES software.

i. Bond. Costs for performance and payment bonds, if required, will be included in the estimate. Specific rates are dependent on factors such as the type of work to be performed, the contract amount, and the time allowed for completion. Bond cost may be calculated within MII or latest version of M-CACES.

j. Contract-Modification Estimates. In certain instances, the designer will be tasked to prepare estimates for a modification to an ongoing contract. Such estimates are used as a basis of negotiations with contractors for additions to or deletions from a project, or both, and will be carefully prepared in accordance with the applicable instructions in this chapter, as well as any supplemental information or instructions furnished elsewhere. Profit may be calculated within MII or latest version of M-CACES.

k. Current Working Estimate (CWE). The CWE is defined as the latest available programming cost estimate for a particular project, and should represent, as closely as possible, the total expected cost of the completed project. It must include the estimated contract cost as of the date of preparation, an allowance for cost growth, as applicable, an amount for contingency reserve to cover unforeseen developments during the actual work which will result in additional costs, and an allowance for Government supervision and administration (S&A). To account for any cost increases which are anticipated to occur between the estimate preparation date and the actual work period, an allowance for cost growth must be made. This will ordinarily be accomplished by using a

percentage factor developed from a cost escalation index provided by the Government. Guidance for contingency allowance and S&A costs will be furnished for each project as required by the Cost Engineering Branch.

l. Supplemental Information. Additional specific information and guidance will be furnished as appropriate for projects which are unique or unusual or for projects outside the Continental United States.

m. Clarification. Should any question or doubt arise concerning the requirements, instructions, procedures, etc., described herein, USAESCH, Cost Engineering Branch should be contacted through the USAESCH, project manager for clarification.

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CHAPTER 16

DESIGN-BUILD

16-1. PURPOSE AND APPLICABILITY. This chapter provides guidance on the development and use of design-build contracting procedures and documents for the procurement of Government facilities. The USAESCH design-build (D-B) projects methodology focuses on the Military Construction (Milcon or MC) Transformation's (MT) Center of Standardization (COS) projects. Standardization of Army facilities is one of the tenets of Army transformation. The USAESCH goal for D-B work is to lead COS standardization for assigned AOR and develop Request for Proposals (RFP) that promulgate world class facilities for USAESCH customers within the MT parameters.

16-2. REFERENCE DOCUMENTS. Requests for Proposal will follow the requirements of the references listed below. The Chemical Demilitarization (CD) Program created an example RFP for CD D-B projects that is available at the website address below.

a. PAM 415-15, Army Military Construction Program Development and Execution

b. UFC 1-200-01, General Building Requirements

c. UFC 1-300-07A, Technical Requirements: Design-Build

d. UFC 3-600-01, Fire Protection Engineering for Facilities

e. ER 1110-1-8158, Corps-Wide Centers of Expertise Program

f. ER 1110-3-113, Department of the Army Facilities Standardization Program

g. ER 1180-1-9, Design-Build Contracting

h. TI 800-01, Design Criteria

i. MT Model RFP Implementation Guide

j. MT Model RFP Evaluation Guide

k. MT Model RFP Field Execution Guide

l. Chemical Demilitarization Guidance on Design Build.

16-3. DESIGN-BUILD SALIENT FEATURES.

a. Single Contractual Entity. Under a Design-Build (D-B) contract, the Government prepares a RFP to solicit a single contractual entity to design and build a designated project. This entity may be a joint venture between an A-E and a construction firm, or a firm certified to do both A-E and construction work.

b. Functional Requirements The D-B RFP states the project functional requirements including design criteria, programmatic requirements, critical technical performance specifications, and the evaluation factors by which the offerors' proposals

will be evaluated. The Offerors develop and submit their proposals to the Government for evaluation based on the evaluation factors contained in the RFP. These evaluation factors may include the proposed costs, technical quality, offeror qualifications, management expertise, life cycle costs, past performance and any other relevant factors.

(1) From the proposal phase through construction, the government evaluates the progress against the RFP, for conformance to the RFP.

(2) Current trends in RFP development are leaning toward standard, non-government construction project models. Using existing building codes and performance versus prescriptive requirements are cornerstones of this method.

(3) The Contractor's Designer of Record (DOR). On a design-build contract the DOR has the responsibility to provide technical products which meet the contract at no less than the standard of care within the commercial industry. The DOR designs based on the RFP's requirements—that is the contract.

c. Phasing. The RFP describes the evaluation process for each solicitation. Commonly either a one or two-phased approach is used. The preferred method is a two-phase approach. A two-phase submittal allows limiting the field of potential offers based on qualifications, technical approach, and experience. Then the top selected offerors proceed to the second phase which includes technical design and price proposals. In a one-phase approach, offerors submit their proposals, are evaluated and a selection is made in accordance with the terms of the solicitation (typically best value, and not necessarily the lowest price). Discussions and revised proposals may be required in a one-phased approach.

d. Scheduling. Under a D-B contract, the D-B contractor may design the entire project and then construct it, or when the schedule is constrained, the design may be developed concurrent with construction activities. This approach, called "fast-track," allows the D-B contractor to design portions of the work, start construction on those designs completed, while continuing to design other portions of the project. On a fast-track, limits on the scheduling of the project, including Government reviews, should be clearly defined in the RFP and in contractor's contract proposal.

e. Contract Type. USAESCH will determine contract type prior to RFP development. The final D-B contract may be a fixed-price or cost reimbursable contract with variations. One variation would be for a cost-reimbursable contract with the D-B contractor with requirements that all or some of his subcontractors be selected on a fixed price basis.

f. Criteria Levels. The RFP will provide a balance between the RFP criteria and proposal development that provides the Government and the design-build contractor with a clear, mutual understanding of the contractually required end product. The following criteria have further explanation in UFC 1-300-07A and in this chapter, paragraph 16-5 of this manual: Nominal Criteria, Partial Criteria, & Full Criteria.

g. Design Submittal Requirements. The RFP and the subsequent contract will state the level of design the winning offeror must submit for review. The preferred method is a Division 01 specification that details the level and types of designs required

(e.g. see Military Transformation (MT) specification section, 01 33 16, Design After Award).

(1) The contractor design submittals must comply with the terms of the contract.

(a) In order to review and enforce requirements must be in the RFP. The RFP must contain requirements for safety, construction QC/QA, cost, project schedule, design submittals, temporary facilities, project objectives, scope, functional and area requirements, applicable criteria, general technical requirements and project specific requirements.

(b) USAESCH specific requirements such as submittal format or as-builts for storage should be detailed in the RFP. The RFP should state that USAESCH requires source files of the design in the latest version of Bentley's Microstation. BIM requirements are in MT RFP Wizard attachment to specification section 01 33 16, Design After Award.

(2) After award, any corrections to the contract, resulting from a changed condition (criteria, design requirements, etc) are accomplished via a contract modification. Deviations to the RFP should be avoided; the RFP should contain information how to make changes (see MT RFP Wizard, section 01 33 16, Design After Award).

(3) The DOR will be allowed to set multiple design submittals. The flexibility allows the contractor to fast track the project. Typically, the contractor will provide a Site Submittal and a Building Submittal, and if required a Demolition Submittal. If the contractor needs to break out specific design submittals that will allow for obtaining components with long lead times, it is in the Government's best interest to allow for the separate submittal.

(4) The RFP will set what the Government requires for design deliverables. The RFP preparer will make the determination of what is required based on the complexity of the project and degree of government oversight. Excessive requirements can drive up cost unnecessarily.

(a) A RFP may allow catalog cuts and sketches on a small design build renovation.

(b) On Military Construction full plans and specifications are often requested.

h. Partnering and Communication. The Government proposes to form a partnership with the DB Contractor to develop a cohesive building team. This partnership will involve the COE project delivery team members, facility users, facility command representatives, installation representatives, Designers of Record, major subcontractors, contractor quality control staff, and contractor construction management staff. Encouraging the Contractor to participate in a partnering process is highly recommended in design-build construction contracts because D-B involves non-traditional roles and responsibilities.

16-4. MILCON TRANSFORMATION, CENTERS OF STANDARDIZATION (COS)

a. *COS Responsibility.* Each COS serves within the Department of the Army as the developer of Army Standards and Army Standard Designs. The COS develops, maintains, and provides Army Standard technical criteria or the Army Standard Design for each designated facility type. A waiver system has been implemented that requires COS evaluation and USACE approval of deviations from either the Army Standard or Army Standard Design.

(1) Develop functional (building, site, furniture, furnishings) and technical requirements of the Standard Design for the assigned facility type.

(2) As applicable, develop land area adjacencies, site plans or layouts in support of area development or real property master plans.

(3) Conduct studies, analyses or assessments directed by the Facility Design Team (FDT) (including Department of the Army (DA), Assistant Chief of Staff for Installation Management (ACSIM), and USACE representation) during the development of Army Standards.

(4) Support the ACSIM approval process for Army Standards.

(5) Work in conjunction with the FDT co-chairs to arrive at Army Standards for FDT staffing leading to review and approval of the Army Standard by ACSIM. When life-cycle investment requirements are identified, conduct analyses and implement innovations to mitigate or reduce implementation cost. Where mitigation by market analyses, constructability, or other engineering factors (for similar functions or facilities in private sector or other areas of Government) cannot achieve design cost impacts, identify courses of action or alternatives for consideration by the FDT.

(6) Ensure consideration and inclusion of appropriate sustainable design considerations to consistently and successfully achieve sustainable design objectives.

(7) Analyze installation design guides for locations where a standard design will be constructed and develop information on architectural theme, colors, exterior/interior signage, furniture, and landscape materials. Determine proper application of “preferences” in the development of Army Standards as substantiated by the approved IDG.

(8) Consider safety features (e.g. fall protection tie-off points) that may be included in the Army Standard to enhance the safe operation and maintenance of the facility. Perform a Facility Systems Safety Assessment on the design if the risks merit it.

(9) Prepare cost estimates for the facilities. Provide market surveys or analyses to ascertain appropriate unit cost consistent with the functional requirements and operational objectives of the standard design. Develop rationales and recommend unit cost changes to the USACE Program Coordinator (PC) for the Army Facilities Standardization Program (HQUSACE/CECW-CE-D) Develop template DD1391s for use in identifying, defining, and validating facility requirements and assessing potential facility impacts associated with materiel fielding. This requirement requires coordination with the HQUSACE (CRST), CEMP-DA.

(10) Develop the standard design of the building to an 80% solution including regional climate and structural requirements. The 80% solution will be predicated on Army Standard criteria, and will be developed in consultation with the FDT. It may be developed using contract or district resources. This requirement is to be phased into the program as discussed below.

(11) Develop a basic floor plan for use in a design build Request for Proposals (RFP). Where a standard design has already been completed with little or no changes expected, this standard design will be developed to the 80% solution and utilized in an adapt build contract to the maximum extent possible.

(12) Participate in design charrettes to ensure the Army Standard and Army Standard Design intent is maintained through design development.

b. COS Facility Types. A variety of facility types have been designated for Army Standardization. The USACE Center of Expertise program in ER 1110-1-8158 defines separate mandatory requirements for application of USACE technical guidance and review applicable in addition to an COS facility type standard. USAESCH Facility Types:

Army Community Service Center
Battle Command Training Center
Bowling Center
Child Development Center - Infant/Toddlers
Child Development Center - School-Age
Close Combat Tactical Trainer
Consolidated Fire, Safety & Security Facility
Correctional Facilities
Fire Station
Hazardous Material Storage Facility
Military Operations Urban Terrain Facility
Medical Facilities
Outdoor Sports Facility
Physical Fitness Facility
Training Ranges
Training Support Center
Youth Activity Center

c. MT Model RFP. The MT Model RFP will be used for Army Transformation/COS projects. This MT Model RFP is being used to incorporate Army Standards by facility type relying on industry input. No changes to the standard are authorized in the MT Model RFP except for incorporation of technical criteria by the COS. This RFP is updated monthly, and is intended to incorporate lessons learned. A USER account is required to use the RFP Wizard. AEs will contact PM or KO to obtain an account for preparing RFPs. The RFP Wizard is located on the internet, at: https://ff.cecer.army.mil/rfp_wizard/index.jsp . Any requests for deviation from the requirements of the RFP Wizard and its current contract clauses shall be directed to the PM for forwarding to USACE for final determination. Deviations will only be granted by USACE.

(1) RFP Wizard Implementation Guide. The purpose of the Implementation Guide is to provide mandatory guidance for developing the “Request For Proposal” documents for all Transformation/COS MILCON projects utilizing the Model RFP. Additionally, the guide provides background information on MILCON Transformation, Information on Type of Construction, Program Intent, Implementation Do’s and Don’ts, and Planned Path Forward. The entire PDT should be familiar with this guide and the information within it should be shared with the Installation. It is extremely important that all PDT members understand the intent in order to make decisions that will meet the Army’s mandates. Additionally, this document gives valuable insight on intent that will be conveyed at all interactions with potential proposers and customers.

(2) RFP Wizard Evaluation Guide. The purpose of the RFP Evaluation Guide is to provide mandatory guidance for the Project Development Team (PDT) as they proceed through the solicitation process.

(3) RFP Wizard Field Execution Guide. The purpose of the Field Execution Guide is to help district and field office personnel understand the MT MILCON Program RFP requirements. Additionally, the guide provides background information that will be helpful understanding the intent of each particular RFP requirement. It includes Do's and Don'ts, as well as recommendations on how the administer the contract. The entire Project Delivery Team (PDT) should be familiar with this guide so that all PDT members understand the intent of field execution in order to make consistent decisions during RFP development and proposal evaluation.

d. MT Adapt-Build. Results and lessons learned from construction awards, and construction, using the MT Model RFP will be used by the COSs to develop adapt-build facility designs. These designs will be prepared to the 5-foot line including functional site elements (such as pavement, fencing, etc.) authorized for the facility type. These adapt-build designs will be prepared to up to an 80 percent level of completion. The GD will prepare the site design outside the 5-foot facility type foot print. The development and maintenance of standards in BIM will facilitate future Adapt-Build projects.

16-5 D-B RFP Development for Non-MT Customers. RFPs for non-MT projects will be prepared to meet the project requirements and follow requirements of UFC 1-200-01, General Building Requirements, UFC 1-300-07A, Design-Build and UFC 3-600-01, Fire Protection Engineering for Facilities. Some project types (i.e., industrial, research and development, National Guard, etc.) are not assigned COS responsibility within the set of 41 Army product lines. A determination shall be made through the PM in coordination with USACE on the procedures to be followed in development of the D-B RFP. Assume that the projects will be developed meeting the goals of MT using the Model RFP Wizard. Projects will follow the tenets of MT, but will incorporate the following guidance and on projects where more prescriptive information is mandated, will follow the other chapters of this manual.

a. UFC 1-300-07A includes guidance to allow for three different levels of RFP development. These are ‘Nominal’, ‘Partial’, and ‘Full’ project criteria development. References paragraph provides both mandatory and specific criteria requirements that shall be used, in conjunction with UFC 1-300-07A in the development of D-B RFPs. Mandatory requirements are those that will be incorporated in every RFP. Specific requirements are those incorporated at the different levels of RFP development. Specific requirements are cumulative – each level is to include the requirements of the preceding

level/s. Where the requirements stated in this Design Manual differ from those in UFC 1-300-07A, this Design Manual will take precedence. The approach (including use of criteria drawings or bridging documents at various levels of design development) to be used will be determined by the KO, PM, and Project Engineer/Architect in coordination with the customer and user prior to the acquisition strategy meeting and pre-design meeting. The Statement of Work (SOW) will define the level of RFP development. The RFP preparer will provide the level of development for all engineer and architect disciplines.

(1) Nominal Criteria. The RFP states the purpose, function, and characteristics of the project in sufficient detail to provide the offeror functional features and visual appearance of the project. Special site, architectural, structural, safety and mechanical requirements are identified. Minimum requirements for architectural, mechanical, and electrical equipment are given. Design criteria including codes, standards, special structural requirements, material strengths, foundation and framing plans, and outline specifications may be given.

(2) Partial Criteria. This approach includes the nominal level criteria plus more detailed information. I.E., the RFP may also contain a concept design with floor plans, special mechanical and electrical equipment layouts, overall dimensions as well as column locations. Provisions for testing, adjusting, balancing, and commissioning may be specified. Exterior elevations and cross-sections may be shown for special design requirements. A site plan may be included.

(3) Full Criteria. Full criteria development has in addition to the provisions for partial criteria, enlarged floor plans, fire protection information, typical wall sections, preliminary site plan, landscaping plan, exterior elevations, cross-sections, floor plans, finish schedule, door schedule, foundation plan, framing plan and sections. Full criteria will cover the requirements of the discipline chapters of this manual. The level of criteria may approach that of a conventional design-bid-build (D-B-D) contract. This approach should only be used on complex projects where the Government already has the expertise or on site-adapted projects.

b. Site Work. The following are requirements and criteria that will be included (as applicable) in the RFP for every project regardless of the level of RFP development:

(1) Provide a general overview of major site features planned, such as building orientation, drainage patterns, parking provisions, traffic circulation, provisions for the handicapped, security requirements, etc.

(2) Provide a discussion of wetlands, as defined by Federal and/or State criteria, historically significant areas, or areas with endangered species of wildlife within the project site area.

(3) Provide discussion of items requiring removal or relocation, method and location of the disposition of waste or salvage materials, demolition phasing requirements, an. The required waste management will be included.

(4) Provide discussion of the geometric layout of the project facilities. Required offsets, site constrictions, site limitations and impacts of new construction on existing facilities shall also be discussed.

(5) Provide discussion of storm drain design scheme and the impacts on the existing storm drain systems.

(6) Provide selected design values to be used in the storm drainage calculations such as surface runoff coefficient, retardance coefficients, infiltration rate, and rainfall intensity based on a 10-year, 25-year, and the 100-year storm frequency.

(7) Discuss existing site features affecting grading such as buildings, streets, curbs, walks, fences, water courses, ponds, elevation of high ground water, rock outcrop, etc.

(8) Provide specific design values for pavement thickness including the number, type, and maximum weights of vehicles, traffic category, and class of road or street. Minimum required thickness of non-reinforced concrete pavement shall be 6-inches.

(9) Provide discussion of roads and streets to include listing of traffic volumes and vehicle types, project design speed, lane and shoulder widths, Rights-of-way and easements and additional requirements for curbs, sidewalks, guardrails, traffic signs and markings, fencing, etc.

(10) Provide discussion of parking areas to include the types of vehicles to be accommodated, size, number, and number and location of handicapped parking spaces.

(11) Provide discussion of the miscellaneous site work features such as emergency vehicle access, dumpsters, location and width of sidewalks, location and type of fencing, etc.

(12) Consult with the local user and Installation personnel to define the extent of landscaping requirements, to determine appropriate plant materials, and Installation grounds maintenance capabilities.

c. Geotechnical. Provide the following geotechnical requirements regardless of the level of RFP development.

(1) If available, provide historical geotechnical data for the site. Minimum requirements for subsurface investigations and assumptions to be used by the designer for bidding purposes should be provided in Section 01 10 10. These minimum requirements should be established so as to provide adequate data to perform the analysis required by paragraph 6.4.2 GEOTECHNICAL REPORT. Section 01 10 10 should make it clear that the D-B Contractor is responsible for the geotechnical design for the project and for encountered at the site.

(2) Include the following statement in the RFP: “If unforeseen subsurface conditions that will significantly impact the design and construction of the project are encountered and additional subsurface investigation is needed, the D-B Contractor should notify the government and submit a plan for additional subsurface investigation for the Government's approval. This additional subsurface investigation must be necessary, directly related to the unforeseen conditions and beyond that required by section 01010 or necessary for an adequate investigation of the site. If the plan is

approved, cost should be negotiated and the contractor should be compensated for the cost of such additional subsurface investigations by change to the contract."

d. Water, Wastewater and Environmental Protection

(1) The environmental protection aspect of an RFP shall minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of the contract.

(2) The D-B RFP guidance shall comply with all applicable environmental Federal, State, and local codes, laws, and regulations. Any delays resulting from failure to comply with environmental laws and regulations shall be the responsibility of the D-B Contractor.

(3) The RFP shall include a comprehensive overview of known or potential environmental issues which the D-B Contractor must address during construction. The contractor shall address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified, but which the contractor considers necessary, shall be identified and discussed after those items have formally been identified.

(4) Identify who is responsible (the Government or the D-B Contractor) for removal of asbestos or lead paint. For projects with asbestos abatement, the contractor shall specifically address the asbestos to be abated, the location of the asbestos, and the quantity. For projects with lead based paint, the contractor shall specifically address the lead paint to be abated (if necessary) or, if the building to be demolished contains lead based paint, the Contractor shall address proper waste debris characterization and disposal and proper worker protection while demolition of the building with the lead-based paint in place.

(5) If the proposed construction or demolition site is located on property with known contamination of either soil or groundwater, the contractor shall provide criteria that will result in the protection of workers and correct handling, treatment (if necessary) and disposal of the soil and/or groundwater.

(6) The water and wastewater systems shall be designed and specified to the latest industry standards, codes, and Government regulations. The RFP shall ensure high quality, energy efficient equipment and systems with minimum maintenance. Design documents shall be submitted and reviewed prior to commencing work on any treatment system.

e. Architecture and Interior Design

(1) Determine and describe user, installation, and community (where applicable) criteria.

(2) Determine and describe requirements for code compliance.

(3) State the purpose, function, and space requirements in sufficient detail to delineate and characterize functional features and the desired image or visual appearance of the project.

(4) The Architecture portion of the RFP will cover the health, safety and welfare of the facility.

(5) Coordination of interior design information with the architectural and engineering disciplines is critical and necessary to ensure no overlapping or conflicting criteria occurs in the D-B RFP. The coordination of the Furniture Fixtures and Equipment Package (FFE) - formally known as the Comprehensive Interior Design (CID) is crucial whether or not it is part of the contract.

(6) Interior design will discuss the following objectives color scheme objectives and aesthetic goals. Provide customer interior signage requirements.

f. Structural

(1) List all structural references, codes, and standards to be used in the design, including Government design documents, industry standards, and criteria given to the designer at the design charrette or predesign meeting.

(2) List the wind speed, building classification category, and exposure category.

(3) List the seismic short period spectral acceleration value (Ss) and the one second period spectral acceleration value (S1) for a 2% probability of exceedance in 50 years, the building classification category and the seismic use group. Provide the seismic site classification or address the appropriate method to derive the seismic site classification.

(4) List any specific live loads such as vehicular loads, cranes, special equipment loads, hanging loads, etc. State locations, weights, and special support requirements.

(5) List any special structural requirements such as floor tolerances or deflection criteria, which deviates from IBC 2006.

(6) List any restrictions on types of structural systems.

g. Mechanical. Including but not limited to: Plumbing, Heating, Ventilating and Air Conditioning, Fire Suppression Requirements, and Other Mechanical Systems and Equipment.

(1) Mandatory energy and water conservation criteria. Title 10 CFR, Subpart A, Part 435, Energy Conservation Voluntary Performance Standards for New Commercial and Multi-family High Rise Residential Buildings, Mandatory For New Federal Buildings Published January 30, 1989; Public Law 100-615, Federal Energy Management Improvement Act of 1988, November 5, 1988; Public Law 102-486, Energy Policy Act of 2005; Executive Order 12902, Energy Efficiency and Water Conservation at Federal Facilities, dated March 8, 1994; and Department of Defense energy goal requirements.

(2) Codes and Standards. Water supply, backflow prevention, and drainage at Army installations will comply with the International Plumbing Code.

(3) Special Plumbing Requirements (handicap requirements, low flow requirements, maximum hot water requirements, dilution basins, grease separators, sewage ejection, etc.).

(4) The HVAC systems shall be designed and specified to the latest industry standards, codes, and Government regulations. The RFP shall ensure high quality, energy efficient HVAC equipment and systems with minimum maintenance. Include a paragraph describing any special HVAC requirements such as clean rooms, kitchens, humidity control, DDC Control System type, etc

(5) The mandatory design criteria are those contained in Unified Facilities Criteria; Fire Protection Engineering for Facilities, UFC 3- 600-01. UFC 3-600-01 contains fire protection and life safety requirements in the following areas:

(a) Type of construction.

(b) Height and area limitation.

(c) Building separation.

(d) Fire resistive construction.

(e) Flame-spread and smoke-developed ratings.

(f) Means of egress.

(g) Special hazard protection.

(h) Automatic sprinkler and fire suppression systems.

(i) Water supplies for fire protection.

(j) Standpipe systems and fire extinguishers.

(k) Fire alarm and detection systems,

(l) Connection to the base fire reporting system.

(6) UFC 3-600-01 may not include all the latest Federal requirements, established by executive orders, public laws, local requirements, and other directives that relate to fire protection and life safety. These requirements must be reviewed and included in the RFP as required for each project.

(7) The mechanical systems shall be designed and specified to the latest industry standards, codes, and Government regulations. The RFP shall ensure high quality, energy efficient mechanical equipment and systems with minimum maintenance. Design documents shall be submitted, reviewed and approved prior to commencing work on the mechanical system.

h. Electrical and Electronic Systems

(1) Provide information on installation/project utilities interface, communications electronic security system, and utility monitoring and control systems. Ensure that Customer Specific Criteria has been incorporated.

i. Antiterrorism/Force Protection

(1) List all Antiterrorism/force protection references to be used in the design including Government design documents, industry standards, and criteria given to the designer at the charrette or pre-design meeting. Sufficient information must be provided to support the proposal without providing information from UFC 4-010-02 (FOUO).

(2) List the building category, the location of the facility within a controlled perimeter, and the level of protection required.

(3) Define the setback distances to be provided.

(4) Describe any progressive collapse requirements.

(5) List any building elements such as mail rooms, equipment enclosures, etc. requiring special design to meet antiterrorism/force protection requirements.

j. Sustainable Design and Development (SDD). Describe the rating tool, reference criteria, and methods of achieving the required SDD rating. Provide any preferred or to be avoided rating points if known for facility type. Follow latest USACE policy on SDD.

k. Specifications

(1) The RFP will delineate which specification system will be used by the offeror. If UFGS are used, they will be prepared in accordance with chapter 2, Specifications. Nationally recognized and industry accepted commercial specifications other than SpecsIntact may be used in some project. When technical specifications are prepared in commercial specification format, the RFP will require that edited specifications be submitted by the D-B Contractor during design after award.

(2) Suggested Qualifications for the D-B Contractor. The RFP preparer in coordination with the PDT shall provide a recommended list of qualifications that the successful D-B Contractor should have on his design and construction team.

(3) The RFP preparer in coordination with the PDT shall define format, extent of design, percentage of completion required, and specific technical information describing performance and key design features of the project to be submitted by the offeror at the Proposal stage, to verify that the offerors design solution will comply with the RFP and can be evaluated against the other proposals. Requirements shall reflect the evaluation factors and agree with the Project Criteria Approach. Evaluation will be performed by a government Source Selection Evaluation Board (SSEB) with the parameters set by USAESCH.

APPENDIX A

STANDARD OPERATING PROCEDURE FOR

AMENDMENT AND CHANGE ORDER PREPARATION

DRAWINGS AND SPECIFICATIONS

A-1. PURPOSE AND APPLICABILITY. The Standard Operating Procedure (SOP) outlined herein will be followed in preparing drawings and specifications for amendments and change orders. The data contained in this appendix should be used in combination with data contained in Chapter 2 and the A/E/C CAD Standards to provide a standardized, uniform, and usable way to record revisions to contract construction drawings. The engineering practices and techniques contained in this appendix will be used by all personnel and are applicable to all projects advertised by the US Army Corps of Engineers, Huntsville Center.

A-2. AMENDMENTS AND CHANGE ORDERS. All revisions will be limited to only those drawing changes required to accomplish the approved Engineering Change Proposal (ECP), Amendment, or other design instruction. This limitation does not restrict the designer or draftsperson from relocating a dimension, note, or detail in order to accomplish the revision at its proper location. Revisions on all affected sheets will be completed for all elements of a proposed amendment or change order before issuing the revised documents to bidders or contractors; similarly, the drawings will not show in any form additional revisions which will be included in a subsequent amendment or change order.

a. Narrative of Specifications and Drawing Changes. A general description of changes on each specification and drawing will be furnished the architectural and project specifications branches for incorporation into amendments and/or change orders. This narrative will be converted into a continuation sheet for Contracting's standard form. The continuation sheet will start out as Page 2 and will describe all additions to bidding documents or contract documents.

A-3. DRAFTING METHOD. All contract construction drawings will be revised on the source computer-aided drafting CAD files and the updates will be formatted for electronic solicitation. Manual drafting will only be used in emergency field or extenuating circumstances and will be scanned into adobe acrobat .PDF format and delivered IAW contract requirements.

A-4. SPECIFICATIONS. The format of specification changes will follow chapter 2, Project Specifications.

a. Revised Specification Pages. Minor mark-ups will be incorporated on the continuation sheet.

b. New Specification Sections. Major mark-ups to a specification section will result in a reissuing of the section. The section number will have an identifier put at the

end of the section. I.E., section 073126 would become 073126X. Changes or amendments resulting in new items added to the project will result in the development of the UFGS or template section added to the job. The continuation sheet will introduce the new section and the new section will follow the continuation sheet in .PDF format.

A-5. RECORD COPY. The files for amendment or change order and the source files will be provided IAW contract requirements. USAESCH currently is in the process of switching record copies from hard copies to electronic files.

A-6. IDENTIFYING REVISIONS. All drawing revisions will be identified by a delta symbol and, unless otherwise directed, each revision with appropriate delta symbol will be encircled with a cloud. To the extent practical, the cloud should highlight only specific revisions. (Refer to figures A-1 and A-2 for examples.)

a. Deltas

(1) Place a delta symbol (Δ) adjacent to each revision. The symbol need only be large enough to contain a 3.0 mm (1/8-inch) high numeral. Where revisions are general, or can be conveniently grouped in a cloud, use only a single delta.

(2) Inside the delta, insert the number which represents the number of times this sheet has been revised. Begin sequential numbering with one (1). The revision number inside the delta has no relationship to the amendment or change order number.

(3) As a subscript or superscript to the right of the delta, place a number of sequential order beginning with 2. This represents the number of individual changes that are clouded to accommodate the new revision.

(4) For those single amendment or change orders that incorporate multiple ECPs, a subscript number will be placed below the delta to identify the specific ECP number prompting the revision.

b. Cloud. Encircle each change or group of changes, including the delta, with a cloud. The Clouds are required to focus attention on the revised areas on the sheet. If the change(s) to a detail become extensive and require a complete review to make a satisfactory analysis, the whole detail will be encircled and draw only one delta.

A-7. RECORDING REVISIONS. All drawing revisions will be recorded in the Revision Area above the title block. The Revision Area will be posted as follows:

a. Symbol Column. Place a delta with the appropriate revision number for the sheet in the first column. Indicate the total number of deltas/clouded areas which appear elsewhere on the sheet for the particular revision to the right of the delta as a subscript or superscript. A new sheet added to the package will be posed as Revision 1. Prior revision history will be included on the redrawn sheet. The original sheet will be labeled “superseded”.

b. Description Column. The amendment number (e.g. “AN-1”) or change order number (e.g. “CO-AA”) must come first. For amendments, simply add the phrase “Revised to Accompany Amendment.” If portions of the changes include revisions due to ECP’s not previously included in the project drawings, add “including ECP….” When

appropriate, the word “Revised” should be changed to “Redrawn” or “Sheet Added”. For change orders, identify the work by ECP number and add a very brief description (not exceeding two lines) of the change(s) to the drawing. If a more detailed description is necessary, add a revision schedule elsewhere on the drawing.

c. Date Column. The date will be the scheduled date for the introduction of the entire amendment or change order. This date will be determined by the Government. The same date will be posed on all revised sheets.

d. Approval. Each drawing will be initialed by the Branch Chief (or other designated person) responsible for that discipline.

e. Border Identification. The word(s) “AMENDMENT” OR “CHANGE ORDER” will be lettered in the space between the border and trim lines under the “sheet reference number” space of the title block. The number of the amendment or change order will be immediately to the right. All lettering and numerals will in accordance with the A/E/C CAD Standards.

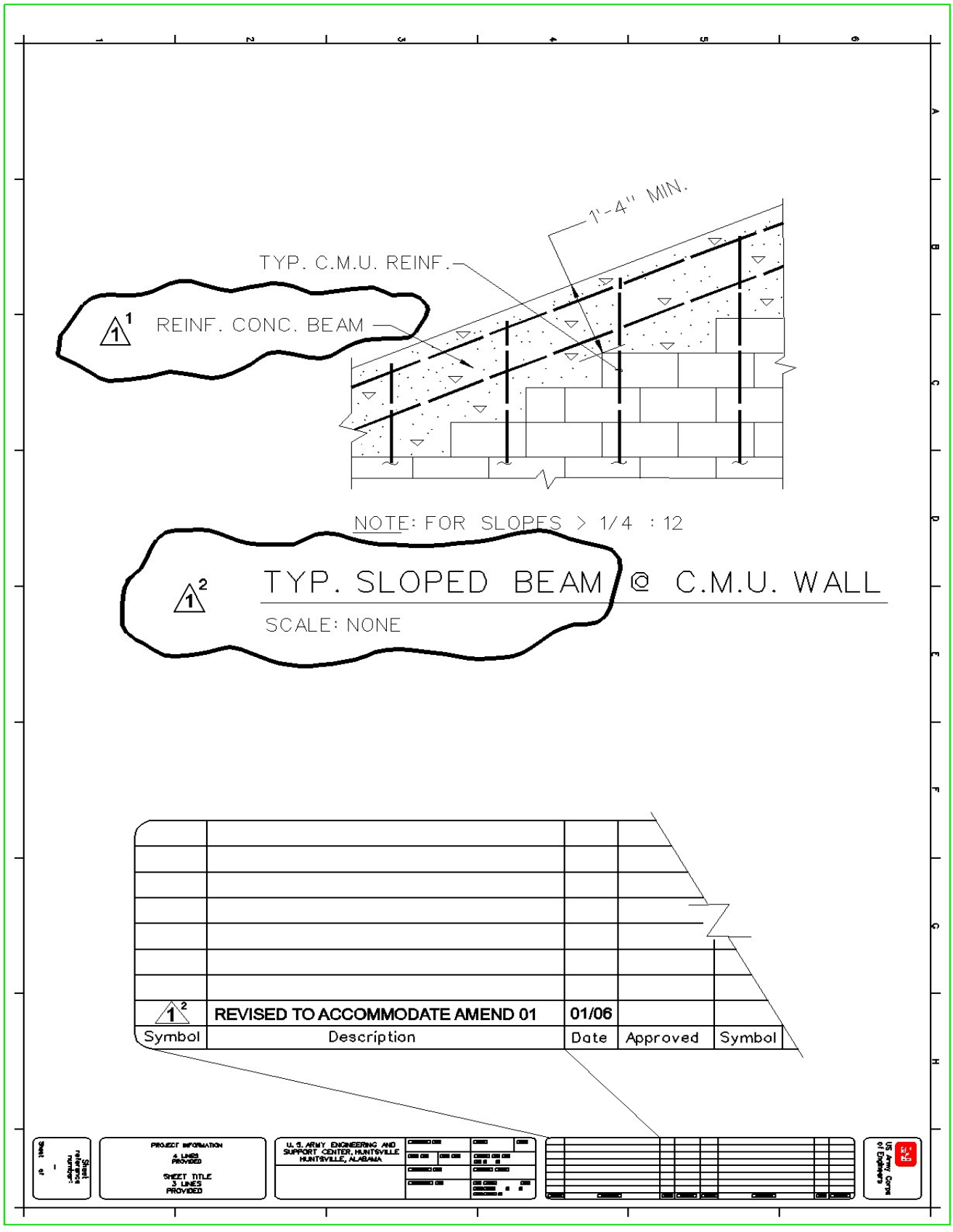
A-8. DRAWING INDEX SHEETS

a. Index Sheet’s. Index sheets are normally the responsibility of the Architectural Branch and will be revised by that office. Index sheets will be revised after receipt of all revised drawings for the particular amendment or change order. Drawings from the design disciplines will, when applicable, include the original of any drawing to be deleted with a note to that effect clipped to it.

b. Posting. Drawings revised for each amendment or change order will be posted on an applicable drawing index sheet. The index sheet will be counted and posted as a revised drawing. In the split revision column opposite the applicable drawing numbers, the revision number of each revised drawing will be entered in the first column portion. In the second column portion, the amendment number (AN- #) or change order number (CO-#) will be entered. Prior revision postings will not be changed, except as necessary for the current posting. Entries in the revision column will not be deleted or clouded.

c. New and Deleted Sheets. New sheets added by the amendment or change order will have their File Numbers, Sheet Reference Numbers, and Titles added, their revision columns posted as Revision 1, and identified with the current change. Deleted drawings will be identified by removal of the Sheet Reference Number and prior Revision Number. The word “Deleted” will be substituted for the sheet title and the current amendment or change order number will be posted in the revision column. Cloud the changes described in this paragraph and all other changes to the drawing index.

d. Recording. Recording of revisions and border identification will be as previously described; however, ECP’s will not be identified. The description will be limited to the amendment number, or change order number, and the words “sheet(s) revised”, “sheet(s) added”, “sheet(s) deleted,” or applicable combination to reflect all changes except those to the index sheet itself.


1'-4" MIN.
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REINF. CONC. BEAM
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Description
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PROJECT INFORMATION
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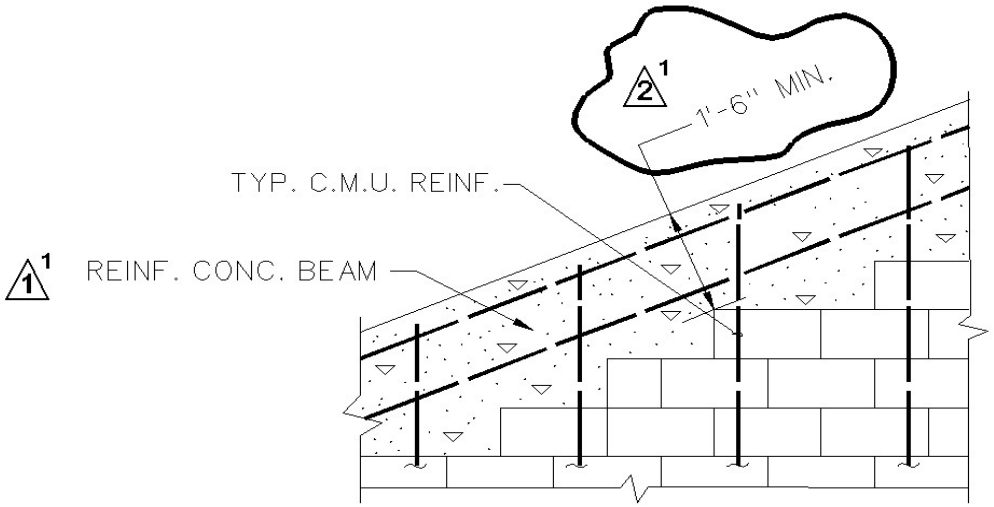
U.S. ARMY ENGINEERING AND SUPPORT CENTER, HUNTSVILLE
HUNTSVILLE, ALABAMA
US Army Corps of Engineers



NOTE: FOR SLOPES > 1/4 : 12

1 2 TYP. SLOPED BEAM @ C.M.U. WALL

SCALE: NONE

Symbol	Description	Date	Approved	Symbol
2 1	REVISED TO ACCOMMODATE AMEND 02	02/06		
1 2	REVISED TO ACCOMMODATE AMEND 01	01/06		

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APPENDIX B

GENERAL PROJECT INFORMATION

(By Project Leader)

(To be completed prior to forwarding to designer for completion)

1. Project Name: _____
2. Project Number: (P-No, SP-No, ESR-NO, Other) _____
3. Contract Number: N68711 - _____
4. Contract Type: IFB _____ RFP _____ DESBLD _____ Other _____
5. Estimated Construction Cost (ECC) $ _____
6. A-E Firm: _____
7. Point of Contact: _____
8. Phone Number: ( ) _____
9. Area Focus Team (AFT) _____
10. Project Leader: _____
11. Phone Number: ( ) _____
12. Contract Specialist: _____
13. Phone Number: ( ) _____
14. ROICC: _____
15. Phone Number: ( ) _____

PROJECT INFORMATION FORM

INFORMATION REQUIRED FOR CONTRACTS

(TO BE COMPLETED BY THE DESIGNER or A-E DESIGNER)

I. *INSTRUCTIONS TO BIDDERS/PROPOSERS*

1. Does project include unit prices? Yes ☐ No ☐

If yes, include the following and coordinate with specification section:

a. Lump sum for all work not covered in the unit price items listed below: _____

$ _____

b. Unit price per _____ for _____

$ _____ Per _____ x _____ = $ _____

c. Unit price per _____ for _____

$ _____ Per _____ x _____ = $ _____

Total Price Base Bid Item 0001 $ _____

2. Are there also Additive or Deductive Bid items? Yes ☐ No ☐

What are the additive or deductive bid item(s): _____

_____

_____

If yes, coordinate with Contracts, as this requires Contracting Officer approval.

Coordinated: _____ Not Applicable _____ Yes ☐ No ☐

3. Reference to FAC 5252.214-9301, Notice To Bidders

Does the project include additive bid items? Yes ☐ No ☐

If yes, include the following (May be included as an attachment):

(i) Base Bid Item 0001 shall be the entire work complete in accordance with the drawings and specifications, but not including work indicated or specified to be provided under any of the other bid items.

(ii) Additive Bid Items 0001AA shall be the addition of the following, complete in accordance with the requirements specified hereinafter:

_____

_____

(iii) Additive Bid Items 0001AB shall be the addition of the following, complete in accordance with the requirements specified hereinafter:

4. Reference FAR 52.236.27, Pre-Bid Site Visitation
(Coordinate with Project Leader and Contracting Officer)
Will a Pre-Bid site visitation be required? Yes ☐ No ☐
If yes, complete the following:

(a) Point Of Contact:

(b) Telephone Number ( )

(c) Special Security requirements:

(d) Other special requirements:

5. Reference to FAR 52.217-7, Option for Increased Quantity Separately Priced Line Item.
Will this project have "Option" items? Yes ☐ No ☐
If yes, requires Contracting Officer's permission. (Coordinate with the Project Leader and Contracting Officer)
If yes, complete the following (May be included as an attachment):

(i) Option Item 0001 shall be the addition of the following, complete in accordance with the requirements specified hereinafter:

(ii) Option Item 0002 shall be the addition of the following, complete in accordance with the requirements specified hereinafter:

How long of a period, in days, will the option to award be for?

Also, will the option item effect the construction period of the contract?

Yes ☐ No ☐

If so, explain (Take into consideration the effect of it being awarded (1) with the original bid, (2) at any time during the specified option period, or (3) at the end of the specified option period):

6. Reference FAR 52.236-4, Physical Data

Is physical data (e.g. test borings, hydrographic, weather conditions data, etc.) to be furnished or made available to offerers Yes ☐ No ☐

If yes, fill in applicable data:

a. The indications of physical conditions on the drawings and in the specifications are the result of site investigations.

Insert description of investigative methods used, such as surveys, auger borings, test pits, probing, test tunnels, etc.)

b. Weather conditions:

(insert a summary of weather records and warnings)

c. Transportation facilities:

(insert a summary of transportation facilities providing access to and from the site, including information about their availability and limitations)

d. Insert other pertinent information:

7. Pre-Proposal Conference (Design/Build).

Is a pre-proposal conference to be scheduled? Yes ☐ No ☐

If yes, complete the following:

a. Scheduled for (day) _____ Date _____

b. Location: _____

c. Point of Contact: _____

d. Telephone Number: ( ) _____

8. FAR 52.252-3, Alterations In Solicitations

(Consult with Project Leader, and/or Contracting Officer if this information is required or if there will be any special conditions for proposals)

a. Will technical proposals be in several parts? Yes ☐ No ☐

If yes describe _____

_____

b. Will costs be separated from technical requirements? Yes ☐ No ☐

c. Will proposal require an administrative breakdown? Yes ☐ No ☐

d. Will proposal require an Organization breakdown? Yes ☐ No ☐

e. Are instructions on how to breakdown costs required? Yes ☐ No ☐

f. Will there be specific or special format for submissions? Yes ☐ No ☐

If yes to any item above, attach description.

II. *INFORMATION FOR EVALUATION SECTION 00202*

1. "Source Selection." If this project is an RFP and is using evaluation of bids for selection, complete this section.

"EVALUATION FACTORS FOR AWARD." _____

_____

_____

_____

III. *INFORMATION FOR SECTION 00452*

1. Reference FAR 52.223-4, Recovered Material Certification

Does this contract specify the use of Recovered Materials? (i.e. materials that have been collected or recovered from solid waste per FAR 23.402)

Yes ☐ No ☐

If yes, describe. _____

_____

_____

_____

IV. *INFORMATION FOR SECTION 00102*

1. A-E edits entire section "List of Drawings" in SPECSINTACT and submits it complete at the 1 00% and final submittal.

Section 00102 included: Yes ☐ No ☐

V. *INFORMATION FOR SECTION 00710 OR 00720*

1. Reference DFARS 252.210-7000, Brand Name or Equal

Does the project include any Brand Name or Equal statements? Yes ☐ No ☐

If yes, requires prior approval by a Level One Contracting Officer.

Provide the following:

Description: _____

Spec Section and/or Dwg. No.: _____

Spec Para. or Drawing View: _____

Obtain copy of justification form from PL. Will require approval of a Level One Contracting Officer. Attach completed form.

2. Reference FAR 52.211-10 Commencement, Prosecution, and Completion of Work and Alternate I

a. Complete the entire work ready for use not later than _____ calendar days after notice to proceed.

b. Phasing sequence as follows: _____

_____

_____

3. Reference FAR 52.223-3, Hazardous Material Identification and Material Safety Data

Will this contract require delivery of hazardous material that will remain in place when the project is completed which the station requires Material Safety Data Sheets? Yes ☐ No

a. Location of hazardous material: _____

_____

b. Material Safety Data Sheet information: _____

_____

4. Reference FAR 52.225-5, Buy America ACT - Construction Materials

Does the project have any exemptions to the Buy America ACT? Yes ☐ No ☐

Prior approval is required for an exemption. If yes, fill in table below:

Description: _____

_____

Spec Section or Drawing No.: _____

Spec Paragraph or Drawing View: _____

5. Does this project specify any Class I Ozone Depleting Substance (ODS)?

Yes ☐ No ☐

Attach memorandum for contract file verifying the specification has been reviewed for these substances. When there is no alternative to using ODS, provide technical certification that no other product is available to meet requirements. Some products do

have waivers, coordinate with the Project Leader. Use of these products requires the Contracting Officer's approval.

VI. *INFORMATION FOR SECTION 00711 OR 00721*

1. Reference FAR 52.236-14, FAC 5252.236-9304, and FAC 5252.236-9305

a. Are utilities furnished by the Government or the Contractor? Yes ☐ No ☐

b. Will there be any cost to the Contractor for utilities furnished by the Government?

Yes ☐ No ☐

If yes, complete the following:

Electric	$ _____	per _____
Water	$ _____	per _____
Gas	$ _____	per _____
Other:_____	$ _____	per _____

VII. *INFORMATION REQUIRED BY SECTION 00830*

1. In what city, county, state, and on which base is the project located?

Complete the following:

a. City _____

b. County _____

c. State _____

d. Base _____

VIII. *SOFTWARE AND COMPUTER REQUIREMENTS*

1. Reference Computer Data and Software Clause, DOD FARS 52.227-7013, and Data Requirements Clause, DOD FAR 52.227-7031

Does this project require any computer software? Yes ☐ No ☐

If yes, complete the following:

Purpose: _____

_____

Description: _____

_____

Specification Section: _____

Project may require completion of Form DD Form 1423, Contract Data, and DD Form 1664, Data Item Description, may be required. Consult with Project Leader and Contracting Officer. RFPs require the use of DD Form 1423.

If these forms are required, complete and attach.

2. Computer Hardware

Does this project require any computer hardware? Yes ☐ No ☐

If yes, complete the following:

Purpose: _____

_____

Description: _____

_____

Specification Section: _____

May require review by Counsel and/or Information Systems Support, ADP services, for any special requirements. Coordinate with PL, Contracting Officer, and user.

IX. *PROPRIETARY PRODUCTS*

1. Does this project specify any proprietary items either directly or indirectly?

Yes ☐ No ☐

If yes, complete the following:

Indicate where these items can be found in the drawings and specifications.

Description: _____

_____

Spec Section or Drawing No. _____

Spec Paragraph or Drawing View: _____

Obtain copy of justification form from PL. Will require approval of a level one Contracting Officer. Attach the completed form.

X. *Government Furnished Equipment* Yes ☐ No ☐

If yes, please identify equipment: _____

_____

Indicate where these items can be found on the drawing and specifications

_____

END